AMRITA VISHWA VIDYAPEETHAM

# Effective use of Big Data Analytics in Crop planning to increase Agriculture Production in India

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# Background Study

- Big Data Analytics is one of the affirmative platforms to implement large scale Data Analytics
- Big Data Analytics is the process to find unidentified correlations, hidden patterns, market trends, customer preferences, and other essential data from extensive distributed datasets.
- Big Data Analytics provides various advantages—it can be used for better decision making, preventing fraudulent activities, among other things.
- Big Data with the help of Machine Learning algorithms can categorize the input data, recognize patterns and translate the data into insights

# Problem Statement

*Quality of inputs is vital for improving crop quality and yield, so availability and accessibility of right inputs to farmers is a key for their empowerment and this emphasizes the usage of Big Data which enables the farmers to improve the quality of their products.*

# Proposed Solution

- Govt. of India created an open data ecosystem for the motive of sharing crop dataset as per National Data Sharing and Accessibility Policy (NDSAP) initiated Open Government Data (OGD) Platform.
- Traditional data analysis methodologies may not be sufficient to predict the crop patterns in the dataset. If the entire process is done by a single node, it usually gets exhausted and consumes time to analyze crop price and yield information.
- This approach proposes popular Map-Reduce concept and R programming concept utilized in clustered file system extensively with Hadoop Distributed File System (HDFS).
- The purpose behind the **Map-Reduce** paradigm is highly scalable which executes massively parallel and distributed computations over a huge number of computing nodes. **R** is a free open source software environment, user interface design for statistical computing and data visualization. **Spark** is a lightning faster tool used for data analytics, and it works better in small dataset

# Technology Stack

- Java: jdk1.8.0_281
- Maven: 3.6.3
- Eclipse: 2020-12 (4.18.0)
- Hadoop: 3.2.1
- R: 4.0.4
- R-Studio: 1.4.1106
- Spark through Databricks
- Git

