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PROJECT REPORT

Project Title	Crop Production Analysis in India
Technologies	Data Science
Domain	Agriculture
Project Difficulties level	Advanced

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GitHub Link: Crop Production Analysis in India

PROBLEM STATEMENT

The Agriculture business domain, as a vital part of the overall supply chain, is expected to highly evolve in the upcoming years via the developments, which are taking place on the side of the Future Internet. This paper presents a novel

Business-to-Business collaboration platform from the agri-food sector perspective, which aims to facilitate the collaboration of numerous stakeholders belonging to associated business domains, in an effective and flexible manner.

This dataset provides a huge amount of information on crop production in India ranging from several years. Based on the Information the ultimate goal would be to predict crop production and find important insights highlighting key indicators and metrics that influence crop production.

ABSTRACT

Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, more so in the vast rural areas. It also contributes a significant figure to the Gross Domestic Product (GDP). About 70% of the Indian population practices agriculture. Hence, the production and management of crops is an important aspect to ensure optimal productivity in the fields.

When plants of the same variety are cultivated on a large scale, they are called crops. The crops are divided on the basis of the seasons in which they grow: **Kharif Crops, Rabi Crops and Whole year crops.**

Kharif crops

Kharif crops are typically sown at the beginning of the first monsoon rains (depending on region to region), Harvesting season begins from the 3rd week Of September to October (the exact harvesting dates differ from region to region). Paddy, maize, bajra, jowar are a few of the Kharif crops grown in India.

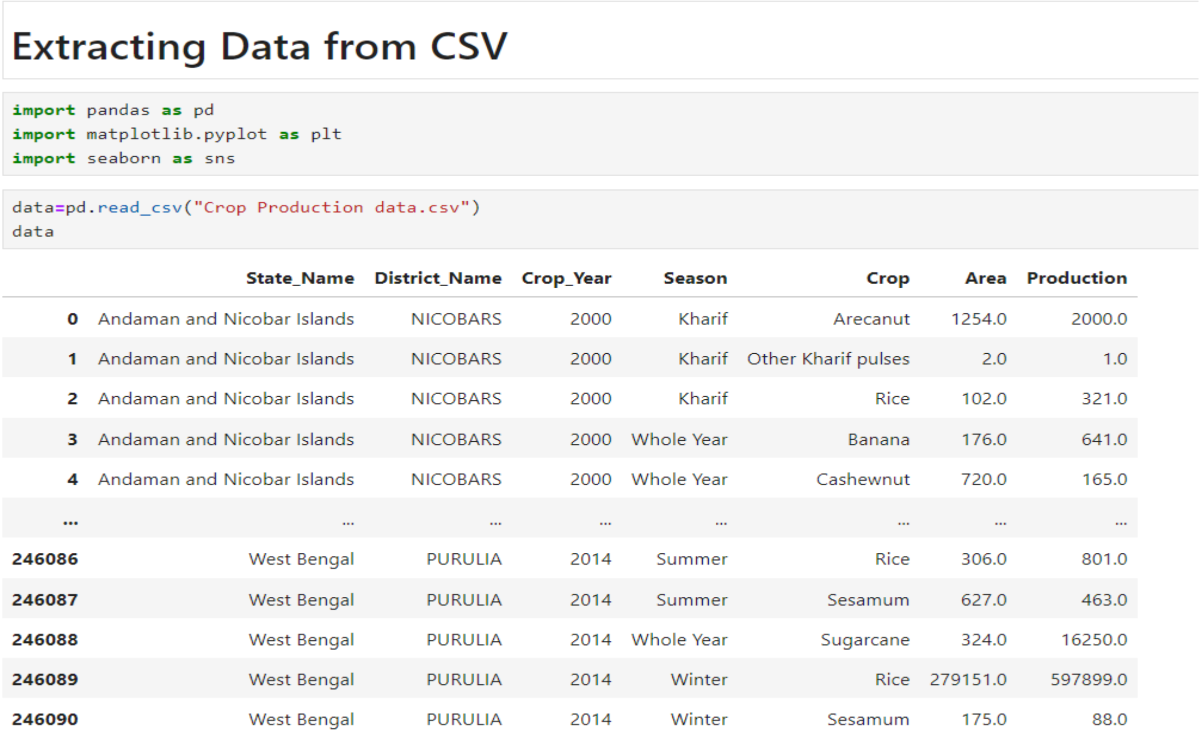
Rabi crops

Rabi crops are known as winter crops. They are grown in October or November. The crops are then harvested in spring. These crops require frequent irrigation because they are grown in dry areas. Wheat, gram, and barley are some of the Rabi crops grown in India.

Whole Year crop

The whole year crop definition is a plant that completes its entire life cycle in one year or one growing season. An annual crop, or yearly crop or plant, only lives for one growing season, which is the length of months that provides optimal growing conditions for that particular plant. Within the course of a single year, annual plants germinate, grow to maturity, and produce their own flowers, seeds, and fruit before dying. Pulses, sugarcanes, potato, dry chillies etc are known as whole year crops or plants.

CODE SNAPSHOTS

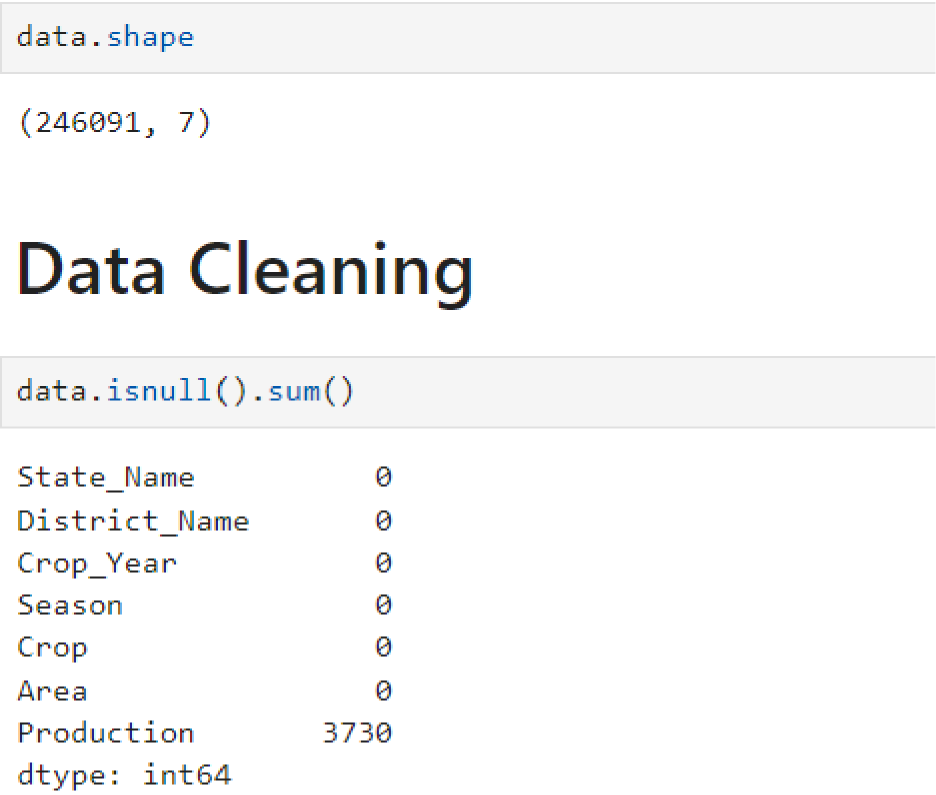


Extracting Data from CSV

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

```
data=pd.read_csv("Crop Production data.csv")
data
```

	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production
0	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Arecanut	1254.0	2000.0
1	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Other Kharif pulses	2.0	1.0
2	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Rice	102.0	321.0
3	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Banana	176.0	641.0
4	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Cashewnut	720.0	165.0
...	...	...	...	...	...	...	...
246086	West Bengal	PURULIA	2014	Summer	Rice	306.0	801.0
246087	West Bengal	PURULIA	2014	Summer	Sesamum	627.0	463.0
246088	West Bengal	PURULIA	2014	Whole Year	Sugarcane	324.0	16250.0
246089	West Bengal	PURULIA	2014	Winter	Rice	279151.0	597899.0
246090	West Bengal	PURULIA	2014	Winter	Sesamum	175.0	88.0



