In [1]:

```
import pandas as pd,os
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
import warnings
warnings.filterwarnings('ignore')
```

In [2]:

```
print(os.listdir())
```

```
['.ipynb_checkpoints', 'India Agriculture Crop Production.csv', 'Untitled.
ipynb']
```

In [5]:

```
# loading dataset

crop_df=pd.read_csv('India Agriculture Crop Production.csv')
```

In [6]:

```
crop_df.head()
```

Out[6]:

	State	District	Crop	Year	Season	Area	Area Units	Production	Production Units
0	Andaman and Nicobar Islands	NICOBARS	Arecanut	2001-02	Kharif	1254.0	Hectare	2061.0	Tonnes
1	Andaman and Nicobar Islands	NICOBARS	Arecanut	2002-03	Whole Year	1258.0	Hectare	2083.0	Tonnes
2	Andaman and Nicobar Islands	NICOBARS	Arecanut	2003-04	Whole Year	1261.0	Hectare	1525.0	Tonnes
3	Andaman and Nicobar Islands	NORTH AND MIDDLE ANDAMAN	Arecanut	2001-02	Kharif	3100.0	Hectare	5239.0	Tonnes
4	Andaman and Nicobar Islands	SOUTH ANDAMANS	Arecanut	2002-03	Whole Year	3105.0	Hectare	5267.0	Tonnes

In [7]:

```
# checking null values count from dataset

crop_df.isnull().sum()
```

Out[7]:

```
State                 0
District              0
Crop                 32
Year                  0
Season                1
Area                 33
Area Units            0
Production         4993
Production Units      0
Yield                33
dtype: int64
```

In [8]:

```
# we have approx 243000 rows and out of that 3730 were null (1.53%) so we decided to dro
crop_df.dropna(inplace=True)
```

In [9]:

```
# after droping null values there is no null value in dataset
crop_df.isnull().sum()
```

Out[9]:

```
State               0
District            0
Crop                0
Year                0
Season              0
Area                0
Area Units          0
Production          0
Production Units    0
Yield               0
dtype: int64
```

In [10]:

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

Out[10]:

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

In [11]:

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

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

In [12]:

```
# after removing white spaces

crop_df.Season.unique()
```

Out[12]:

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

In [13]:

```
# checking the values counts of each season

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

Out[13]:

```
Kharif        136165
Rabi           99805
Whole Year     67265
Summer         21974
Winter          8238
Autumn          6967
Name: Season, dtype: int64
```

In [14]:

```
'''since there are Three types of crop out of which two are mainly seasonal Rabi and Kha
 5 crops season were present in our datset.we got to know that summer and Autumn synonym
 of Rabi so we decided to replace with their original name which is Kharif Rabi'''

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

In [15]:

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

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

Out[15]:

```
Kharif        165106
Rabi          108043
Whole Year     67265
Name: Season, dtype: int64
```

In [16]:

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

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

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

```
After removing the row which has 0 Production : 339390
```

In [17]:

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

crop_df.Crop.unique()
```

Out[17]:

```
array(['Arecanut', 'Banana', 'Black pepper', 'Cashewnut', 'Coconut',
       'Dry chillies', 'Ginger', 'Other Kharif pulses', 'other oilseeds',
       'Rice', 'Sugarcane', 'Sweet potato', 'Arhar/Tur', 'Bajra',
       'Castor seed', 'Coriander', 'Cotton(lint)', 'Gram', 'Groundnut',
       'Horse-gram', 'Jowar', 'Linseed', 'Maize', 'Mesta',
       'Moong(Green Gram)', 'Niger seed', 'Onion', 'Other Rabi pulses',
       'Potato', 'Ragi', 'Rapeseed &Mustard', 'Safflower', 'Sesamum',
       'Small millets', 'Soyabean', 'Sunflower', 'Tapioca', 'Tobacco',
       'Turmeric', 'Urad', 'Wheat', 'Oilseeds total', 'Jute', 'Masoor',
       'Peas & beans (Pulses)', 'Barley', 'Garlic', 'Khesari', 'Sannhamp',
       'Guar seed', 'Moth', 'Cardamom', 'Other Cereals', 'Cowpea(Lobia)',
       'Dry Ginger', 'Other Summer Pulses'], dtype=object)
```

In [18]:

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

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

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

In [19]:

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

crop_df['Crop']=crop_df['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'))
```