# Methodology

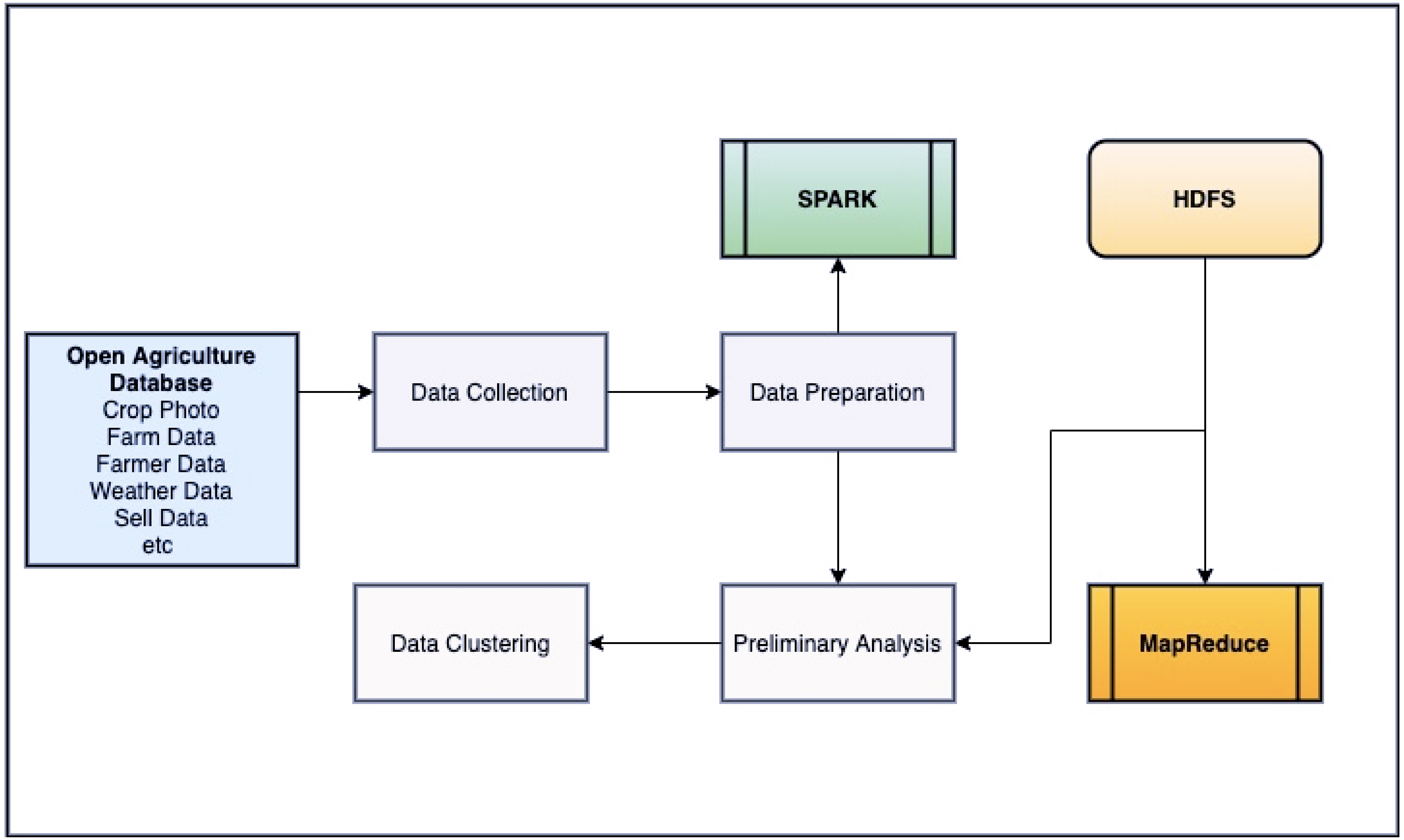
## Solution Paradigm

The following Data Analysis methodologies are used:

- Demand Calculation using ***Map Reduce*** Paradigm
- Demand Calculation using ***Spark*** through Databricks
- K-means Clustering using ***R***
- Data Visualizations using ***R***

# Methodology

## Workflow



# Methodology

## Dataset

- **Reliable crop dataset collected from an open data ecosystem of Open Government Data (OGD) Platform India published by National Data Sharing and Accessibility Policy.**

- **<u>Dataset 1:</u>** **area_production_and_productivity_of_principal_crops_2019.csv**

- **Major Fields are :**

  **[ Crop,Area (Hectare),Production (Tonnes), Productivity (in Kg / Hectare), Max.Production ]**

- **<u>Dataset 2:</u> Apy.csv (is dataset 246091 obs. of 7 variables)**

- **Major Fields are :**

  **[ State_Name, District_Name, Crop_Year, Season, Crop, Area ]**

# Methodology

## Data Preprocessing

- Upon analysis of the data, we focused on removing the row wise summary information of state wise crop production.
- We have added a new field ‘demand’ to the dataset by deriving it from available fields like production.
- For these preprocessing tasks we used Microsoft Excel as a tool.

# Result

## Demand Calculation using Spark

```
from pyspark.sql.types import *
from pyspark.sql.functions import *
df=spark.read.csv("/FileStore/tables/areal-6.csv",header="true")
display(df)
```

(1) Spark Jobs

df: pyspark.sql.dataframe.DataFrame = [S.No: string, Crop: string ... 7 more fields]

| | S.No | Crop | Area (Hectare) | Production (Tonnes) | Productivity (in Kg / Hectare) | Max.Production | Demand |
|---|---|---|---|---|---|---|---|
| 1 | 1 | Paddy in cereals | 1828919 | 6638450 | 3630 | 6638975970 | 6638972340 |
| 2 | 2 | Cholam Jowar in cereals | 385646 | 430661 | 1117 | 430766582 | 430765465 |
| 3 | 3 | Cumbu Bajra in cereals | 63029 | 143548 | 2277 | 143517033 | 143514756 |
| 4 | 4 | Ragi in cereals | 86513 | 321332 | 3714 | 321309282 | 321305568 |
| 5 | 5 | Maize in cereals | 324518 | 2591632 | 7986 | 2591600748 | 2591592762 |
| 6 | 6 | Small Millets in cereals | 25278 | 31226 | 1235 | 31218330 | 31217095 |
| 7 | 7 | Bengal gram in pulses | 5205 | 4820 | 926 | 4819830 | 4818904 |
| 8 | 8 | Red gram in pulses | 49225 | 53788 | 1093 | 53802925 | 53801832 |
| 9 | 9 | Green gram in pulses | 180587 | 78259 | 433 | 78194171 | 78193738 |
| 10 | 10 | Black gram in pulses | 426332 | 301662 | 707 | 301416724 | 301416017 |

Showing all 21 rows.



Command took 22.95 seconds -- by joicet@am.amrita.edu at 6/5/2021, 1:35:05 pm on My Cluster

7186099#

Cmd 2

```
df2=df.select("Crop","Demand","Group").groupBy("Group").agg(sum("Demand"))
df2.show()
```