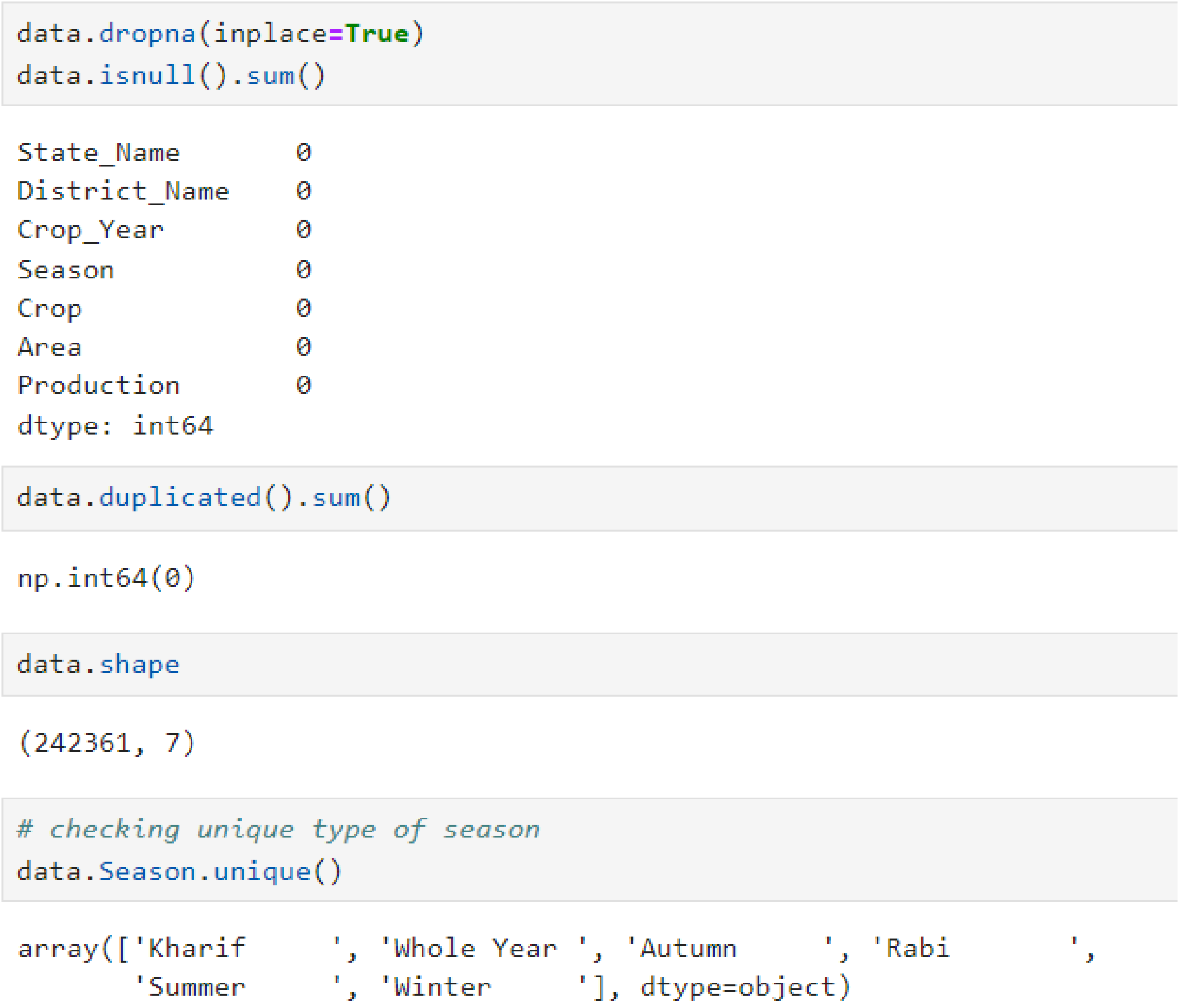
```
data.shape
```

```
(246091, 7)
```

Data Cleaning

```
data.isnull().sum()
```

```
State_Name          0
District_Name       0
Crop_Year           0
Season              0
Crop                0
Area                0
Production       3730
dtype: int64
```



```
data.dropna(inplace=True)
data.isnull().sum()
```

```
State_Name       0
District_Name    0
Crop_Year        0
Season           0
Crop             0
Area             0
Production       0
dtype: int64
```

```
data.duplicated().sum()
```

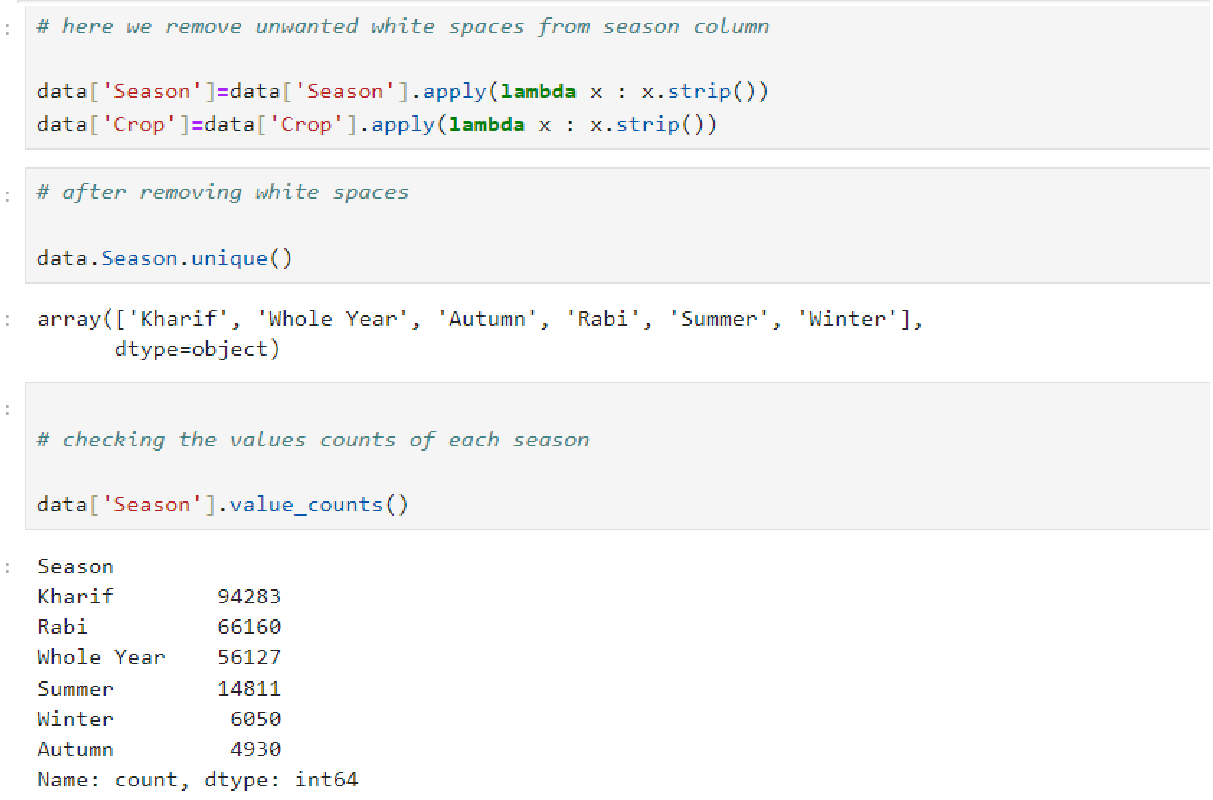
```
np.int64(0)
```

```
data.shape
```

```
(242361, 7)
```

```
# checking unique type of season
data.Season.unique()
```

```
array(['Kharif     ', 'Whole Year ', 'Autumn     ', 'Rabi       ',
       'Summer     ', 'Winter     '], dtype=object)
```



```
# here we remove unwanted white spaces from season column

data['Season']=data['Season'].apply(lambda x : x.strip())
data['Crop']=data['Crop'].apply(lambda x : x.strip())
```

```
# after removing white spaces

data.Season.unique()
```

```
array(['Kharif', 'Whole Year', 'Autumn', 'Rabi', 'Summer', 'Winter'],
      dtype=object)
```

```

# checking the values counts of each season

data['Season'].value_counts()
```

```
Season
Kharif        94283
Rabi          66160
Whole Year    56127
Summer        14811
Winter         6050
Autumn         4930
Name: count, dtype: int64
```

```
'''since there are Three types of crop out of which two are mainly seasonal Rabi and Kharif and one is for whole year but
 6 crops season were present in our datset.we got to know that summer and Autumn synonyms of Kharif and winter is synonyms of
 of Rabi so we decided to replace with their original name which is Kharif Rabi'''

data['Season']=data['Season'].apply(lambda x : x.replace('Autumn','Kharif'))
data['Season']=data['Season'].apply(lambda x : x.replace('Summer','Kharif'))
data['Season']=data['Season'].apply(lambda x : x.replace('Winter','Rabi'))
```

```
#Checking values counts of season after replacing wiyh their original name

data['Season'].value_counts()
```

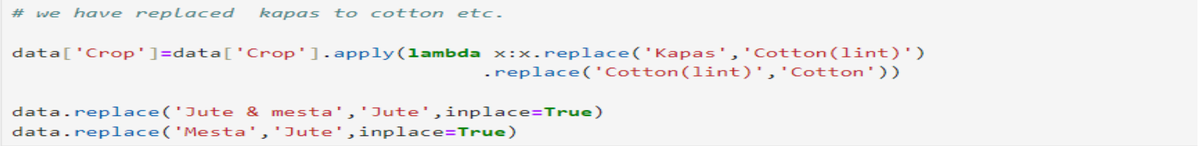
```
Season
Kharif        113167
Rabi           71686
Whole Year     51352
Name: count, dtype: int64
```

```
# we have observed that many values of producation were 0 since it is represntating producation of whole district
# so we decided drop all rows whose producation values are zero

data.drop(data[data['Production']==0].index,inplace=True)

print(f'After removing the row which has 0 Production : {data.shape[0]}')
```

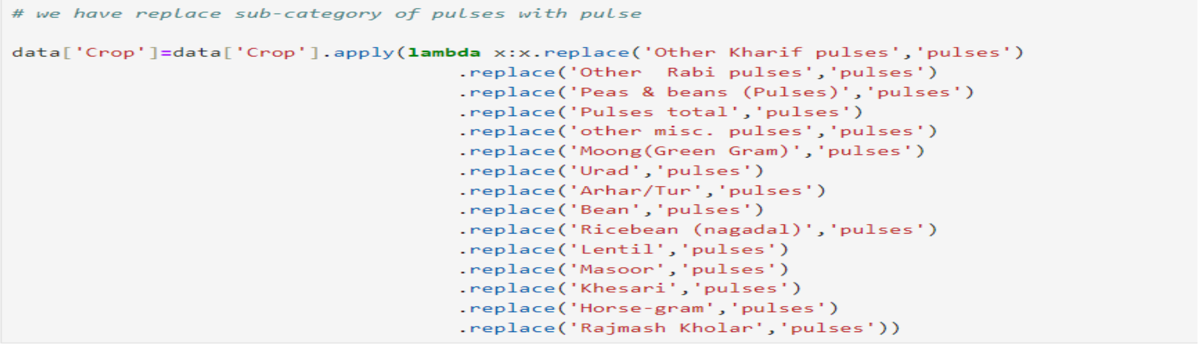
```
After removing the row which has 0 Production : 238838
```

```
# checking unique crops names
# we observed that many crops were presenyed with their syononame so we decided all synonyms of crops to replace with their popular name
# like paddy and rice are same so we replace paddy with Rice
# also number of rows of crops sub-category were very less

data.Crop.unique()
```

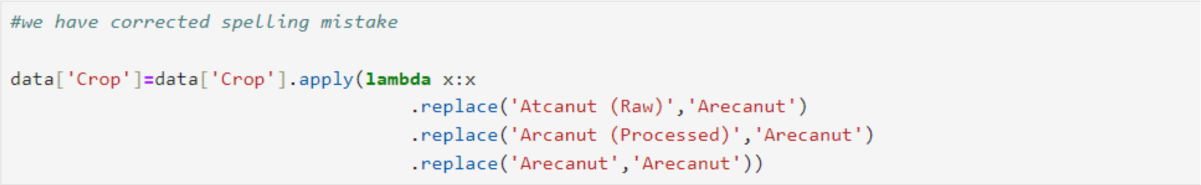
```
array(['Arecanut', 'Other Kharif pulses', 'Rice', 'Banana', 'Cashewnut',
       'Coconut', 'Dry ginger', 'Sugarcane', 'Sweet potato', 'Tapioca',
       'Black pepper', 'Dry chillies', 'other oilseeds', 'Turmeric',
       'Maize', 'Moong(Green Gram)', 'Urad', 'Arhar/Tur', 'Groundnut',
       'Sunflower', 'Bajra', 'Castor seed', 'Cotton(lint)', 'Horse-gram',
       'Jowar', 'Korra', 'Ragi', 'Tobacco', 'Gram', 'Wheat', 'Masoor',
       'Sesamum', 'Linseed', 'Safflower', 'Onion', 'other misc. pulses',
       'Samai', 'Small millets', 'Coriander', 'Potato',
       'Other  Rabi pulses', 'Beans & Mutter(Vegetable)', 'Bhindi',
       'Brinjal', 'Citrus Fruit', 'Grapes', 'Mango', 'Orange',
       'Other Fresh Fruits', 'Papaya', 'Pome Fruit', 'Tomato', 'Soyabean',
       'Mesta', 'Cowpea(Lobia)', 'Lemon', 'Pome Granet', 'Sapota',
       'Cabbage', 'Rapeseed &Mustard', 'Niger seed', 'Varagu', 'Garlic',
       'Ginger', 'Oilseeds total', 'Pulses total', 'Jute',
       'Peas & beans (Pulses)', 'Blackgram', 'Paddy', 'Pineapple',
       'Barley', 'Sannhamp', 'Khesari', 'Guar seed', 'Other Vegetables',
       'Moth', 'Other Cereals & Millets', 'Cond-spcs other', 'Turnip',
       'Carrot', 'Redish', 'Arcanut (Processed)', 'Atcanut (Raw)',
       'Cashewnut Processed', 'Cashewnut Raw', 'Cardamom', 'Rubber',
       'Drum Stick', 'Jack Fruit', 'Tea', 'Coffee', 'Total foodgrain',
       'Cauliflower', 'Bitter Gourd', 'Bottle Gourd', 'Kapas',
       'Colocosia', 'Lentil', 'Bean', 'Jobster', 'Perilla',
       'Rajmash Kholar', 'Ricebean (nagadal)', 'Jute & mesta'],
      dtype=object)
```



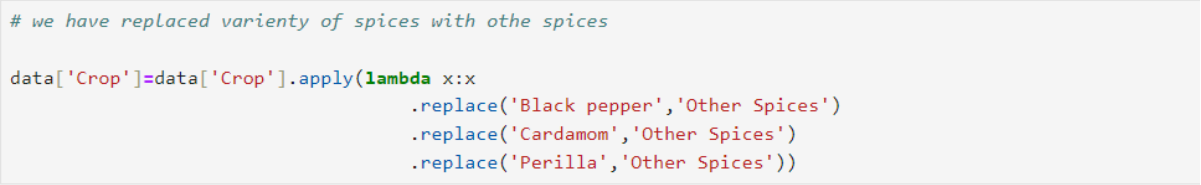
```
# we have replaced  kapas to cotton etc.

data['Crop']=data['Crop'].apply(lambda x:x.replace('Kapas','Cotton(lint)')
                                       .replace('Cotton(lint)','Cotton'))

data.replace('Jute & mesta','Jute',inplace=True)
data.replace('Mesta','Jute',inplace=True)
```



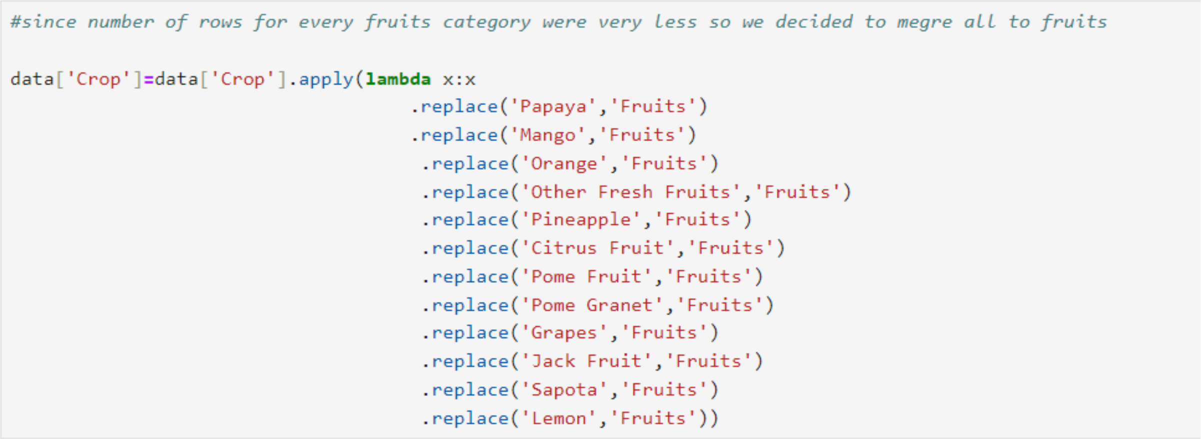
```
# we have replace sub-category of pulses with pulse

data['Crop']=data['Crop'].apply(lambda x:x.replace('Other Kharif pulses','pulses')
                                     .replace('Other  Rabi pulses','pulses')
                                     .replace('Peas & beans (Pulses)','pulses')
                                     .replace('Pulses total','pulses')
                                     .replace('other misc. pulses','pulses')
                                     .replace('Moong(Green Gram)','pulses')
                                     .replace('Urad','pulses')
                                     .replace('Arhar/Tur','pulses')
                                     .replace('Bean','pulses')
                                     .replace('Ricebean (nagadal)','pulses')
                                     .replace('Lentil','pulses')
                                     .replace('Masoor','pulses')
                                     .replace('Khesari','pulses')
                                     .replace('Horse-gram','pulses')
                                     .replace('Rajmash Kholar','pulses'))
```



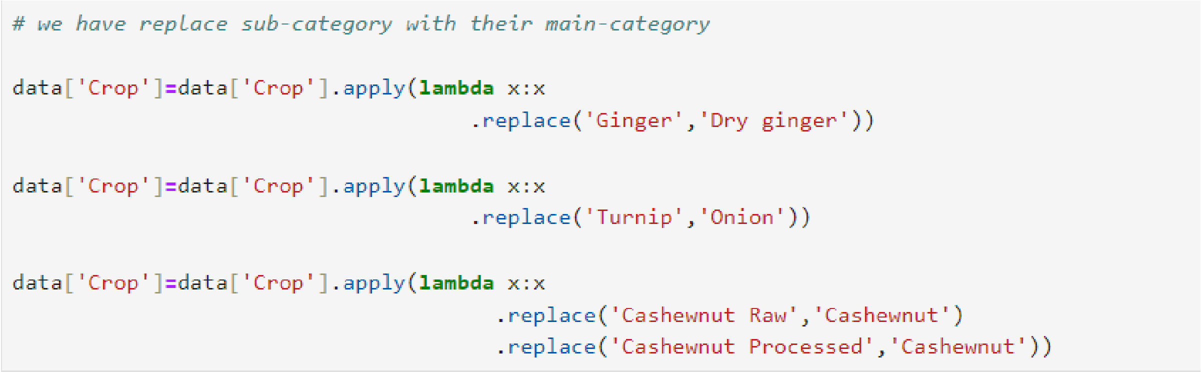
```
#we have corrected spelling mistake

data['Crop']=data['Crop'].apply(lambda x:x
                                    .replace('Atcanut (Raw)','Arecanut')
                                    .replace('Arcanut (Processed)','Arecanut')
                                    .replace('Arecanut','Arecanut'))
```



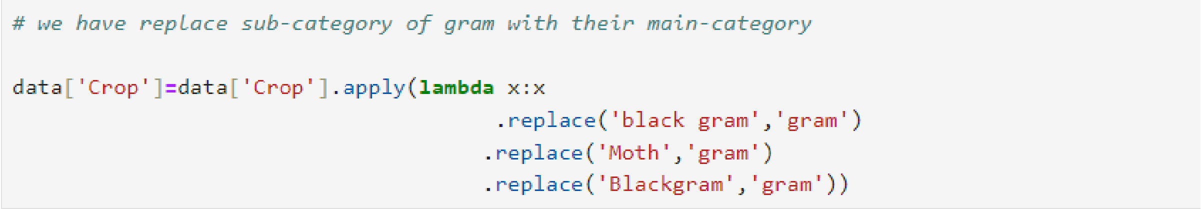
```
# we have replaced varienty of spices with othe spices

data['Crop']=data['Crop'].apply(lambda x:x
                                    .replace('Black pepper','Other Spices')
                                    .replace('Cardamom','Other Spices')
                                    .replace('Perilla','Other Spices'))
```



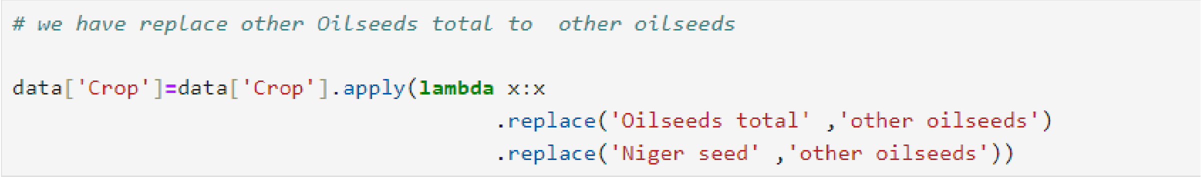
```
#since number of rows for every fruits category were very less so we decided to megre all to fruits

data['Crop']=data['Crop'].apply(lambda x:x
                                    .replace('Papaya','Fruits')
                                    .replace('Mango','Fruits')
                                     .replace('Orange','Fruits')
                                     .replace('Other Fresh Fruits','Fruits')
                                     .replace('Pineapple','Fruits')
                                     .replace('Citrus Fruit','Fruits')
                                     .replace('Pome Fruit','Fruits')
                                     .replace('Pome Granet','Fruits')
                                     .replace('Grapes','Fruits')
                                     .replace('Jack Fruit','Fruits')
                                     .replace('Sapota','Fruits')
                                     .replace('Lemon','Fruits'))
```



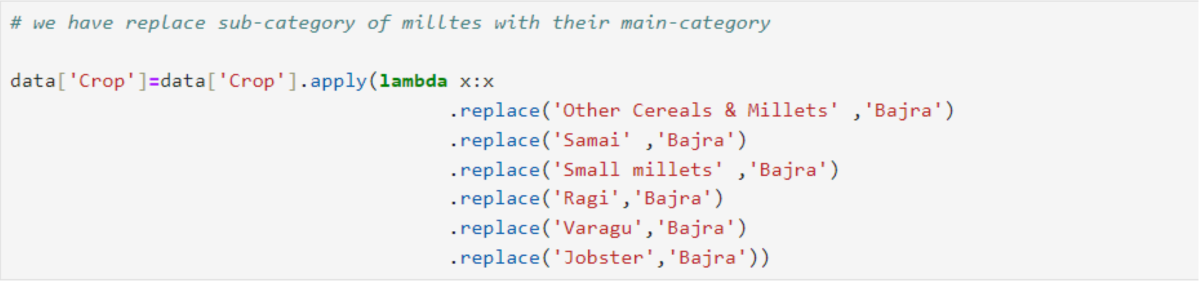
```
# we have replace sub-category with their main-category

data['Crop']=data['Crop'].apply(lambda x:x
                                    .replace('Ginger','Dry ginger'))

data['Crop']=data['Crop'].apply(lambda x:x
                                    .replace('Turnip','Onion'))

data['Crop']=data['Crop'].apply(lambda x:x
                                      .replace('Cashewnut Raw','Cashewnut')
                                      .replace('Cashewnut Processed','Cashewnut'))
```



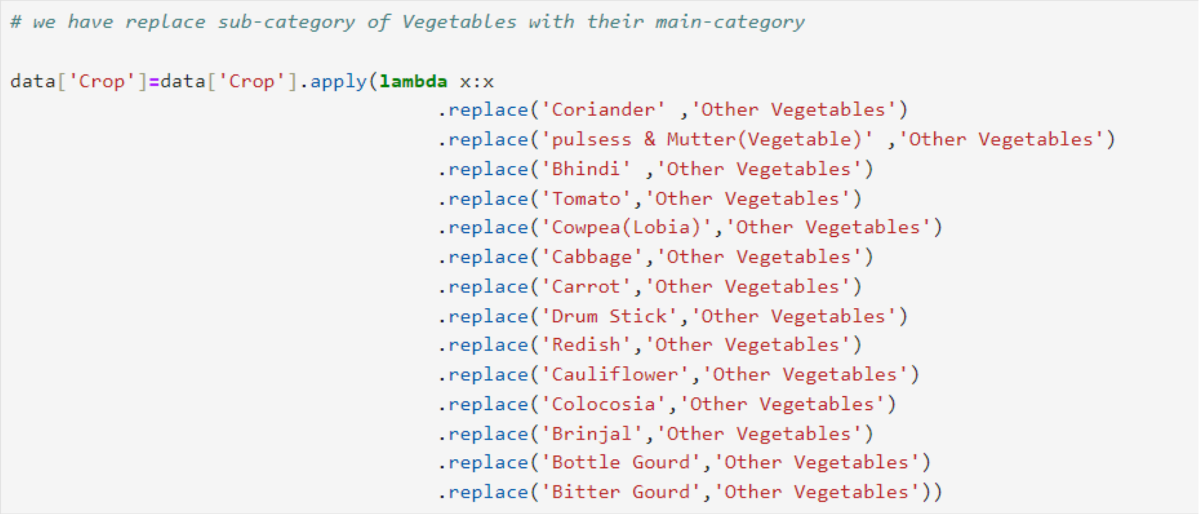
```
# we have replace sub-category of gram with their main-category

data['Crop']=data['Crop'].apply(lambda x:x
                                      .replace('black gram','gram')
                                     .replace('Moth','gram')
                                     .replace('Blackgram','gram'))
```



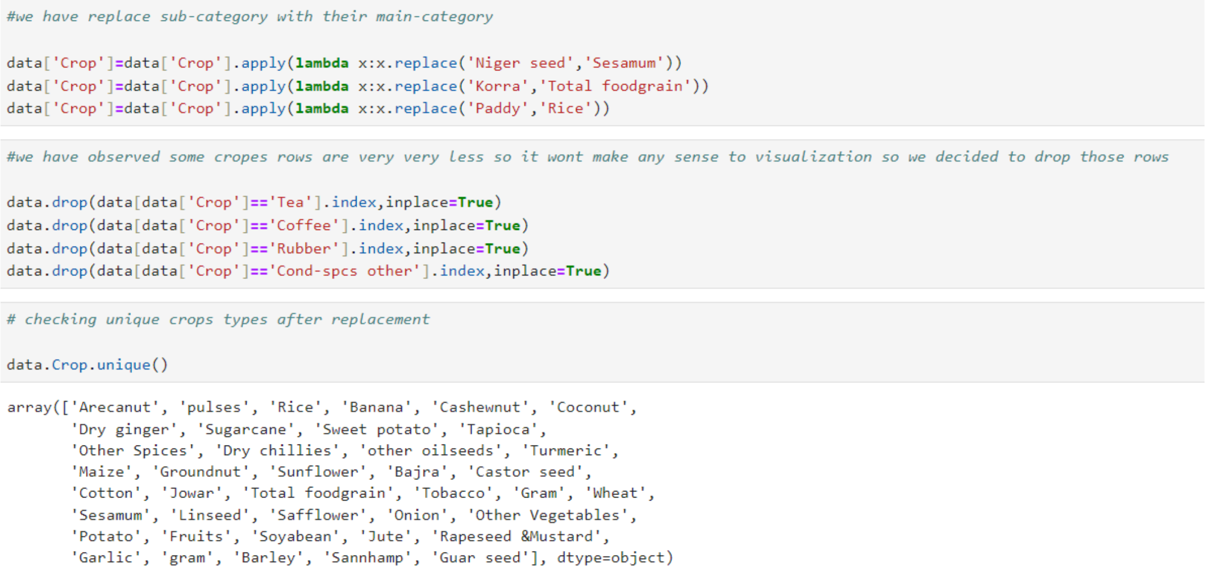
```
# we have replace other Oilseeds total to  other oilseeds

data['Crop']=data['Crop'].apply(lambda x:x
                                      .replace('Oilseeds total' ,'other oilseeds')
                                      .replace('Niger seed' ,'other oilseeds'))
```



```
# we have replace sub-category of milltes with their main-category

data['Crop']=data['Crop'].apply(lambda x:x
                                      .replace('Other Cereals & Millets' ,'Bajra')
                                      .replace('Samai' ,'Bajra')
                                      .replace('Small millets' ,'Bajra')
                                      .replace('Ragi','Bajra')
                                      .replace('Varagu','Bajra')
                                      .replace('Jobster','Bajra'))
```



```
# we have replace sub-category of Vegetables with their main-category

data['Crop']=data['Crop'].apply(lambda x:x
                                     .replace('Coriander' ,'Other Vegetables')
                                     .replace('pulsess & Mutter(Vegetable)' ,'Other Vegetables')
                                     .replace('Bhindi' ,'Other Vegetables')
                                     .replace('Tomato','Other Vegetables')
                                     .replace('Cowpea(Lobia)','Other Vegetables')
                                     .replace('Cabbage','Other Vegetables')
                                     .replace('Carrot','Other Vegetables')
                                     .replace('Drum Stick','Other Vegetables')
                                     .replace('Redish','Other Vegetables')
                                     .replace('Cauliflower','Other Vegetables')
                                     .replace('Colocosia','Other Vegetables')
                                     .replace('Brinjal','Other Vegetables')
                                     .replace('Bottle Gourd','Other Vegetables')
                                     .replace('Bitter Gourd','Other Vegetables'))
```



```
#we have replace sub-category with their main-category

data['Crop']=data['Crop'].apply(lambda x:x.replace('Niger seed','Sesamum'))
data['Crop']=data['Crop'].apply(lambda x:x.replace('Korra','Total foodgrain'))
data['Crop']=data['Crop'].apply(lambda x:x.replace('Paddy','Rice'))
```

```
#we have observed some cropes rows are very very less so it wont make any sense to visualization so we decided to drop those rows

data.drop(data[data['Crop']=='Tea'].index,inplace=True)
data.drop(data[data['Crop']=='Coffee'].index,inplace=True)
data.drop(data[data['Crop']=='Rubber'].index,inplace=True)
data.drop(data[data['Crop']=='Cond-spcs other'].index,inplace=True)
```

```
# checking unique crops types after replacement

data.Crop.unique()
```

```
array(['Arecanut', 'pulses', 'Rice', 'Banana', 'Cashewnut', 'Coconut',
       'Dry ginger', 'Sugarcane', 'Sweet potato', 'Tapioca',
       'Other Spices', 'Dry chillies', 'other oilseeds', 'Turmeric',
       'Maize', 'Groundnut', 'Sunflower', 'Bajra', 'Castor seed',
       'Cotton', 'Jowar', 'Total foodgrain', 'Tobacco', 'Gram', 'Wheat',
       'Sesamum', 'Linseed', 'Safflower', 'Onion', 'Other Vegetables',
       'Potato', 'Fruits', 'Soyabean', 'Jute', 'Rapeseed &Mustard',
       'Garlic', 'gram', 'Barley', 'Sannhamp', 'Guar seed'], dtype=object)
```

```
# Since india very big country for better vislization we will divide states name in four zone (East , West , North ,South)
# details of these zones are mentioned below
West_India= ['Maharashtra','Goa','Gujarat','Dadra and Nagar Haveli']
East_India= ['Arunachal Pradesh','Assam','Manipur','Meghalaya','Mizoram','Nagaland','Sikkim','Tripura','West Bengal','Bihar','Odisha','Jharkhand' ]
North_India=['Jammu and Kashmir ','Himachal Pradesh','Punjab','Uttarakhand','Haryana','Rajasthan','Uttar Pradesh','Chandigarh','Madhya Pradesh','Chhattis
South_India = ['Andhra Pradesh','Karnataka','Kerala','Tamil Nadu','Telangana','Puducherry']
```

```
# creating a list for zones
zone = []

for df in data['State_Name']:
    if df in West_India:
        zone.append('West India')
    elif df in East_India:
        zone.append('EastIndia')
    elif df in North_India:
        zone.append('North India')
    elif df in South_India:
        zone.append('South India')
    else:
        zone.append('Union Territory')
```

```
# creatinh new column
data['zone'] = zone
```

```
# Adding a new column of yield into our data
data['Yield']=data['Production']/data['Area']
```

```
data
```

	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production	zone	Yield
0	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Arecanut	1254.0	2000.0	Union Territory	1.594896
1	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	pulses	2.0	1.0	Union Territory	0.500000
2	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Rice	102.0	321.0	Union Territory	3.147059
3	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Banana	176.0	641.0	Union Territory	3.642045
4	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Cashewnut	720.0	165.0	Union Territory	0.229167
...	...	...	...	...	...	...	...	...	...
246086	West Bengal	PURULIA	2014	Kharif	Rice	306.0	801.0	EastIndia	2.617647
246087	West Bengal	PURULIA	2014	Kharif	Sesamum	627.0	463.0	EastIndia	0.738437
246088	West Bengal	PURULIA	2014	Whole Year	Sugarcane	324.0	16250.0	EastIndia	50.154321
246089	West Bengal	PURULIA	2014	Rabi	Rice	279151.0	597899.0	EastIndia	2.141848
246090	West Bengal	PURULIA	2014	Rabi	Sesamum	175.0	88.0	EastIndia	0.502857

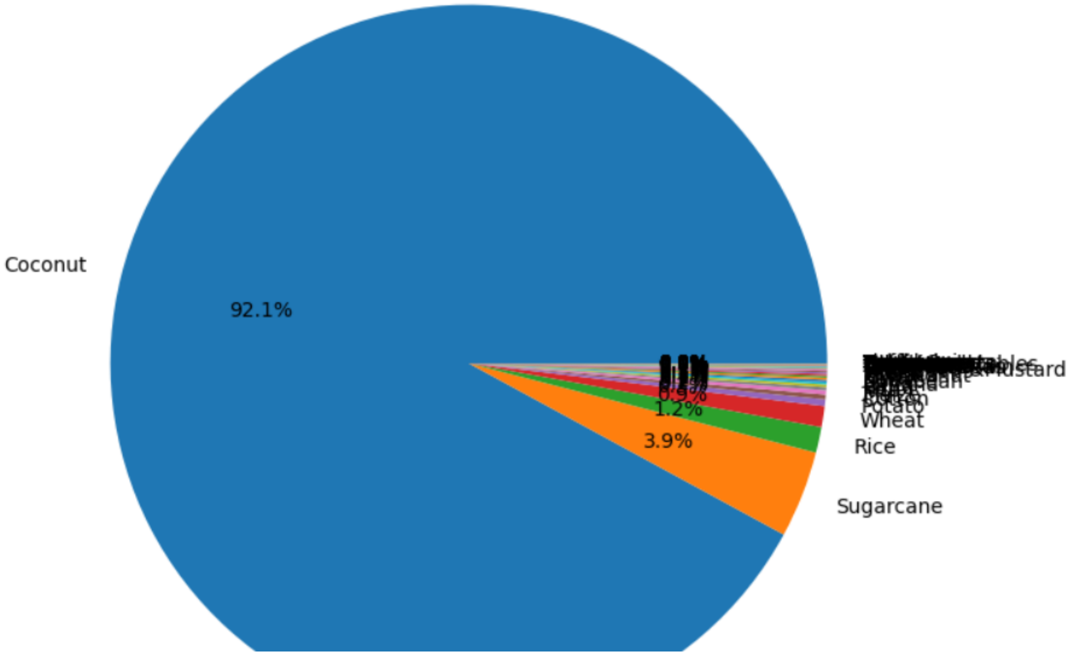
238723 rows × 9 columns

```
# checking value counts of year in dataset

data['Crop_Year'].value_counts()
```

```
Crop_Year
2003    15541
2002    15060
2007    14261
2008    14230
2006    13976
2004    13834
2010    13793
2011    13791
2009    13767
2005    13519
2013    13474
2000    13393
2012    13183
2001    13107
1999    12258
1998    11262
2014    10814
1997     8899
2015      561
Name: count, dtype: int64
```

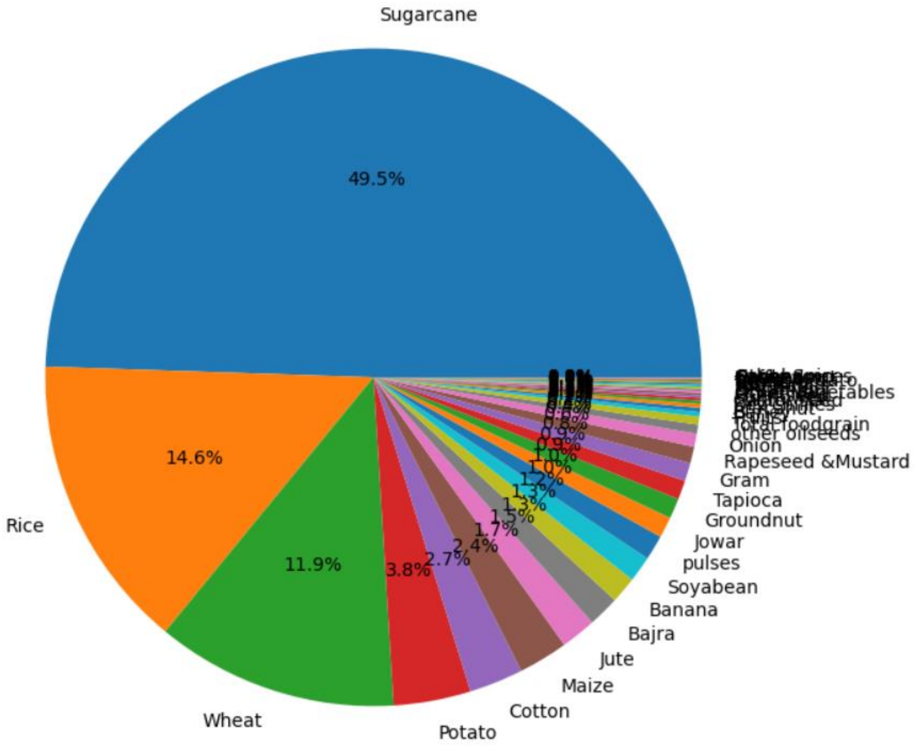
```
# sinces the number of rows for year 2015 is very less so it will not give correct visualization for year 2015
# so we decided to remove it from dataset

data.drop(data[data['Crop_Year'] == 2015].index,inplace=True)
```

```
# we plotted pie chart of Production of different crops to check the outliers in crops
plt.figure(figsize=(10,8))
plt.pie(val,labels=lab,autopct='%0.1f%%')
plt.show()
```



```
# we have observed that Production of coconut is more than 92% of total Production so we not able to visualize our dataset
# so we have decided to visualize coconut seprately

coconut_df = data[data['Crop'] == 'Coconut']

coconut_df.to_csv('coconut_df.csv')

data.drop(data[data['Crop']=='Coconut'].index,inplace=True)
```

```
# we plotted pie chart between total Production and different types of crops after removing outlier

val=data.groupby('Crop').sum().sort_values(by='Production',ascending = False)['Production'].values
lab=data.groupby('Crop').sum().sort_values(by='Production',ascending = False)['Production'].index
# we have observed that now our dataset is balance

plt.figure(figsize=(10,8))
plt.pie(val,labels=lab,autopct='%0.1f%%')
plt.show()
```

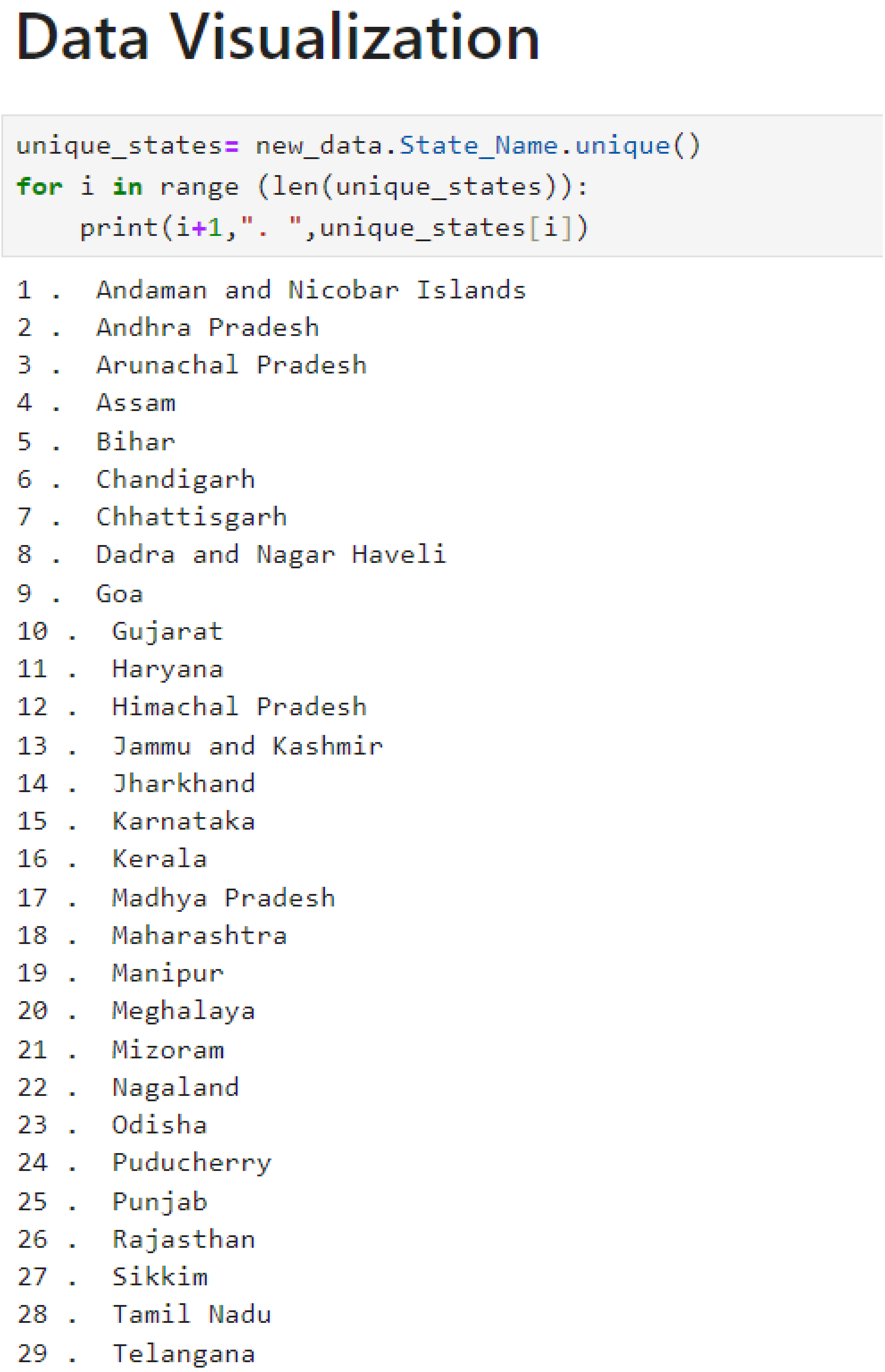


```
data.to_csv('Cleaned_Crop_Data.csv')
```

```
new_data=pd.read_csv("Cleaned_Crop_Data.csv")
new_data
```

	Unnamed: 0	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production	zone	Yield
0	0	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Arecanut	1254.0	2000.0	Union Territory	1.594896
1	1	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	pulses	2.0	1.0	Union Territory	0.500000
2	2	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Rice	102.0	321.0	Union Territory	3.147059
3	3	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Banana	176.0	641.0	Union Territory	3.642045
4	4	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Cashewnut	720.0	165.0	Union Territory	0.229167
...	...	...	...	...	...	...	...	...	...	...
236200	246086	West Bengal	PURULIA	2014	Kharif	Rice	306.0	801.0	EastIndia	2.617647
236201	246087	West Bengal	PURULIA	2014	Kharif	Sesamum	627.0	463.0	EastIndia	0.738437
236202	246088	West Bengal	PURULIA	2014	Whole Year	Sugarcane	324.0	16250.0	EastIndia	50.154321
236203	246089	West Bengal	PURULIA	2014	Rabi	Rice	279151.0	597899.0	EastIndia	2.141848
236204	246090	West Bengal	PURULIA	2014	Rabi	Sesamum	175.0	88.0	EastIndia	0.502857

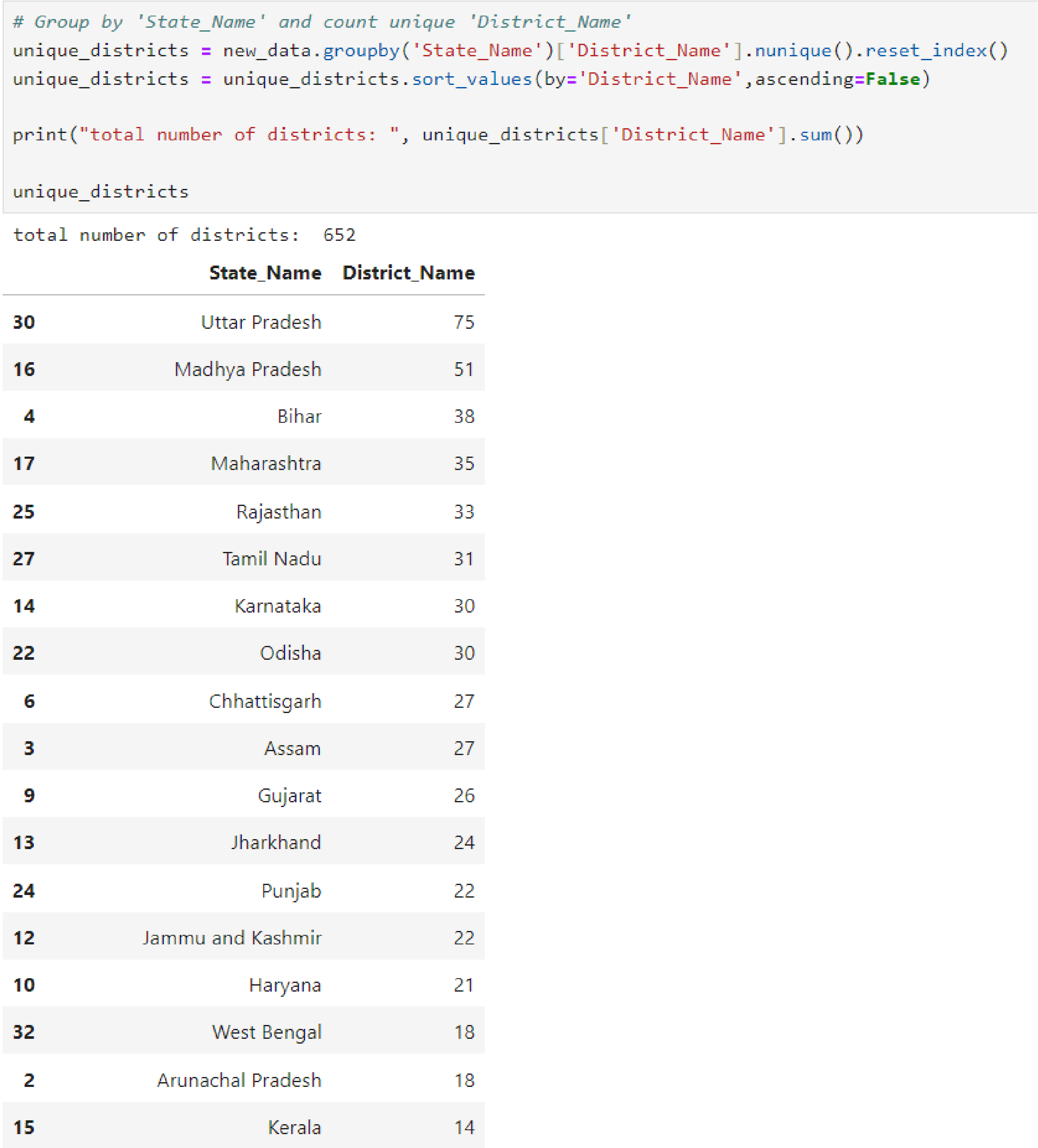
236205 rows × 10 columns



Data Visualization

```
unique_states= new_data.State_Name.unique()
for i in range (len(unique_states)):
    print(i+1,". ",unique_states[i])
```

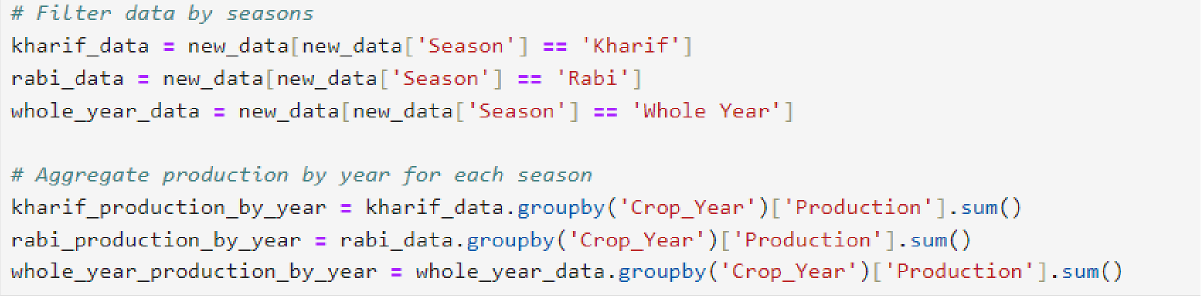
```
1 .  Andaman and Nicobar Islands
2 .  Andhra Pradesh
3 .  Arunachal Pradesh
4 .  Assam
5 .  Bihar
6 .  Chandigarh
7 .  Chhattisgarh
8 .  Dadra and Nagar Haveli
9 .  Goa
10 .  Gujarat
11 .  Haryana
12 .  Himachal Pradesh
13 .  Jammu and Kashmir
14 .  Jharkhand
15 .  Karnataka
16 .  Kerala
17 .  Madhya Pradesh
18 .  Maharashtra
19 .  Manipur
20 .  Meghalaya
21 .  Mizoram
22 .  Nagaland
23 .  Odisha
24 .  Puducherry
25 .  Punjab
26 .  Rajasthan
27 .  Sikkim
28 .  Tamil Nadu
29 .  Telangana
```



```python
# Group by 'State_Name' and count unique 'District_Name'
unique_districts = new_data.groupby('State_Name')['District_Name'].nunique().reset_index()
unique_districts = unique_districts.sort_values(by='District_Name',ascending=False)

print("total number of districts: ", unique_districts['District_Name'].sum())

unique_districts
```

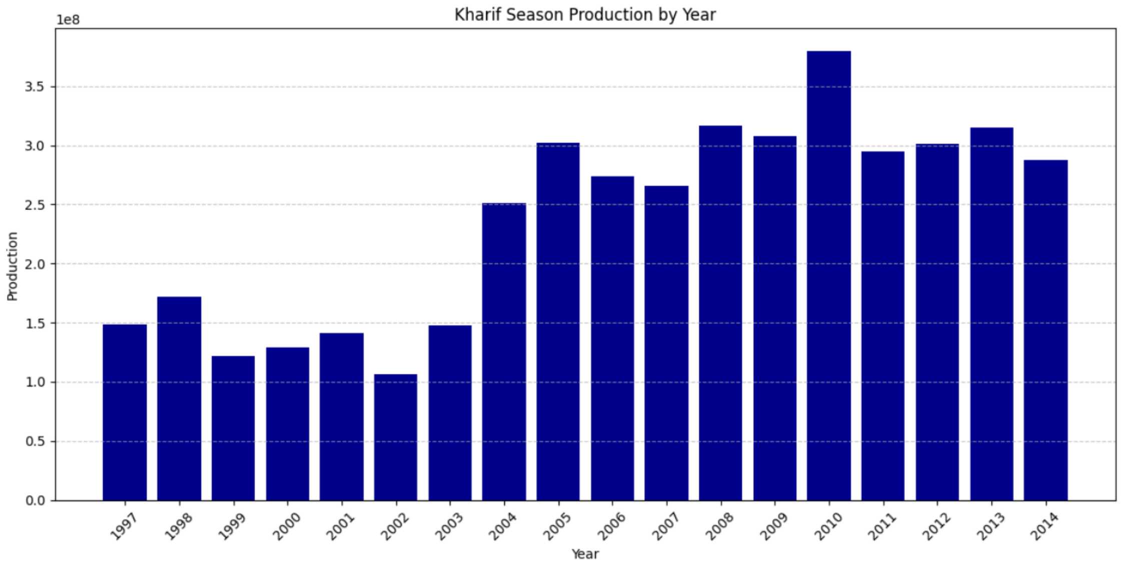
```
total number of districts:  652
```

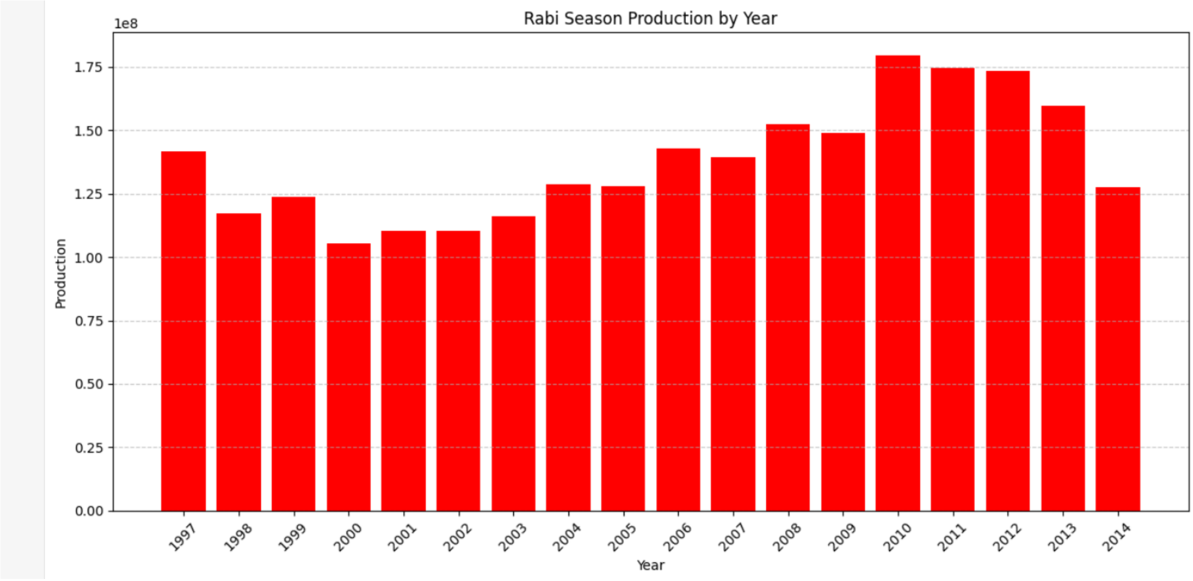
	State_Name	District_Name
30	Uttar Pradesh	75
16	Madhya Pradesh	51
4	Bihar	38
17	Maharashtra	35
25	Rajasthan	33
27	Tamil Nadu	31
14	Karnataka	30
22	Odisha	30
6	Chhattisgarh	27
3	Assam	27
9	Gujarat	26
13	Jharkhand	24
24	Punjab	22
12	Jammu and Kashmir	22
10	Haryana	21
32	West Bengal	18
2	Arunachal Pradesh	18
15	Kerala	14

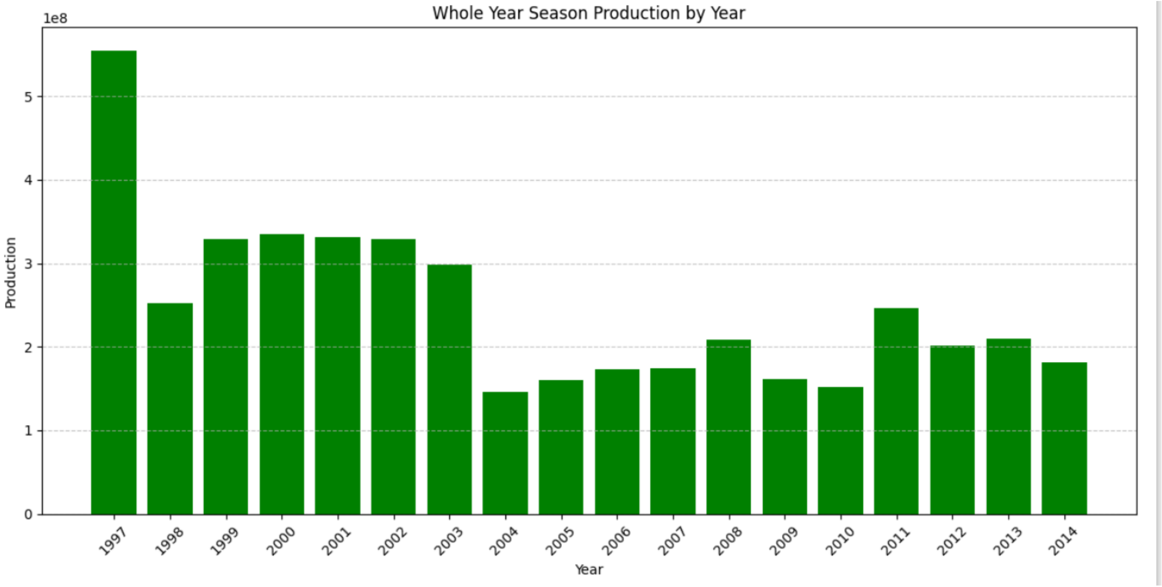


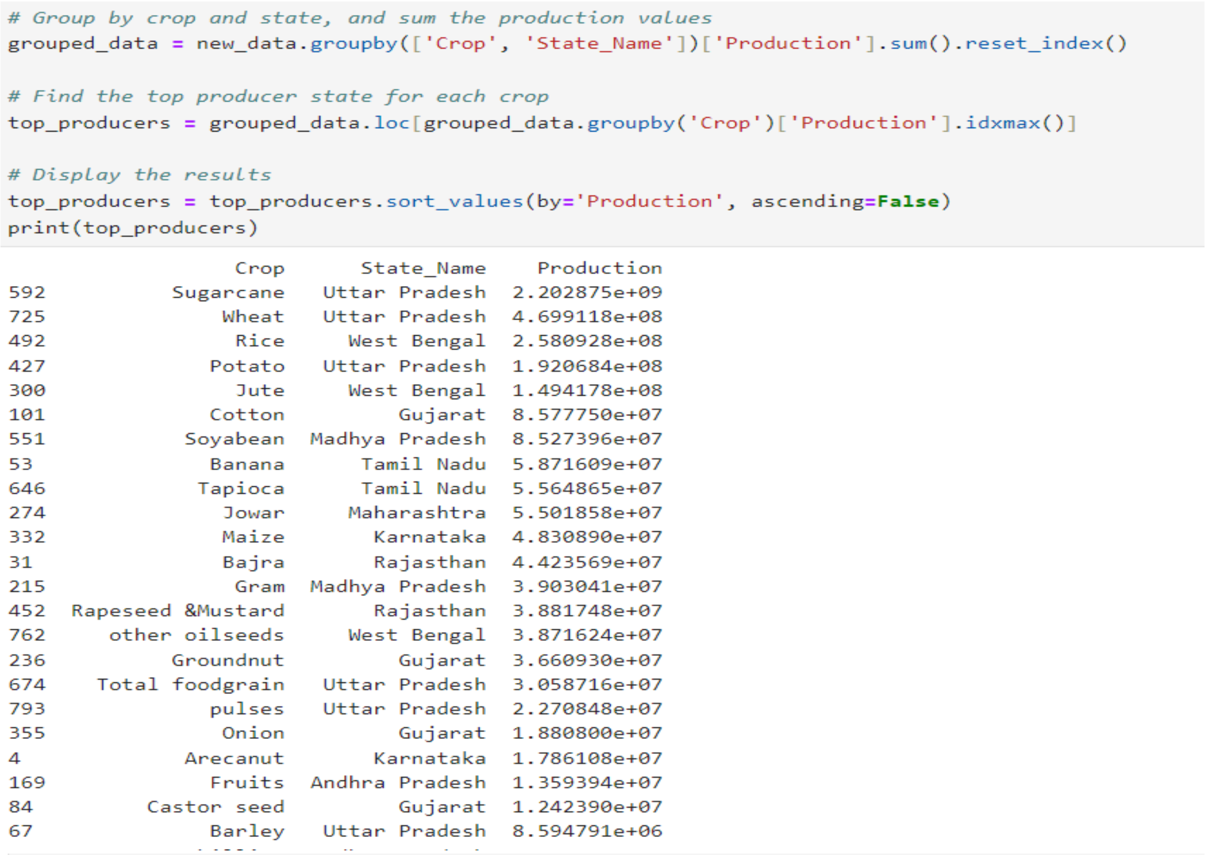
```python
# Filter data by seasons
kharif_data = new_data[new_data['Season'] == 'Kharif']
rabi_data = new_data[new_data['Season'] == 'Rabi']
whole_year_data = new_data[new_data['Season'] == 'Whole Year']

# Aggregate production by year for each season
kharif_production_by_year = kharif_data.groupby('Crop_Year')['Production'].sum()
rabi_production_by_year = rabi_data.groupby('Crop_Year')['Production'].sum()
whole_year_production_by_year = whole_year_data.groupby('Crop_Year')['Production'].sum()
```

```
# Create bar charts
fig, axs = plt.subplots(3, 1, figsize=(12, 18))

# Kharif Season
axs[0].bar(kharif_production_by_year.index, kharif_production_by_year, color='darkblue')
axs[0].set_title('Kharif Season Production by Year')
axs[0].set_xlabel('Year')
axs[0].set_ylabel('Production')
axs[0].grid(axis='y', linestyle='--', alpha=0.7)
axs[0].set_xticks(kharif_production_by_year.index)
axs[0].set_xticklabels(kharif_production_by_year.index, rotation=45)

# Rabi Season
axs[1].bar(rabi_production_by_year.index, rabi_production_by_year, color='red')
axs[1].set_title('Rabi Season Production by Year')
axs[1].set_xlabel('Year')
axs[1].set_ylabel('Production')
axs[1].grid(axis='y', linestyle='--', alpha=0.7)
axs[1].set_xticks(rabi_production_by_year.index)
axs[1].set_xticklabels(rabi_production_by_year.index, rotation=45)

# Whole Year Season
axs[2].bar(whole_year_production_by_year.index, whole_year_production_by_year, color='green')
axs[2].set_title('Whole Year Season Production by Year')
axs[2].set_xlabel('Year')
axs[2].set_ylabel('Production')
axs[2].grid(axis='y', linestyle='--', alpha=0.7)
axs[2].set_xticks(whole_year_production_by_year.index)
axs[2].set_xticklabels(whole_year_production_by_year.index, rotation=45)

plt.tight_layout()
plt.show()
```



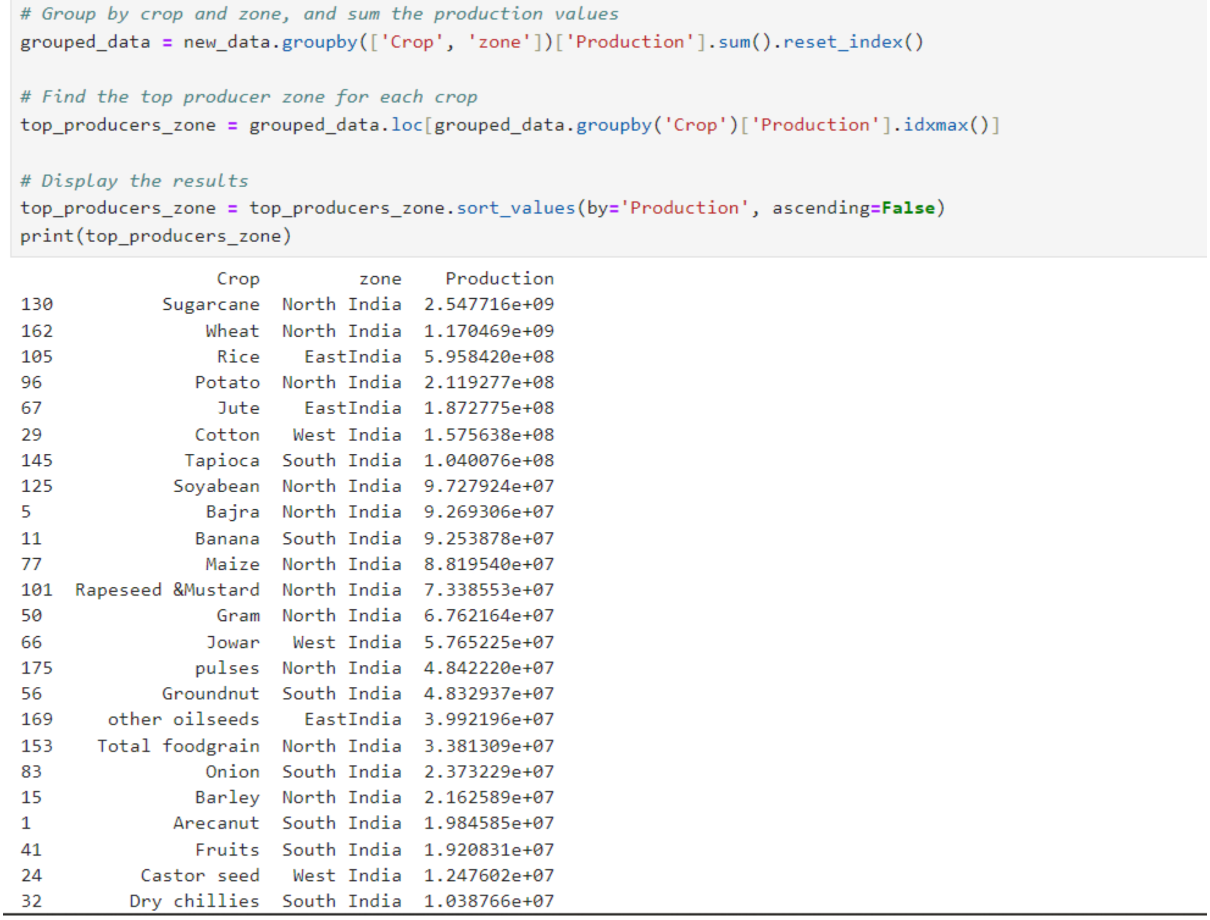

Rabi Season Production by Year
1e8
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Production
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year


Whole Year Season Production by Year
1e8
5
4
3
2
1
0
Production
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year



```
# Group by crop and state, and sum the production values
grouped_data = new_data.groupby(['Crop', 'State_Name'])['Production'].sum().reset_index()

# Find the top producer state for each crop
top_producers = grouped_data.loc[grouped_data.groupby('Crop')['Production'].idxmax()]

# Display the results
top_producers = top_producers.sort_values(by='Production', ascending=False)
print(top_producers)
```

```
                  Crop       State_Name    Production
592          Sugarcane    Uttar Pradesh  2.202875e+09
725              Wheat    Uttar Pradesh  4.699118e+08
492               Rice      West Bengal  2.580928e+08
427             Potato    Uttar Pradesh  1.920684e+08
300               Jute      West Bengal  1.494178e+08
101             Cotton          Gujarat  8.577750e+07
551           Soyabean   Madhya Pradesh  8.527396e+07
53              Banana       Tamil Nadu  5.871609e+07
646            Tapioca       Tamil Nadu  5.564865e+07
274              Jowar      Maharashtra  5.501858e+07
332              Maize        Karnataka  4.830890e+07
31               Bajra        Rajasthan  4.423569e+07
215               Gram   Madhya Pradesh  3.903041e+07
452     Rapeseed &Mustard       Rajasthan  3.881748e+07
762     other oilseeds      West Bengal  3.871624e+07
236          Groundnut          Gujarat  3.660930e+07
674    Total foodgrain    Uttar Pradesh  3.058716e+07
793             pulses    Uttar Pradesh  2.270848e+07
355              Onion          Gujarat  1.880800e+07
4             Arecanut        Karnataka  1.786108e+07
169             Fruits   Andhra Pradesh  1.359394e+07
84          Castor seed          Gujarat  1.242390e+07
67              Barley    Uttar Pradesh  8.594791e+06
```



```
# Group by crop and zone, and sum the production values
grouped_data = new_data.groupby(['Crop', 'zone'])['Production'].sum().reset_index()

# Find the top producer zone for each crop
top_producers_zone = grouped_data.loc[grouped_data.groupby('Crop')['Production'].idxmax()]

# Display the results
top_producers_zone = top_producers_zone.sort_values(by='Production', ascending=False)
print(top_producers_zone)
```

```
                  Crop         zone    Production
130          Sugarcane  North India  2.547716e+09
162              Wheat  North India  1.170469e+09
105               Rice    EastIndia  5.958420e+08
96              Potato  North India  2.119277e+08
67                Jute    EastIndia  1.872775e+08
29              Cotton   West India  1.575638e+08
145            Tapioca  South India  1.040076e+08
125           Soyabean  North India  9.727924e+07
5                Bajra  North India  9.269306e+07
11              Banana  South India  9.253878e+07
77               Maize  North India  8.819540e+07
101  Rapeseed &Mustard  North India  7.338553e+07
50                Gram  North India  6.762164e+07
66               Jowar   West India  5.765225e+07
175             pulses  North India  4.842220e+07
56           Groundnut  South India  4.832937e+07
169     other oilseeds    EastIndia  3.992196e+07
153    Total foodgrain  North India  3.381309e+07
83               Onion  South India  2.373229e+07
15              Barley  North India  2.162589e+07
1             Arecanut  South India  1.984585e+07
41              Fruits  South India  1.920831e+07
24         Castor seed   West India  1.247602e+07
32        Dry chillies  South India  1.038766e+07
```

CODE EXPLANATION

Importing Libraries

The code begins by importing necessary libraries:

- “pandas” for data manipulation.

- “os” for interacting with the operating system.

- “seaborn” and “matplotlib.pyplot” for visualization.

- “numpy” for numerical operations.

- “warnings” to ignore warnings.

Loading the Dataset

The dataset “crop_production.csv” is loaded into a pandas DataFrame named “crop_df”. The first few rows of the dataset are displayed using “crop_df.head()”.

Checking and Handling Null Values

- The code checks for null values in the dataset using “crop_df.isnull().sum()”.

- It finds 3730 null values in the “Production” column, which is about 1.53% of the total rows.

- These rows are dropped using “crop_df.dropna(inplace=True)”.

- The code verifies that there are no more null values in the dataset.

Cleaning and Standardizing Data

- The code checks unique values in the “Season” column and removes unwanted white spaces using the “strip()” function.

- Similarly, white spaces are removed from the “Crop” and “State_Name” columns.

- After cleaning, the unique values of the “Season” column are checked again.

Replacing Synonyms and Standardizing Names

- The code standardizes the “Season” column by replacing synonyms (e.g., replacing 'Autumn', 'Summer', and 'Winter' with 'Kharif' and 'Rabi').

- The code identifies and replaces synonyms and sub-categories in the “Crop” column with their main or popular names (e.g., replacing 'Kapas' with 'Cotton', merging various pulses, fruits, and vegetables into single categories).

- Spelling mistakes in the “Crop” column are corrected.

- The code drops rows with crops that have very few entries or are not relevant for visualization.

Saving Cleaned Data

- The cleaned data is saved into a new CSV file named “Crop_clean.csv”.

- The final cleaned DataFrame is displayed.

Summary of the Cleaned Data

- The cleaned DataFrame contains 238,723 rows and 7 columns: “State_Name”, “District_Name”, “Crop_Year”, “Season”, “Crop”, “Area”, and “Production”.

This code effectively handles null values, removes unnecessary white spaces, standardizes the naming conventions, and prepares the data for further analysis or visualization.

CONCLUSION

We used two different datasets for our visualization one with coconut values and another dataset for which we removed coconut values from there.

After this we used these datasets in Power BI and found different valuable insights from it which helped us to understand the variation in crop production of India based on different seasons, years, states and districts.