In [20]:

```
#we have corrected spelling mistake

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

In [21]:

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

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

In [22]:

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

crop_df['Crop']=crop_df['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'))
```

In [23]:

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

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

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

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

In [24]:

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

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

In [25]:

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

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

In [26]:

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

crop_df['Crop']=crop_df['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'))
```

In [27]:

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

crop_df['Crop']=crop_df['Crop'].apply(lambda x:x
                                     .replace('Coriander' ,'Other Vegetables')
                                     .replace('pulsess & Mutter(Vegetable)' ,'Other Vege
                                     .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'))
```

In [28]:

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

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

In [29]:

```
#we have observed some cropes rows are very very less so it wont make any sense to visua

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

In [30]:

```
# checking unique crops types after replacement

crop_df.Crop.unique()
```

Out[30]:

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

In [31]:

```
# saving cleaned data file

crop_df.to_csv('India Agriculture Crop Production.csv')
```

In [32]:

```
crop_df
```

Out[32]:

	State	District	Crop	Year	Season	Area	Area Units	Production	Produ
0	Andaman and Nicobar Islands	NICOBARS	Arecanut	2001-02	Kharif	1254.0	Hectare	2061.0	T
1	Andaman and Nicobar Islands	NICOBARS	Arecanut	2002-03	Whole Year	1258.0	Hectare	2083.0	T
2	Andaman and Nicobar Islands	NICOBARS	Arecanut	2003-04	Whole Year	1261.0	Hectare	1525.0	T
3	Andaman and Nicobar Islands	NORTH AND MIDDLE ANDAMAN	Arecanut	2001-02	Kharif	3100.0	Hectare	5239.0	T
4	Andaman and Nicobar Islands	SOUTH ANDAMANS	Arecanut	2002-03	Whole Year	3105.0	Hectare	5267.0	T
...	...	...	...	...	...	...	...	...	
345370	West Bengal	PURBA BARDHAMAN	Wheat	2000-01	Rabi	6310.0	Hectare	15280.0	T
345371	West Bengal	PURULIA	Wheat	1997-98	Rabi	1895.0	Hectare	2760.0	T
345372	West Bengal	PURULIA	Wheat	1998-99	Rabi	3736.0	Hectare	5530.0	T
345373	West Bengal	PURULIA	Wheat	1999-00	Rabi	2752.0	Hectare	6928.0	T
345374	West Bengal	PURULIA	Wheat	2000-01	Rabi	2979.0	Hectare	7430.0	T

339390 rows × 10 columns

In [33]:

```
# to find outlier we created new column Producation_area_factor

crop_df['Producation_area_factor']= crop_df['Production'] / crop_df['Area']
```

In [34]:

```
# checking newly created column

crop_df
```

Out[34]:

	State	District	Crop	Year	Season	Area	Area Units	Production	Produ
0	Andaman and Nicobar Islands	NICOBARS	Arecanut	2001-02	Kharif	1254.0	Hectare	2061.0	T
1	Andaman and Nicobar Islands	NICOBARS	Arecanut	2002-03	Whole Year	1258.0	Hectare	2083.0	T
2	Andaman and Nicobar Islands	NICOBARS	Arecanut	2003-04	Whole Year	1261.0	Hectare	1525.0	T
3	Andaman and Nicobar Islands	NORTH AND MIDDLE ANDAMAN	Arecanut	2001-02	Kharif	3100.0	Hectare	5239.0	T
4	Andaman and Nicobar Islands	SOUTH ANDAMANS	Arecanut	2002-03	Whole Year	3105.0	Hectare	5267.0	T
...	...	...	...	...	...	...	...	...	
345370	West Bengal	PURBA BARDHAMAN	Wheat	2000-01	Rabi	6310.0	Hectare	15280.0	T
345371	West Bengal	PURULIA	Wheat	1997-98	Rabi	1895.0	Hectare	2760.0	T
345372	West Bengal	PURULIA	Wheat	1998-99	Rabi	3736.0	Hectare	5530.0	T
345373	West Bengal	PURULIA	Wheat	1999-00	Rabi	2752.0	Hectare	6928.0	T
345374	West Bengal	PURULIA	Wheat	2000-01	Rabi	2979.0	Hectare	7430.0	T

339390 rows × 11 columns

In [35]:

```
Q1 = crop_df['Area'].quantile(0.25)
Q3 = crop_df['Area'].quantile(0.75)
Q1, Q3
```

Out[35]:

```
(80.0, 4290.0)
```

In [36]:

```
IQR = Q3 - Q1
```

In [37]:

```
lower_limit = Q1 - 1.5*IQR
upper_limit = Q3 + 1.5*IQR
lower_limit,upper_limit
```

Out[37]:

```
(-6235.0, 10605.0)
```

In [38]:

```
area_outlier = crop_df[(crop_df['Area'] < lower_limit) | (crop_df['Area'] > upper_limit)
```

In [39]:

```
area_outlier['Crop'].value_counts()
```

Out[39]:

```
Rice                    12526
Wheat                    7247
pulses                   6562
Maize                    4032
Bajra                    3183
Gram                     2955
Jowar                    2564
Rapeseed &Mustard        2266
Cotton                   2264
Groundnut                1994
Sugarcane                1857
Soyabean                 1624
Sesamum                   874
Coconut                   818
Potato                    603
Sunflower                 573
Guar seed                 486
Jute                      392
Castor seed               384
other oilseeds            381
Barley                    268
Dry chillies              259
Other Rabi pulses         242
Cashewnut                 225
Arecanut                  223
Tobacco                   216
Other Vegetables          184
Safflower                 174
gram                      170
Onion                     168
Linseed                   142
Tapioca                   124
Other Spices              104
Banana                     82
Garlic                     68
Turmeric                   50
Other Cereals              39
Dry ginger                  7
Name: Crop, dtype: int64
```

In [40]:

```
# Since india very big country for better vislization we will divide states name in four
# details of these zones are mentioned below
```

In [41]:

```
West_India= ['Maharashtra','Goa','Gujarat','Dadra and Nagar Haveli']
East_India= ['Arunachal Pradesh','Assam','Manipur','Meghalaya','Mizoram','Nagaland','Sik
North_India=['Jammu and Kashmir ','Himachal Pradesh','Punjab','Uttarakhand','Haryana','R
South_India = ['Andhra Pradesh','Karnataka','Kerala','Tamil Nadu','Telangana','Puducherr
```

In [42]:

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

for df in crop_df['State']:
    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')
```

In [43]:

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

In [44]:

```
crop_df.head()
```

Out[44]:

	State	District	Crop	Year	Season	Area	Area Units	Production	Production Units
0	Andaman and Nicobar Islands	NICOBARS	Arecanut	2001-02	Kharif	1254.0	Hectare	2061.0	Tonnes
1	Andaman and Nicobar Islands	NICOBARS	Arecanut	2002-03	Whole Year	1258.0	Hectare	2083.0	Tonnes
2	Andaman and Nicobar Islands	NICOBARS	Arecanut	2003-04	Whole Year	1261.0	Hectare	1525.0	Tonnes
3	Andaman and Nicobar Islands	NORTH AND MIDDLE ANDAMAN	Arecanut	2001-02	Kharif	3100.0	Hectare	5239.0	Tonnes
4	Andaman and Nicobar Islands	SOUTH ANDAMANS	Arecanut	2002-03	Whole Year	3105.0	Hectare	5267.0	Tonnes

In [45]:

```
crop_df['zone'].value_counts()
```

Out[45]:

```
North India        130478
EastIndia           99502
South India         71912
West India          32185
Union Territory      5313
Name: zone, dtype: int64
```