(2) Spark Jobs

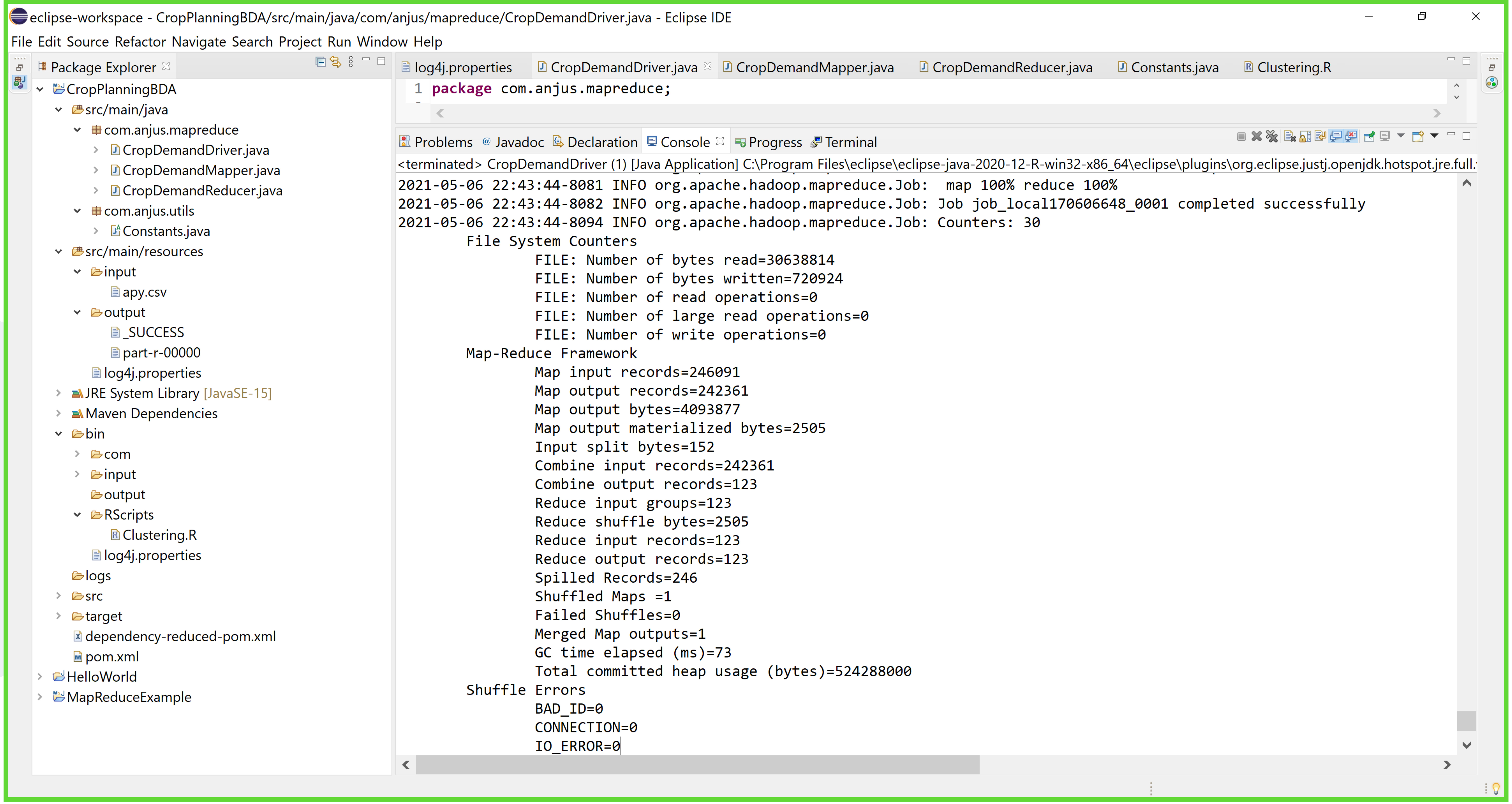
df2: pyspark.sql.dataframe.DataFrame = [Group: string, sum(Demand): double]

```
+-----------+---------------+
|      Group|    sum(Demand)|
+-----------+---------------+
|  oil seeds|  5.208673368E9|
|    Cereals|1.0157367986E10|
|Other crops|   7.58807045E8|
|     pulses|   5.56132525E8|
+-----------+---------------+
```

Command took 3.76 seconds -- by joicet@am.amrita.edu at 6/5/2021, 1:46:59 pm on My Cluster

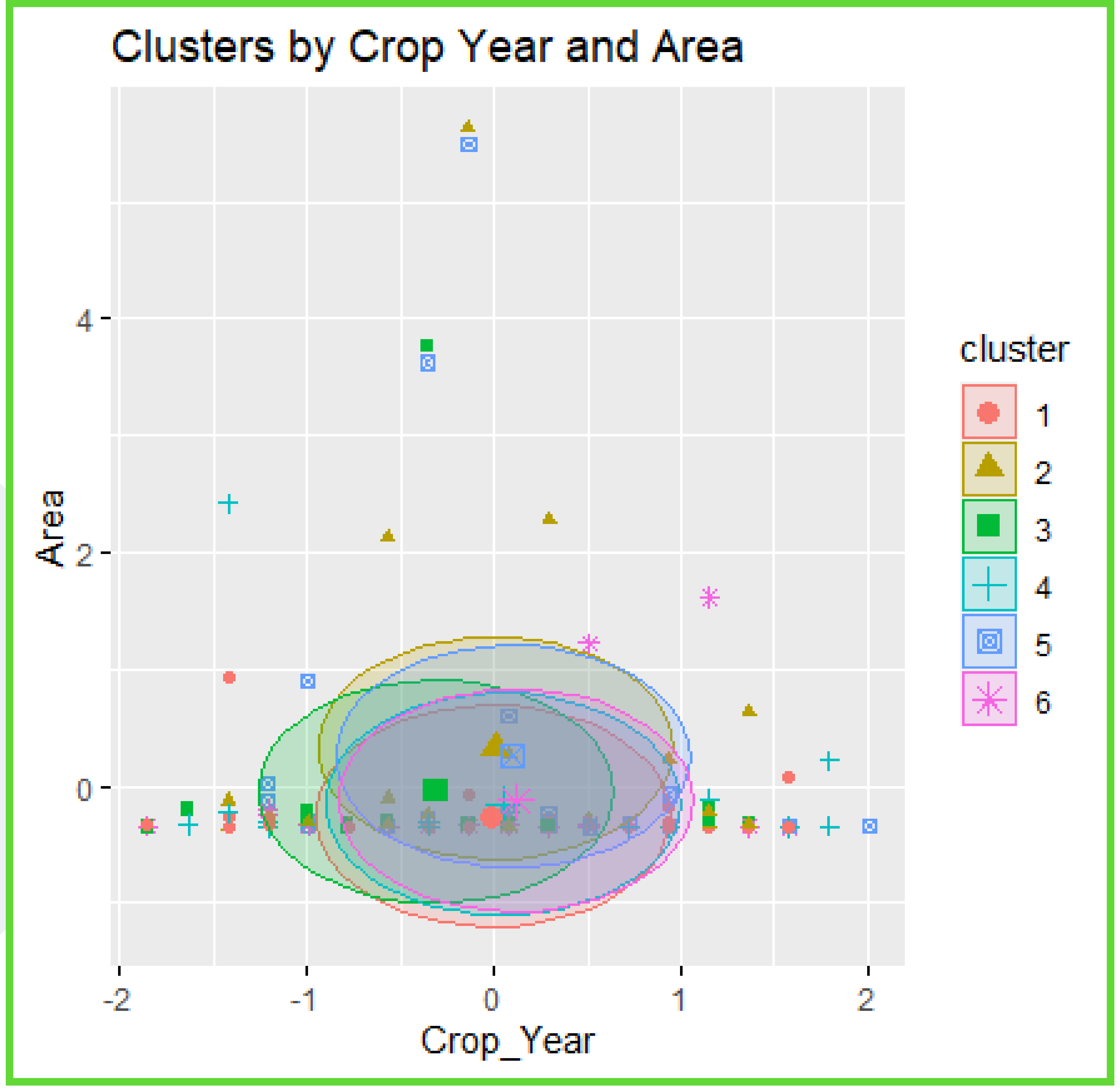
# Result

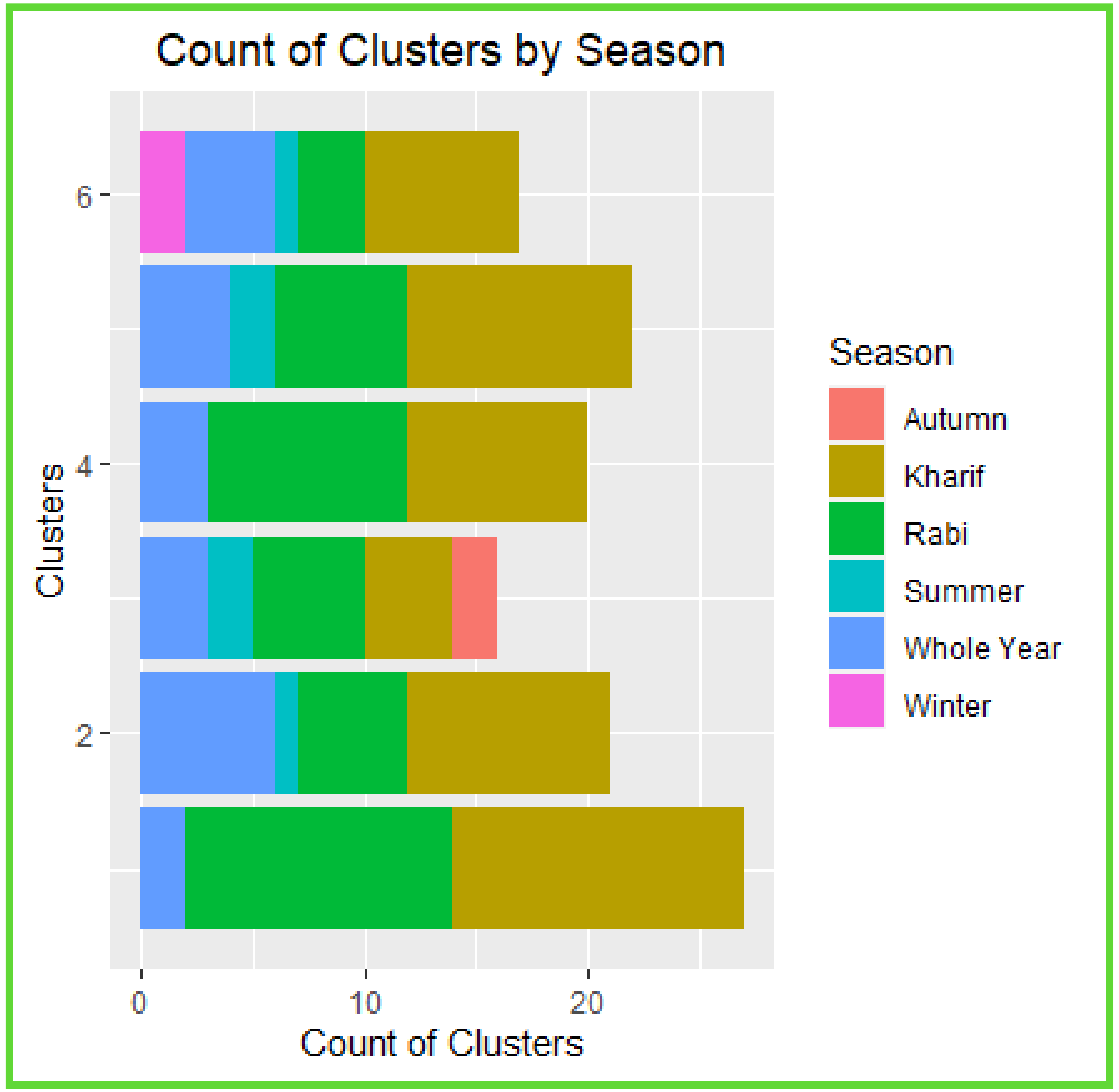
## Demand Calculation using MapReduce



# Result

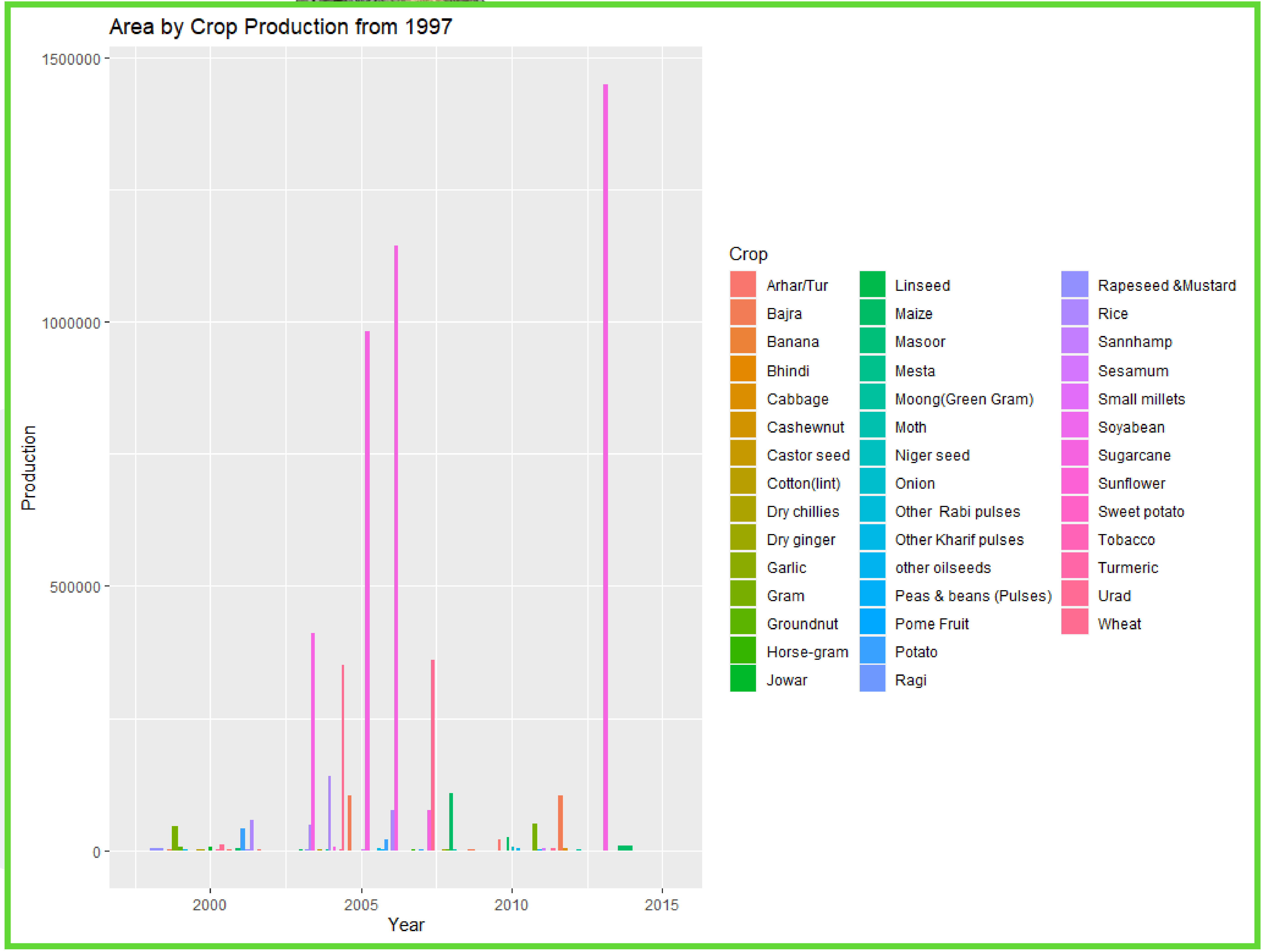
## K Means Clustering

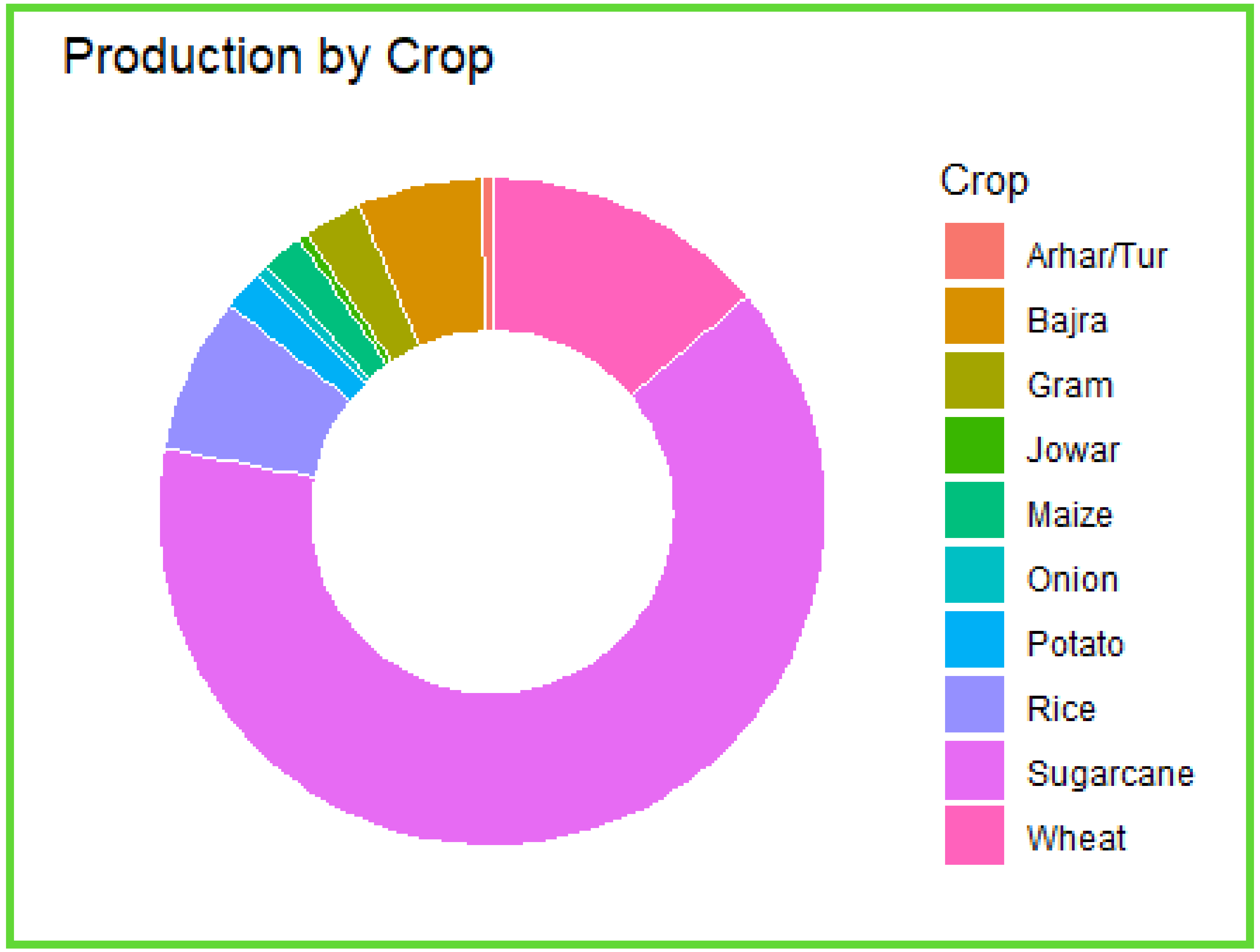


# Result

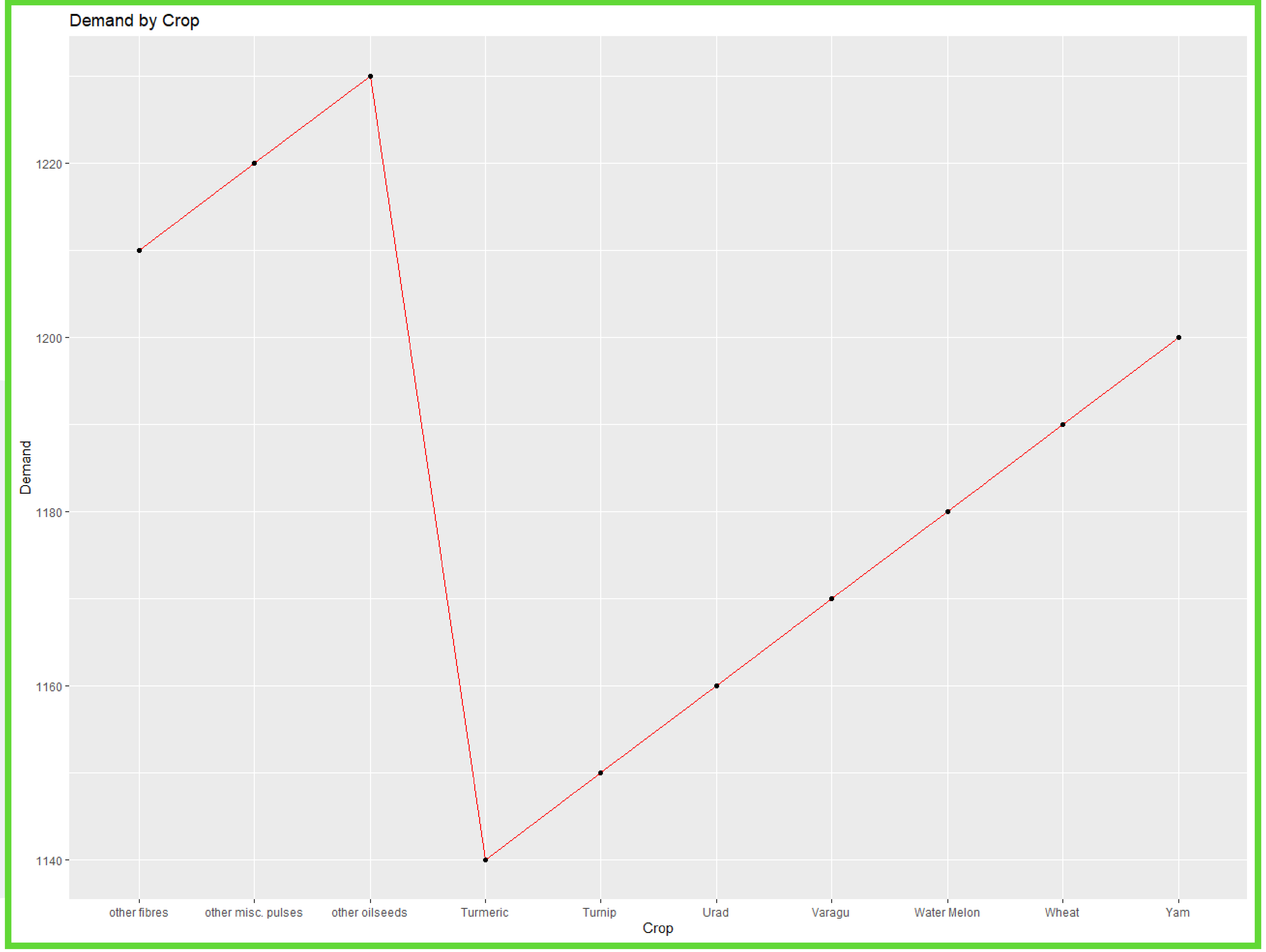
## Data Visualizations

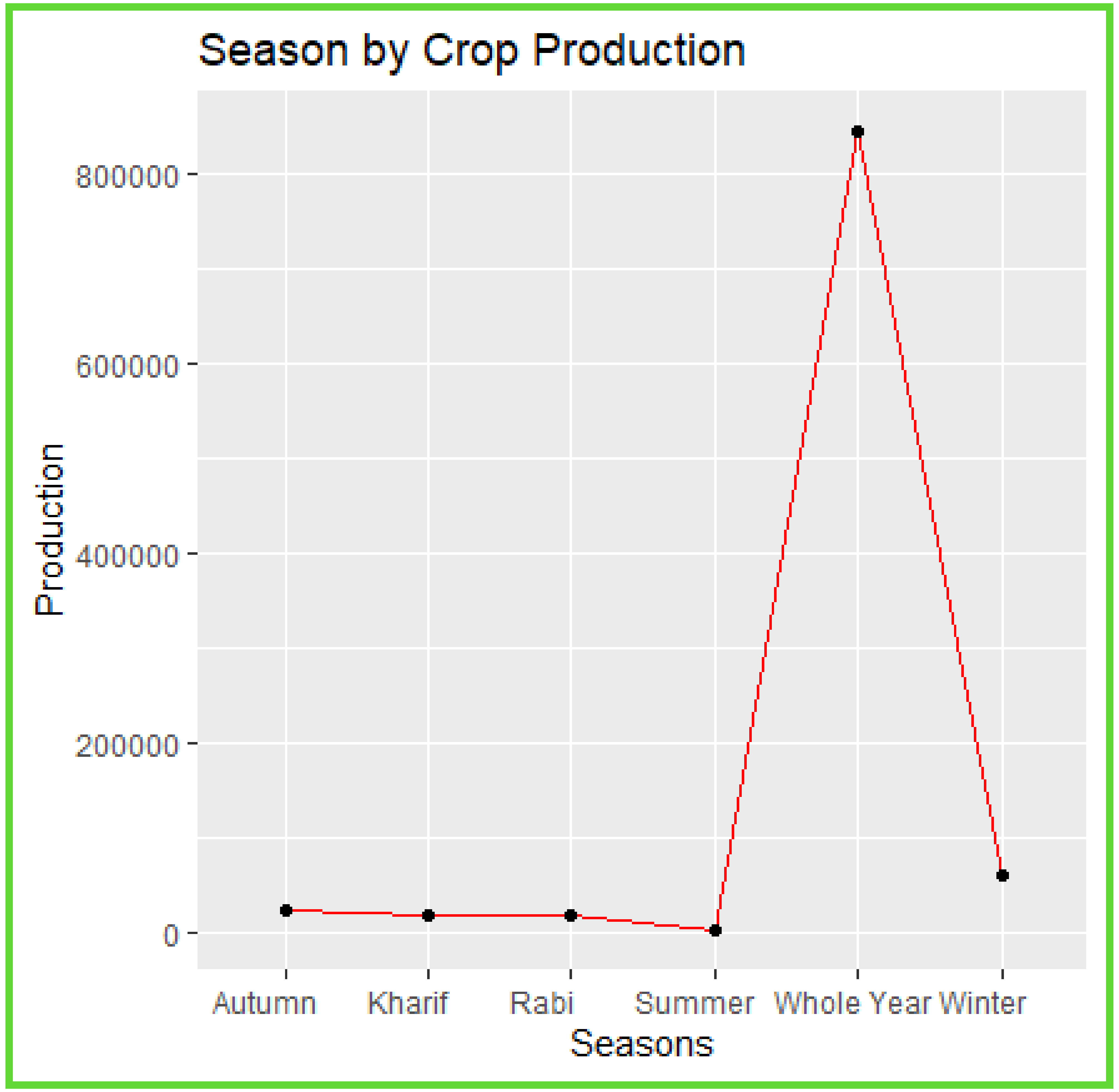


# Result

## Data Visualizations



# Spark Vs Map Reduce

| *Factors* | *Spark* | *Map Reduce* |
|---|---|---|
| **Speed** | 100x faster than Map Reduce | Faster than traditional processing |
| **Written In** | Scala | Java |
| **Data Processing** | Batch/real-time/iterative/interactive/graph | Batch processing |
| **Ease of use** | Compact and easy | Complex and lengthy |
| **Caching** | In-memory caching of data | Caching of data is not supported |
| **Cost** | More cost since it requires little high end commodity hardware with more RAM | Works with lesser RAM, commodity hardware is sufficient and hence less cost |
| **Scheduling** | Map Reduce requires YARN or Mesos for execution. | Spark can run in standalone mode using default scheduler. It can also run on YARN or Mesos. |
| **Security** | Less support for authentication using HDFS ACLs, Kerberos and shared secrets. | Uses all Hadoop security benefits and integrates with Hadoop Security projects like Knox, Gateway and Sentry. |
| **Latency** | Low | High |
| **Interactive mode** | Supports spark shell for Scala/ Python/ R | No |
| **Machine Learning/ Graph Processing** | Dedicated modules like Spark MLLib and GraphX for ML and Graph processing. | No inbuilt support. But Mahout can be used for ML. |

# Conclusion

Big Data Analytics is one of the best systems for crop planning to increase agriculture productiveness.

Effective use of Big Data Analytics on crop planning may be very significant to boom agricultural manufacturing.

The advancements in Information and Communication Technology is a boon to common man.

Thank You…!