In [47]:

```
# checking value counts of year in dataset

crop_df['Year'].value_counts()
```

Out[47]:

```
2019-20    18988
2018-19    18046
2017-18    17780
2016-17    17260
2015-16    16196
2013-14    15961
2011-12    15827
2014-15    15361
2012-13    15042
2009-10    14949
2008-09    14813
2010-11    14622
2007-08    14411
2006-07    14313
2003-04    14268
2004-05    13867
2002-03    13831
2005-06    13775
2000-01    13337
2001-02    13085
1999-00    12776
1998-99    12014
1997-98     8549
2020-21      319
Name: Year, dtype: int64
```

In [49]:

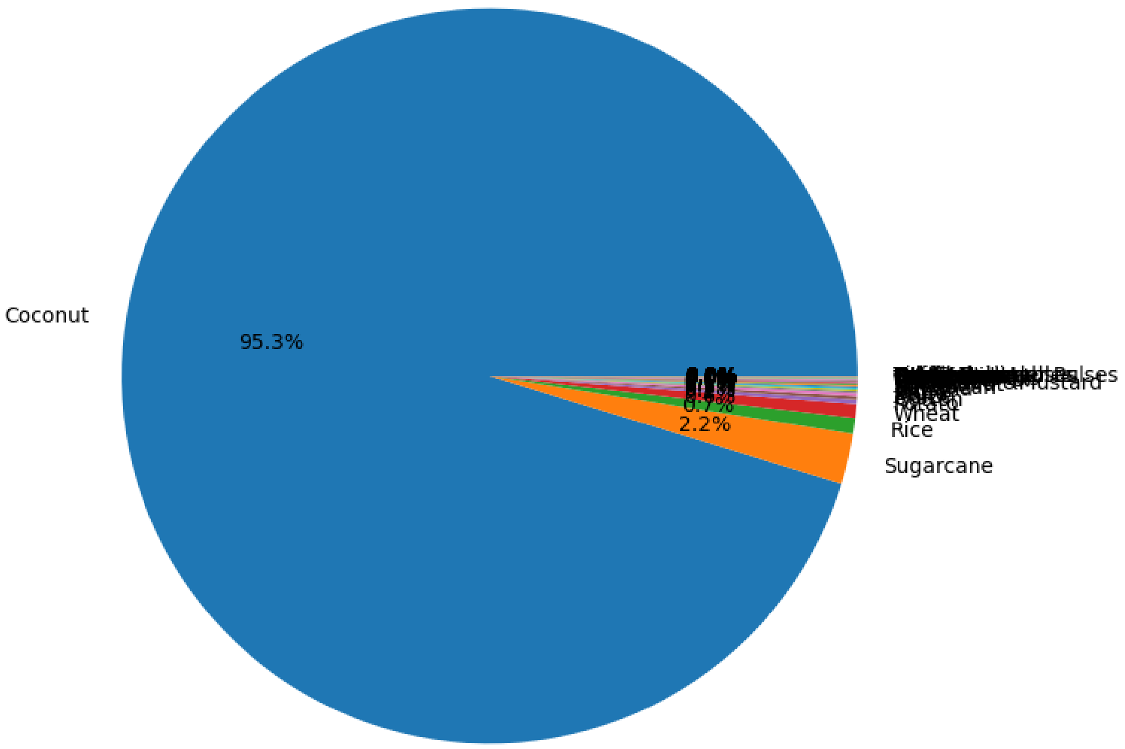
```
# sinces the number of rows for year 2015 is very less so it will not give correct visua
# so we decided to remove it from dataset

crop_df.drop(crop_df[crop_df['Year'] == 2015].index,inplace=True)
```

In [50]:

```
val=crop_df.groupby('Crop').sum().sort_values(by='Production',ascending = False)['Produc
lab=crop_df.groupby('Crop').sum().sort_values(by='Production',ascending = False)['Produc
```

In [51]:

```
# 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()
```



In [52]:

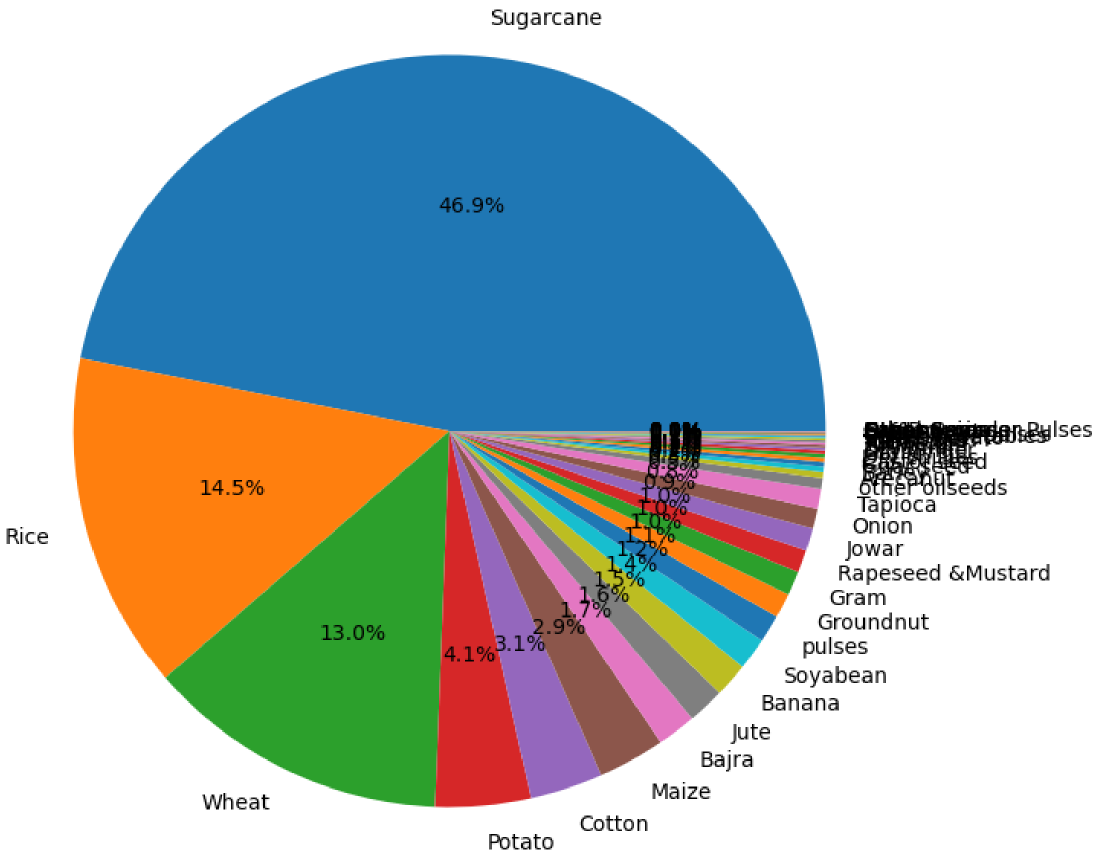
```
# we have observed that Production of coconut is more than 92% of total Production so we
# so we have decided to visualize coconut seprately

coconut_df = crop_df[crop_df['Crop'] == 'Coconut']

coconut_df.to_csv('coconut_df.csv')

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

In [53]:

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

val=crop_df.groupby('Crop').sum().sort_values(by='Production',ascending = False)['Produc
lab=crop_df.groupby('Crop').sum().sort_values(by='Production',ascending = False)['Produc
```

In [54]:

```
# we have observed that now our dataset is balance

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



Conclusion

In [56]:

```
# Since we have found out that number of outliers are almost approx 20% and 46000k in nu
# to avoide loss of information and producation also depends types soil and area,availab
# so we dont have much information about these other factors so we cant not remove outli
# Producation_area_factor can not be same for all crops sinces this factors is hihh for
# so we cant not compare both on one scale
# we have observed that Production of coconut is more than 92% of total Production so we
# so we have decided to consider coconut as an outlier and we have removed it from datas
```

In [ ]: