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.

In [1]:
```
# Importing the libraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt

%matplotlib inline
```

In [2]:
```
crop=pd.read_csv(r"C:\Users\nived\OneDrive\Desktop\Crop Production data.csv")
```

In [3]:
```
crop
```

Out[3]:

	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

246091 rows × 7 columns

In [4]:
```
crop.columns
```

Out[4]:
```
Index(['State_Name', 'District_Name', 'Crop_Year', 'Season', 'Crop', 'Area',
       'Production'],
      dtype='object')
```

In [5]:
```
crop.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 246091 entries, 0 to 246090
Data columns (total 7 columns):
 #   Column         Non-Null Count   Dtype  
---  ------         --------------   -----  
 0   State_Name     246091 non-null  object 
 1   District_Name  246091 non-null  object 
 2   Crop_Year      246091 non-null  int64  
 3   Season         246091 non-null  object 
 4   Crop           246091 non-null  object 
 5   Area           246091 non-null  float64
 6   Production     242361 non-null  float64
dtypes: float64(2), int64(1), object(4)
memory usage: 13.1+ MB
```

In [7]:
```
crop.head()
```

Out[7]:

	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

In [8]:
```
crop.tail()
```

Out[8]:

	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production
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

In [9]:
```
crop.describe()
```

Out[9]:

	Crop_Year	Area	Production
count	246091.000000	2.460910e+05	2.423610e+05
mean	2005.643018	1.200282e+04	5.825034e+05
std	4.952164	5.052340e+04	1.706581e+07
min	1997.000000	4.000000e-02	0.000000e+00
25%	2002.000000	8.000000e+01	8.800000e+01
50%	2006.000000	5.820000e+02	7.290000e+02
75%	2010.000000	4.392000e+03	7.023000e+03
max	2015.000000	8.580100e+06	1.250800e+09

In [10]:
```
crop.isnull().sum()
```

Out[10]:
```
State_Name          0
District_Name       0
Crop_Year           0
Season              0
Crop                0
Area                0
Production       3730
dtype: int64
```

In [13]:
```
3730/246091
```

Out[13]:
```
0.015156994770227274
```

In [14]:
```
# Dropping missing values
crop.dropna(subset=["Production"],axis=0,inplace=True)
```

In [15]:
```
crop.isnull().sum()
```

Out[15]:
```
State_Name       0
District_Name    0
Crop_Year        0
Season           0
Crop             0
Area             0
Production       0
dtype: int64
```

In [17]:
```
Ncrop=crop.copy()
Ncrop
```

Out[17]:

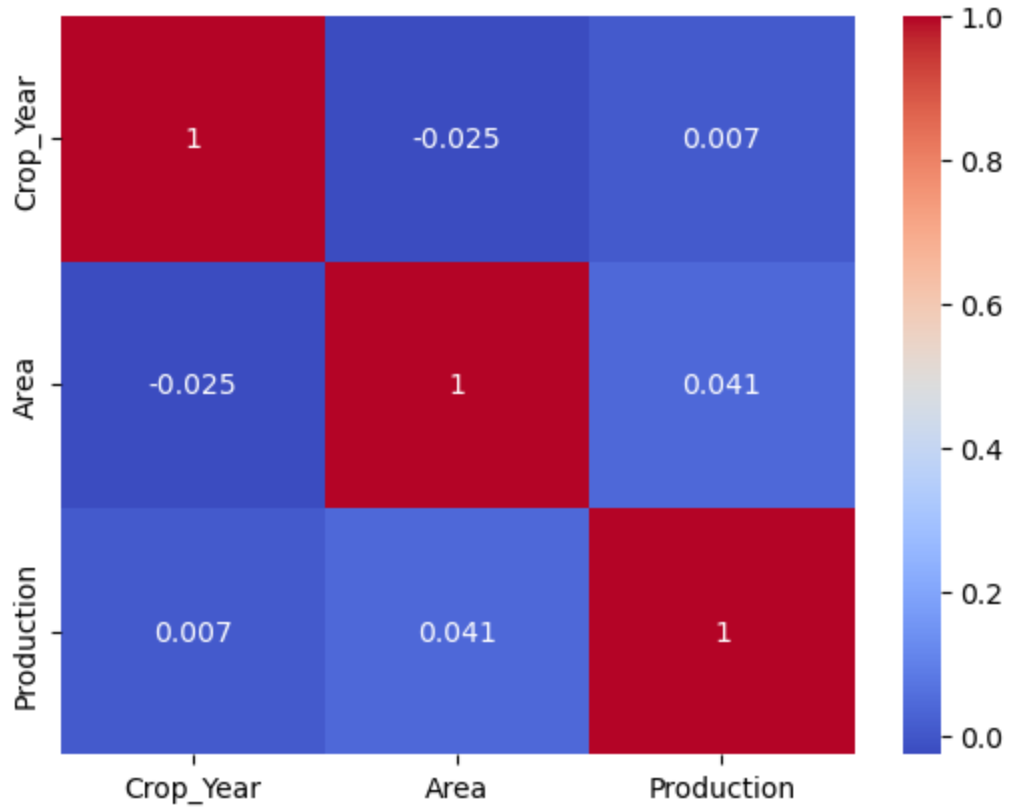
	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production
0	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Arecanut	1254.0	2000.0
1	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Other Kharif pulses	2.0	1.0
2	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Rice	102.0	321.0
3	Andaman and Nicobar 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

242361 rows × 7 columns

In [18]:
```
# Correlation Matrix
corr_matrix = crop.corr()
```

```
C:\Users\nived\AppData\Local\Temp\ipykernel_12024\655291470.py:2: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future version, it will default to False. Select only valid columns or specify the value of numeric_only to silence this warning.
  corr_matrix = crop.corr()
```

In [19]:
```
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm')
plt.show()
```



In [21]:
```
crop.State_Name.unique()
```

Out[21]:
```
array(['Andaman and Nicobar Islands', 'Andhra Pradesh',
       'Arunachal Pradesh', 'Assam', 'Bihar', 'Chandigarh',
       'Chhattisgarh', 'Dadra and Nagar Haveli', 'Goa', 'Gujarat',
       'Haryana', 'Himachal Pradesh', 'Jammu and Kashmir ', 'Jharkhand',
       'Karnataka', 'Kerala', 'Madhya Pradesh', 'Maharashtra', 'Manipur',
       'Meghalaya', 'Mizoram', 'Nagaland', 'Odisha', 'Puducherry',
       'Punjab', 'Rajasthan', 'Sikkim', 'Tamil Nadu', 'Telangana ',
       'Tripura', 'Uttar Pradesh', 'Uttarakhand', 'West Bengal'],
      dtype=object)
```

In [25]:
```
crop.State_Name.nunique()
```

Out[25]:
```
33
```

In [23]:
```
crop.District_Name.unique()
```

Out[23]:
```
array(['NICOBARS', 'NORTH AND MIDDLE ANDAMAN', 'SOUTH ANDAMANS',
       'ANANTAPUR', 'CHITTOOR', 'EAST GODAVARI', 'GUNTUR', 'KADAPA',
       'KRISHNA', 'KURNOOL', 'PRAKASAM', 'SPSR NELLORE', 'SRIKAKULAM',
       'VISAKHAPATANAM', 'VIZIANAGARAM', 'WEST GODAVARI', 'ANJAW',
       'CHANGLANG', 'DIBANG VALLEY', 'EAST KAMENG', 'EAST SIANG',
       'KURUNG KUMEY', 'LOHIT', 'LONGDING', 'LOWER DIBANG VALLEY',
       'LOWER SUBANSIRI', 'NAMSAI', 'PAPUM PARE', 'TAWANG', 'TIRAP',
       'UPPER SIANG', 'UPPER SUBANSIRI', 'WEST KAMENG', 'WEST SIANG',
       'BAKSA', 'BARPETA', 'BONGAIGAON', 'CACHAR', 'CHIRANG', 'DARRANG',
       'DHEMAJI', 'DHUBRI', 'DIBRUGARH', 'DIMA HASAO', 'GOALPARA',
       'GOLAGHAT', 'HAILAKANDI', 'JORHAT', 'KAMRUP', 'KAMRUP METRO',
       'KARBI ANGLONG', 'KARIMGANJ', 'KOKRAJHAR', 'LAKHIMPUR', 'MARIGAON',
       'NAGAON', 'NALBARI', 'SIVASAGAR', 'SONITPUR', 'TINSUKIA',
       'UDALGURI', 'ARARIA', 'ARWAL', 'AURANGABAD', 'BANKA', 'BEGUSARAI',
       'BHAGALPUR', 'BHOJPUR', 'BUXAR', 'DARBHANGA', 'GAYA', 'GOPALGANJ',
       'JAMUI', 'JEHANABAD', 'KAIMUR (BHABUA)', 'KATIHAR', 'KHAGARIA',
       'KISHANGANJ', 'LAKHISARAI', 'MADHEPURA', 'MADHUBANI', 'MUNGER',
       'MUZAFFARPUR', 'NALANDA', 'NAWADA', 'PASHCHIM CHAMPARAN', 'PATNA',
       'PURBI CHAMPARAN', 'PURNIA', 'ROHTAS', 'SAHARSA', 'SAMASTIPUR',
       'SARAN', 'SHEIKHPURA', 'SHEOHAR', 'SITAMARHI', 'SIWAN', 'SUPAUL',
       'VAISHALI', 'CHANDIGARH', 'BALOD', 'BALODA BAZAR', 'BALRAMPUR',
       'BASTAR', 'BEMETARA', 'BIJAPUR', 'BILASPUR', 'DANTEWADA',
       'DHAMTARI', 'DURG', 'GARIYABAND', 'JANJGIR-CHAMPA', 'JASHPUR',
       'KABIRDHAM', 'KANKER', 'KONDAGAON', 'KORBA', 'KOREA', 'MAHASAMUND',
       'MUNGELI', 'NARAYANPUR', 'RAIGARH', 'RAIPUR', 'RAJNANDGAON',
       'SUKMA', 'SURAJPUR', 'SURGUJA', 'DADRA AND NAGAR HAVELI',
       'NORTH GOA', 'SOUTH GOA', 'AHMADABAD', 'AMRELI', 'ANAND',
       'BANAS KANTHA', 'BHARUCH', 'BHAVNAGAR', 'DANG', 'DOHAD',
       'GANDHINAGAR', 'JAMNAGAR', 'JUNAGADH', 'KACHCHH', 'KHEDA',
       'MAHESANA', 'NARMADA', 'NAVSARI', 'PANCH MAHALS', 'PATAN',
       'PORBANDAR', 'RAJKOT', 'SABAR KANTHA', 'SURAT', 'SURENDRANAGAR',
       'TAPI', 'VADODARA', 'VALSAD', 'AMBALA', 'BHIWANI', 'FARIDABAD',
       'FATEHABAD', 'GURGAON', 'HISAR', 'JHAJJAR', 'JIND', 'KAITHAL',
       'KARNAL', 'KURUKSHETRA', 'MAHENDRAGARH', 'MEWAT', 'PALWAL',
       'PANCHKULA', 'PANIPAT', 'REWARI', 'ROHTAK', 'SIRSA', 'SONIPAT',
       'YAMUNANAGAR', 'CHAMBA', 'HAMIRPUR', 'KANGRA', 'KINNAUR', 'KULLU',
       'LAHUL AND SPITI', 'MANDI', 'SHIMLA', 'SIRMAUR', 'SOLAN', 'UNA',
       'ANANTNAG', 'BADGAM', 'BANDIPORA', 'BARAMULLA', 'DODA',
       'GANDERBAL', 'JAMMU', 'KARGIL', 'KATHUA', 'KISHTWAR', 'KULGAM',
       'KUPWARA', 'LEH LADAKH', 'POONCH', 'PULWAMA', 'RAJAURI', 'RAMBAN',
       'REASI', 'SAMBA', 'SHOPIAN', 'SRINAGAR', 'UDHAMPUR', 'BOKARO',
       'CHATRA', 'DEOGHAR', 'DHANBAD', 'DUMKA', 'EAST SINGHBUM', 'GARHWA',
       'GIRIDIH', 'GODDA', 'GUMLA', 'HAZARIBAGH', 'JAMTARA', 'KHUNTI',
       'KODERMA', 'LATEHAR', 'LOHARDAGA', 'PAKUR', 'PALAMU', 'RAMGARH',
       'RANCHI', 'SAHEBGANJ', 'SARAIKELA KHARSAWAN', 'SIMDEGA',
       'WEST SINGHBHUM', 'BAGALKOT', 'BANGALORE RURAL', 'BELGAUM',
       'BELLARY', 'BENGALURU URBAN', 'BIDAR', 'CHAMARAJANAGAR',
       'CHIKBALLAPUR', 'CHIKMAGALUR', 'CHITRADURGA', 'DAKSHIN KANNAD',
       'DAVANGERE', 'DHARWAD', 'GADAG', 'GULBARGA', 'HASSAN', 'HAVERI',
       'KODAGU', 'KOLAR', 'KOPPAL', 'MANDYA', 'MYSORE', 'RAICHUR',
       'RAMANAGARA', 'SHIMOGA', 'TUMKUR', 'UDUPI', 'UTTAR KANNAD',
       'YADGIR', 'ALAPPUZHA', 'ERNAKULAM', 'IDUKKI', 'KANNUR',
       'KASARAGOD', 'KOLLAM', 'KOTTAYAM', 'KOZHIKODE', 'MALAPPURAM',
       'PALAKKAD', 'PATHANAMTHITTA', 'THIRUVANANTHAPURAM', 'THRISSUR',
       'WAYANAD', 'AGAR MALWA', 'ALIRAJPUR', 'ANUPPUR', 'ASHOKNAGAR',
       'BALAGHAT', 'BARWANI', 'BETUL', 'BHIND', 'BHOPAL', 'BURHANPUR',
       'CHHATARPUR', 'CHHINDWARA', 'DAMOH', 'DATIA', 'DEWAS', 'DHAR',
       'DINDORI', 'GUNA', 'GWALIOR', 'HARDA', 'HOSHANGABAD', 'INDORE',
       'JABALPUR', 'JHABUA', 'KATNI', 'KHANDWA', 'KHARGONE', 'MANDLA',
       'MANDSAUR', 'MORENA', 'NARSINGHPUR', 'NEEMUCH', 'PANNA', 'RAISEN',
       'RAJGARH', 'RATLAM', 'REWA', 'SAGAR', 'SATNA', 'SEHORE', 'SEONI',
       'SHAHDOL', 'SHAJAPUR', 'SHEOPUR', 'SHIVPURI', 'SIDHI', 'SINGRAULI',
       'TIKAMGARH', 'UJJAIN', 'UMARIA', 'VIDISHA', 'AHMEDNAGAR', 'AKOLA',
       'AMRAVATI', 'BEED', 'BHANDARA', 'BULDHANA', 'CHANDRAPUR', 'DHULE',
```

```
'GADCHIROLI', 'GONDIA', 'HINGOLI', 'JALGAON', 'JALNA', 'KOLHAPUR',
'LATUR', 'MUMBAI', 'NAGPUR', 'NANDED', 'NANDURBAR', 'NASHIK',
'OSMANABAD', 'PALGHAR', 'PARBHANI', 'PUNE', 'RAIGAD', 'RATNAGIRI',
'SANGLI', 'SATARA', 'SINDHUDURG', 'SOLAPUR', 'THANE', 'WARDHA',
'WASHIM', 'YAVATMAL', 'BISHNUPUR', 'CHANDEL', 'CHURACHANDPUR',
'IMPHAL EAST', 'IMPHAL WEST', 'SENAPATI', 'TAMENGLONG', 'THOUBAL',
'UKHRUL', 'EAST GARO HILLS', 'EAST JAINTIA HILLS',
'EAST KHASI HILLS', 'NORTH GARO HILLS', 'RI BHOI',
'SOUTH GARO HILLS', 'SOUTH WEST GARO HILLS',
'SOUTH WEST KHASI HILLS', 'WEST GARO HILLS', 'WEST JAINTIA HILLS',
'WEST KHASI HILLS', 'AIZAWL', 'CHAMPHAI', 'KOLASIB', 'LAWNGTLAI',
'LUNGLEI', 'MAMIT', 'SAIHA', 'SERCHHIP', 'DIMAPUR', 'KIPHIRE',
'KOHIMA', 'LONGLENG', 'MOKOKCHUNG', 'MON', 'PEREN', 'PHEK',
'TUENSANG', 'WOKHA', 'ZUNHEBOTO', 'ANUGUL', 'BALANGIR',
'BALESHWAR', 'BARGARH', 'BHADRAK', 'BOUDH', 'CUTTACK', 'DEOGARH',
'DHENKANAL', 'GAJAPATI', 'GANJAM', 'JAGATSINGHAPUR', 'JAJAPUR',
'JHARSUGUDA', 'KALAHANDI', 'KANDHAMAL', 'KENDRAPARA', 'KENDUJHAR',
'KHORDHA', 'KORAPUT', 'MALKANGIRI', 'MAYURBHANJ', 'NABARANGPUR',
'NAYAGARH', 'NUAPADA', 'PURI', 'RAYAGADA', 'SAMBALPUR', 'SONEPUR',
'SUNDARGARH', 'KARAIKAL', 'MAHE', 'PONDICHERRY', 'YANAM',
'AMRITSAR', 'BARNALA', 'BATHINDA', 'FARIDKOT', 'FATEHGARH SAHIB',
'FAZILKA', 'FIROZEPUR', 'GURDASPUR', 'HOSHIARPUR', 'JALANDHAR',
'KAPURTHALA', 'LUDHIANA', 'MANSA', 'MOGA', 'MUKTSAR', 'NAWANSHAHR',
'PATHANKOT', 'PATIALA', 'RUPNAGAR', 'S.A.S NAGAR', 'SANGRUR',
'TARN TARAN', 'AJMER', 'ALWAR', 'BANSWARA', 'BARAN', 'BARMER',
'BHARATPUR', 'BHILWARA', 'BIKANER', 'BUNDI', 'CHITTORGARH',
'CHURU', 'DAUSA', 'DHOLPUR', 'DUNGARPUR', 'GANGANAGAR',
'HANUMANGARH', 'JAIPUR', 'JAISALMER', 'JALORE', 'JHALAWAR',
'JHUNJHUNU', 'JODHPUR', 'KARAULI', 'KOTA', 'NAGAUR', 'PALI',
'PRATAPGARH', 'RAJSAMAND', 'SAWAI MADHOPUR', 'SIKAR', 'SIROHI',
'TONK', 'UDAIPUR', 'EAST DISTRICT', 'NORTH DISTRICT',
'SOUTH DISTRICT', 'WEST DISTRICT', 'ARIYALUR', 'COIMBATORE',
'CUDDALORE', 'DHARMAPURI', 'DINDIGUL', 'ERODE', 'KANCHIPURAM',
'KANNIYAKUMARI', 'KARUR', 'KRISHNAGIRI', 'MADURAI', 'NAGAPATTINAM',
'NAMAKKAL', 'PERAMBALUR', 'PUDUKKOTTAI', 'RAMANATHAPURAM', 'SALEM',
'SIVAGANGA', 'THANJAVUR', 'THE NILGIRIS', 'THENI', 'THIRUVALLUR',
'THIRUVARUR', 'TIRUCHIRAPPALLI', 'TIRUNELVELI', 'TIRUPPUR',
'TIRUVANNAMALAI', 'TUTICORIN', 'VELLORE', 'VILLUPURAM',
'VIRUDHUNAGAR', 'ADILABAD', 'HYDERABAD', 'KARIMNAGAR', 'KHAMMAM',
'MAHBUBNAGAR', 'MEDAK', 'NALGONDA', 'NIZAMABAD', 'RANGAREDDI',
'WARANGAL', 'DHALAI', 'GOMATI', 'KHOWAI', 'NORTH TRIPURA',
'SEPAHIJALA', 'SOUTH TRIPURA', 'UNAKOTI', 'WEST TRIPURA', 'AGRA',
'ALIGARH', 'ALLAHABAD', 'AMBEDKAR NAGAR', 'AMETHI', 'AMROHA',
'AURAIYA', 'AZAMGARH', 'BAGHPAT', 'BAHRAICH', 'BALLIA', 'BANDA',
'BARABANKI', 'BAREILLY', 'BASTI', 'BIJNOR', 'BUDAUN',
'BULANDSHAHR', 'CHANDAULI', 'CHITRAKOOT', 'DEORIA', 'ETAH',
'ETAWAH', 'FAIZABAD', 'FARRUKHABAD', 'FATEHPUR', 'FIROZABAD',
'GAUTAM BUDDHA NAGAR', 'GHAZIABAD', 'GHAZIPUR', 'GONDA',
'GORAKHPUR', 'HAPUR', 'HARDOI', 'HATHRAS', 'JALAUN', 'JAUNPUR',
'JHANSI', 'KANNAUJ', 'KANPUR DEHAT', 'KANPUR NAGAR', 'KASGANJ',
'KAUSHAMBI', 'KHERI', 'KUSHI NAGAR', 'LALITPUR', 'LUCKNOW',
'MAHARAJGANJ', 'MAHOBA', 'MAINPURI', 'MATHURA', 'MAU', 'MEERUT',
'MIRZAPUR', 'MORADABAD', 'MUZAFFARNAGAR', 'PILIBHIT', 'RAE BARELI',
'RAMPUR', 'SAHARANPUR', 'SAMBHAL', 'SANT KABEER NAGAR',
'SANT RAVIDAS NAGAR', 'SHAHJAHANPUR', 'SHAMLI', 'SHRAVASTI',
'SIDDHARTH NAGAR', 'SITAPUR', 'SONBHADRA', 'SULTANPUR', 'UNNAO',
'VARANASI', 'ALMORA', 'BAGESHWAR', 'CHAMOLI', 'CHAMPAWAT',
'DEHRADUN', 'HARIDWAR', 'NAINITAL', 'PAURI GARHWAL', 'PITHORAGARH',
'RUDRA PRAYAG', 'TEHRI GARHWAL', 'UDAM SINGH NAGAR', 'UTTAR KASHI',
'24 PARAGANAS NORTH', '24 PARAGANAS SOUTH', 'BANKURA', 'BARDHAMAN',
'BIRBHUM', 'COOCHBEHAR', 'DARJEELING', 'DINAJPUR DAKSHIN',
'DINAJPUR UTTAR', 'HOOGHLY', 'HOWRAH', 'JALPAIGURI', 'MALDAH',
'MEDINIPUR EAST', 'MEDINIPUR WEST', 'MURSHIDABAD', 'NADIA',
'PURULIA'], dtype=object)
```

In [24]:
```
crop.District_Name.nunique()
```

Out[24]:
```
646
```

In [26]:
```
crop.Crop_Year.unique()
```

Out[26]:
```
array([2000, 2001, 2002, 2003, 2004, 2005, 2006, 2010, 1997, 1998, 1999,
       2007, 2008, 2009, 2011, 2012, 2013, 2014, 2015], dtype=int64)
```

The dataset has data for 19 years . Fromm 1997 to 2015

In [27]:
```
crop.Season.unique()
```

Out[27]:
```
array(['Kharif     ', 'Whole Year ', 'Autumn     ', 'Rabi       ',
       'Summer     ', 'Winter     '], dtype=object)
```

In [28]:
```
crop.Season.value_counts()
```

Out[28]:
```
Kharif         94283
Rabi           66160
Whole Year     56127
Summer         14811
Winter          6050
Autumn          4930
Name: Season, dtype: int64
```

In [29]:
```
crop.Crop.unique()
```

Out[29]:
```
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', 'Soyabean', 'Beans & Mutter(Vegetable)',
       'Bhindi', 'Brinjal', 'Citrus Fruit', 'Cucumber', 'Grapes', 'Mango',
       'Orange', 'other fibres', 'Other Fresh Fruits', 'Other Vegetables',
       'Papaya', 'Pome Fruit', 'Tomato', 'Mesta', 'Cowpea(Lobia)',
       'Lemon', 'Pome Granet', 'Sapota', 'Cabbage', 'Rapeseed &Mustard',
       'Peas  (vegetable)', 'Niger seed', 'Bottle Gourd', 'Varagu',
       'Garlic', 'Ginger', 'Oilseeds total', 'Pulses total', 'Jute',
       'Peas & beans (Pulses)', 'Blackgram', 'Paddy', 'Pineapple',
       'Barley', 'Sannhamp', 'Khesari', 'Guar seed', 'Moth',
       'Other Cereals & Millets', 'Cond-spcs other', 'Turnip', 'Carrot',
       'Redish', 'Arcanut (Processed)', 'Atcanut (Raw)',
       'Cashewnut Processed', 'Cashewnut Raw', 'Cardamom', 'Rubber',
       'Bitter Gourd', 'Drum Stick', 'Jack Fruit', 'Snak Guard', 'Tea',
       'Coffee', 'Cauliflower', 'Other Citrus Fruit', 'Water Melon',
       'Total foodgrain', 'Kapas', 'Colocosia', 'Lentil', 'Bean',
       'Jobster', 'Perilla', 'Rajmash Kholar', 'Ricebean (nagadal)',
       'Ash Gourd', 'Beet Root', 'Lab-Lab', 'Ribed Guard', 'Yam',
       'Pump Kin', 'Apple', 'Peach', 'Pear', 'Plums', 'Litchi', 'Ber',
       'Other Dry Fruit', 'Jute & mesta'], dtype=object)
```

In [30]:
```
crop.Crop.nunique()
```

Out[30]:
```
124
```

In [31]:
```
crop.Crop.value_counts()
```

Out[31]:
```
Rice                  15082
Maize                 13787
Moong(Green Gram)     10106
Urad                   9710
Sesamum                8821
                      ...
Litchi                    6
Coffee                    6
Apple                     4
Peach                     4
Other Dry Fruit           1
Name: Crop, Length: 124, dtype: int64
```

We get to know that top 3 crops are Rice 15082 Maize 13787 Moong(Green Gram) 10106

In [32]:
```
# Check the distribution of area using descriptive statistics
area_stats = crop['Area'].describe()
print(area_stats)
```

```
count    2.423610e+05
mean     1.216741e+04
std      5.085744e+04
min      1.000000e-01
25%      8.700000e+01
50%      6.030000e+02
75%      4.545000e+03
max      8.580100e+06
Name: Area, dtype: float64
```

The "count" row shows that there are 242,361 entries in this column. The "mean" row shows that the average area of land used for cultivation is around 12,167 hectares. The "std" row shows that there is a lot of variation in the size of land used for cultivation, with a standard deviation of around 50,857 hectares. The "min" row shows that the smallest area used for cultivation in the dataset is 0.1 hectares. The "25%" row shows that 25% of the areas used for cultivation are less than or equal to 87 hectares. The "50%" row shows that 50% of the areas used for cultivation are less than or equal to 603 hectares. The "75%" row shows that 75% of the areas used for cultivation are less than or equal to 4,545 hectares. The "max" row shows that the largest area used for cultivation in the dataset is 8,580,100 hectares.

In [33]:
```
crop
```

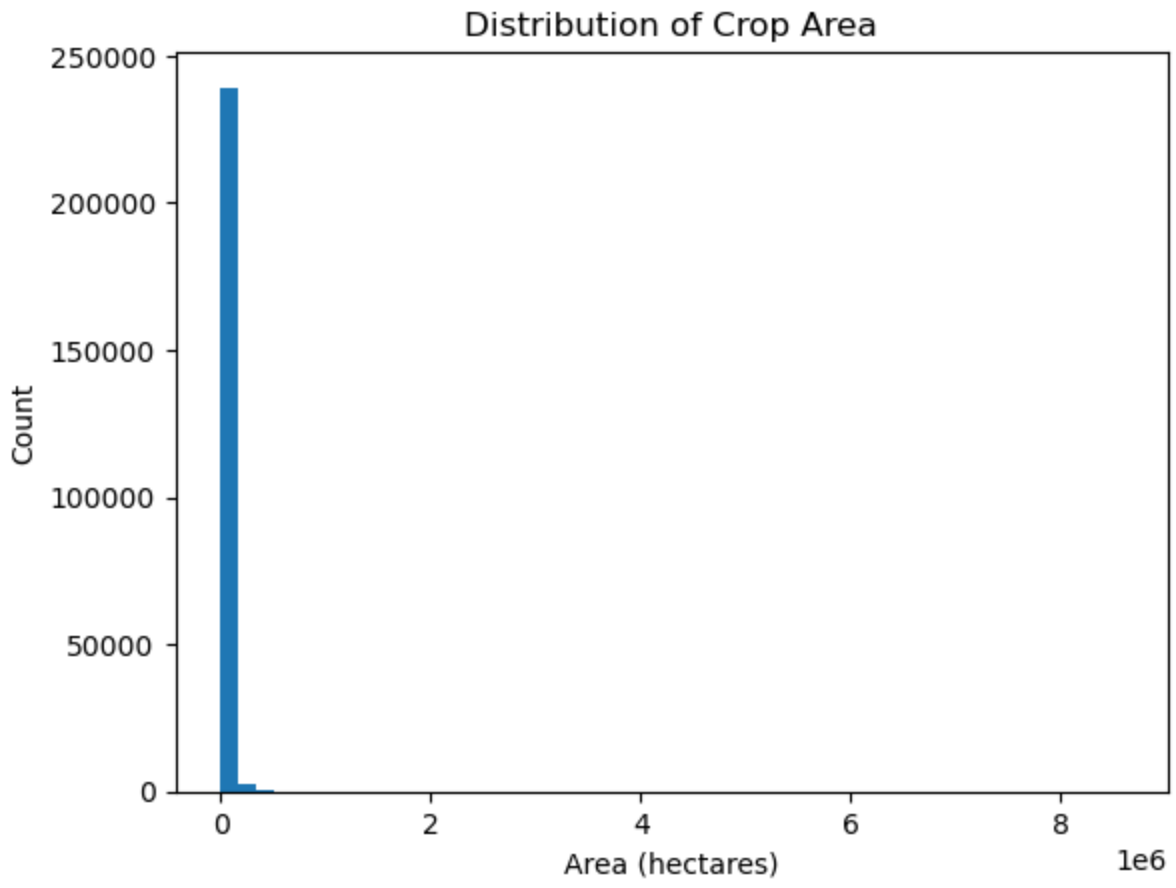
Out[33]:

	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

242361 rows × 7 columns

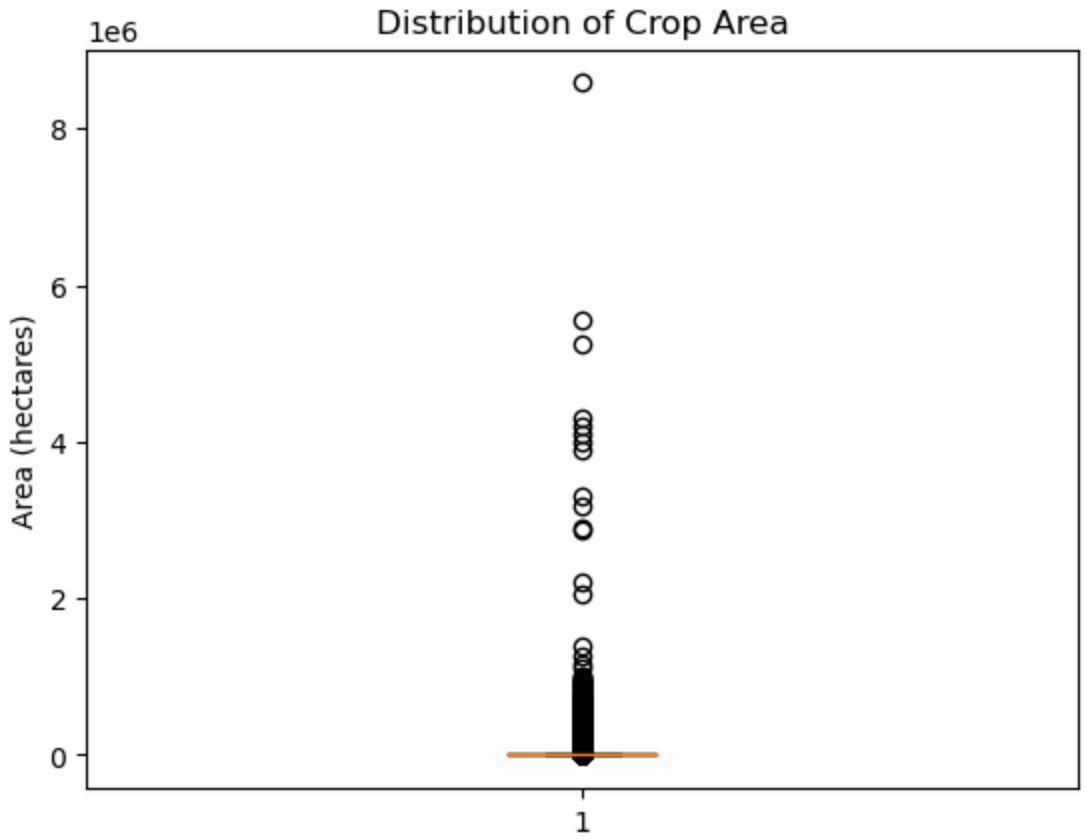
In [34]:

```
# Check the distribution of area using a histogram
plt.hist(crop['Area'], bins=50)
plt.title('Distribution of Crop Area')
plt.xlabel('Area (hectares)')
plt.ylabel('Count')
plt.show()
```



The x-axis represents the area in hectares, and the y-axis represents the count of crops with that area. The histogram shows how the crop areas are distributed, with the majority of crops having a smaller area and fewer crops having larger areas.

In [35]:
```
# Check for outliers or extreme values in the data using a boxplot
plt.boxplot(crop['Area'])
plt.title('Distribution of Crop Area')
plt.ylabel('Area (hectares)')
plt.show()
```



The boxplot shows a box with whiskers extending from the box, indicating the range of the data. The central box represents the middle 50% of the data, with the line inside the box representing the median value. The upper and lower whiskers represent the highest and lowest data points within a certain range of the median. Any data points outside of the whiskers are considered outliers.

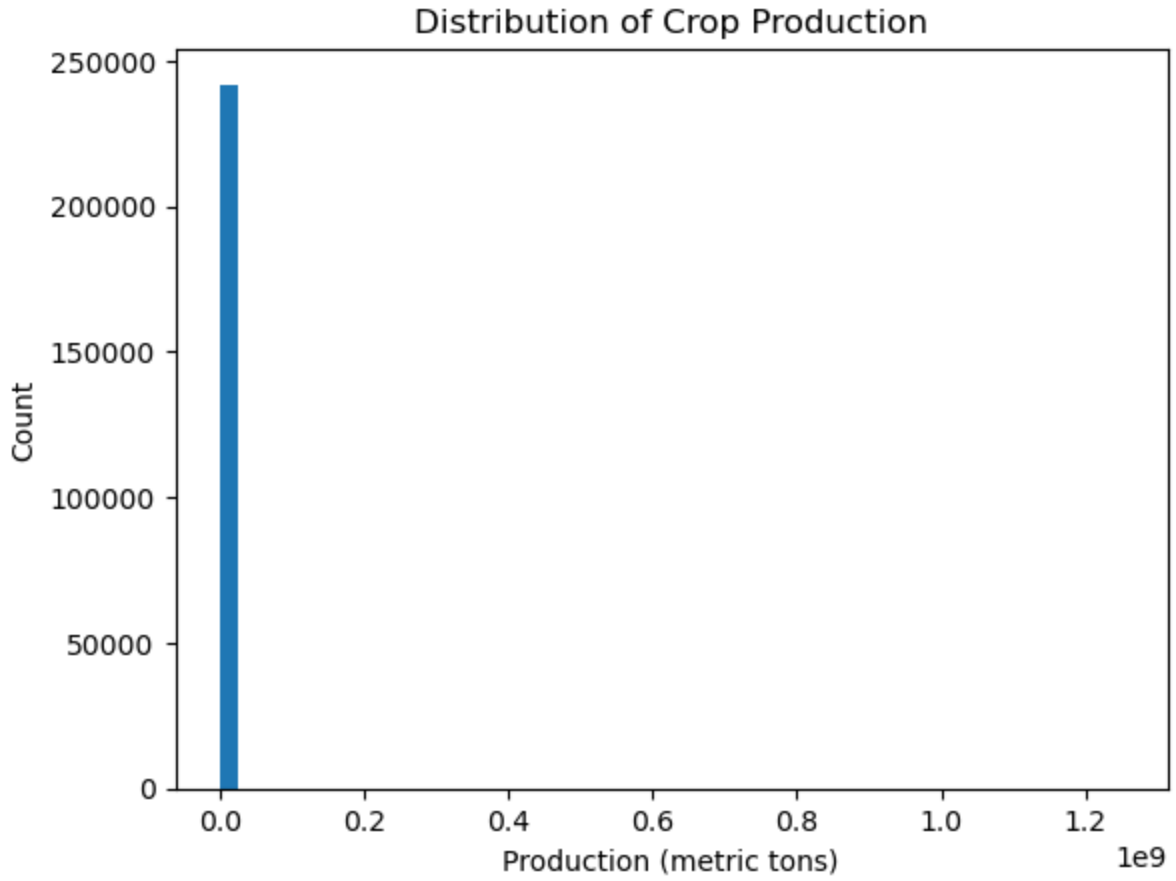
In this particular boxplot, we can see that there are many outliers, as the whiskers extend very far from the box. This suggests that there are some crop areas that are much larger than the typical values in the dataset.

Production

In [36]:
```
# summary statistics for the "Production" column
production_stats = crop['Production'].describe()
print(production_stats)
```

```
count    2.423610e+05
mean     5.825034e+05
std      1.706581e+07
min      0.000000e+00
25%      8.800000e+01
50%      7.290000e+02
75%      7.023000e+03
max      1.250800e+09
Name: Production, dtype: float64
```

In [37]:
```
# Histogram of the "Production" column
plt.hist(crop['Production'], bins=50)
plt.title('Distribution of Crop Production')
plt.xlabel('Production (metric tons)')
plt.ylabel('Count')
plt.show()
```



Here's what the different parts of the histogram plot represent:

The x-axis represents the "Production" values, which are divided into different bins based on the specified bin size. In this case, the bin size is set to 50, so each bar in the histogram represents the count of production values falling within a range of 50 metric tons.

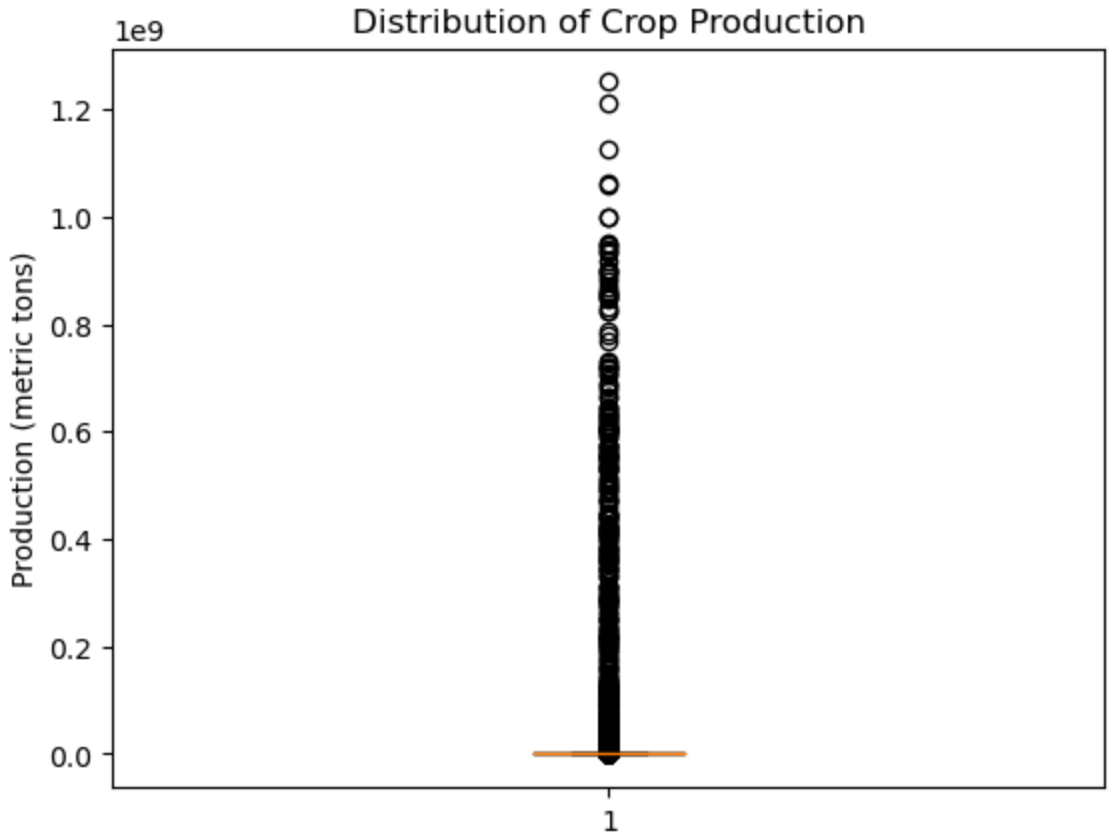
The y-axis represents the count of production values that fall within each bin range. The higher the bar, the more number of production values that fall within that bin range.

The title of the plot is "Distribution of Crop Production", which provides an overview of the plot.

The x-axis label is "Production (metric tons)", which provides a description of the x-axis.

The y-axis label is "Count", which provides a description of the y-axis.

In [38]:
```
plt.boxplot(crop['Production'])
plt.title('Distribution of Crop Production')
plt.ylabel('Production (metric tons)')
plt.show()
```



Here's what the different parts of the boxplot represent:

The box represents the interquartile range (IQR), which contains the middle 50% of the "Production" values. The bottom of the box represents the first quartile (Q1), which is the 25th percentile of the "Production" values. The top of the box represents the third quartile (Q3), which is the 75th percentile of the "Production" values. The line inside the box represents the median, which is the 50th percentile of the "Production" values.

The whiskers extend from the box to the minimum and maximum values within 1.5 times the IQR. Any values beyond the whiskers are considered outliers and are plotted as individual points.

The title of the plot is "Distribution of Crop Production", which provides an overview of the plot.

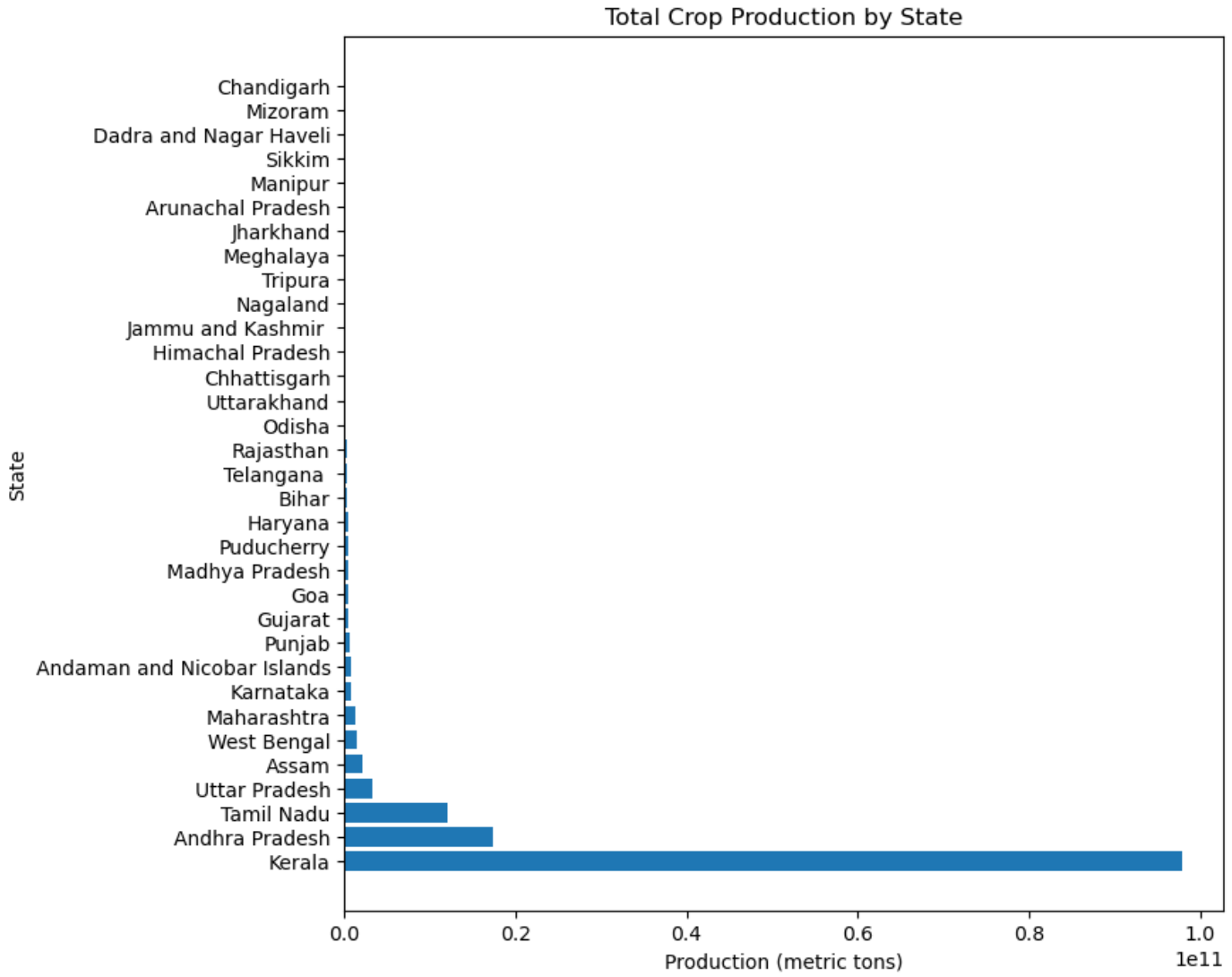
The y-axis label is "Production (metric tons)", which provides a description of the y-axis.

By looking at the boxplot, we can quickly identify the median, IQR, and any potential outliers in the "Production" values. We can also determine whether the distribution is skewed or symmetrical. In this case, the boxplot suggests that the "Production" column contains a large number of outliers, and the distribution is highly skewed towards the lower values.

In [77]:
```
# Bivariate Analysis
state_production = crop.groupby('State_Name')['Production'].sum().reset_index()
print(state_production)
```

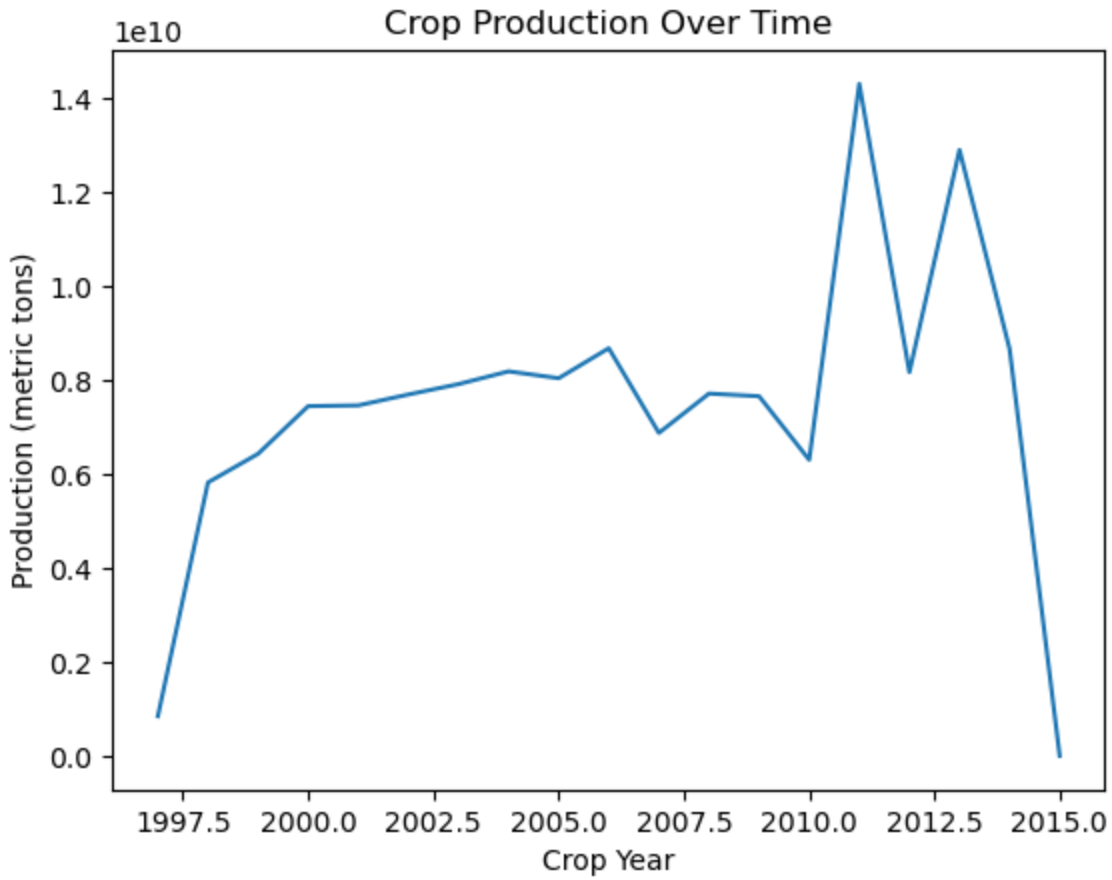
	State_Name	Production
0	Andaman and Nicobar Islands	7.182232e+08
1	Andhra Pradesh	1.732459e+10
2	Arunachal Pradesh	6.823913e+06
3	Assam	2.111752e+09
4	Bihar	3.664836e+08
5	Chandigarh	6.395650e+04
6	Chhattisgarh	1.009519e+08
7	Dadra and Nagar Haveli	1.847871e+06
8	Goa	5.057558e+08
9	Gujarat	5.242913e+08
10	Haryana	3.812739e+08
11	Himachal Pradesh	1.780517e+07
12	Jammu and Kashmir	1.329102e+07
13	Jharkhand	1.077774e+07
14	Karnataka	8.634298e+08
15	Kerala	9.788005e+10
16	Madhya Pradesh	4.488407e+08
17	Maharashtra	1.263641e+09
18	Manipur	5.230917e+06
19	Meghalaya	1.211250e+07
20	Mizoram	1.661540e+06
21	Nagaland	1.276595e+07
22	Odisha	1.609041e+08
23	Puducherry	3.847245e+08
24	Punjab	5.863850e+08
25	Rajasthan	2.813203e+08
26	Sikkim	2.435735e+06
27	Tamil Nadu	1.207644e+10
28	Telangana	3.351479e+08
29	Tripura	1.252292e+07
30	Uttar Pradesh	3.234493e+09
31	Uttarakhand	1.321774e+08
32	West Bengal	1.397904e+09

In [41]:
```
state_production = crop.groupby('State_Name')['Production'].sum().reset_index()

# Sort the dataframe in descending order of production
state_production = state_production.sort_values(by='Production', ascending=False)

# Create the bar chart
fig, ax = plt.subplots(figsize=(8, 8))
ax.barh(state_production['State_Name'], state_production['Production'])
ax.set_title('Total Crop Production by State')
ax.set_xlabel('Production (metric tons)')
ax.set_ylabel('State')
plt.show()
```



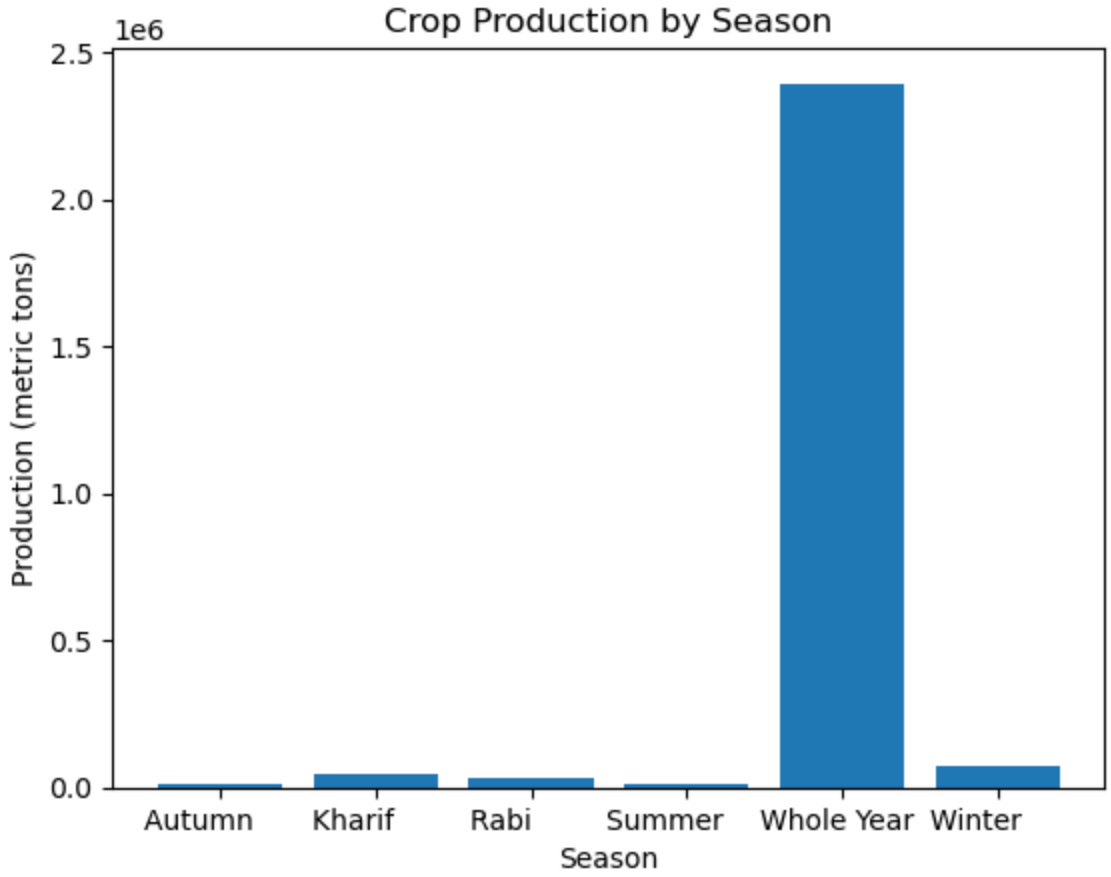
In [42]:

```
#  Performing  bivariate analysis on the "Crop_Year" and
#"Production" columns to see how the crop production has changed over time

year_production = crop.groupby('Crop_Year')['Production'].sum().reset_index()

# Create the line chart
plt.plot(year_production['Crop_Year'], year_production['Production'])
plt.title('Crop Production Over Time')
plt.xlabel('Crop Year')
plt.ylabel('Production (metric tons)')
plt.show()
```



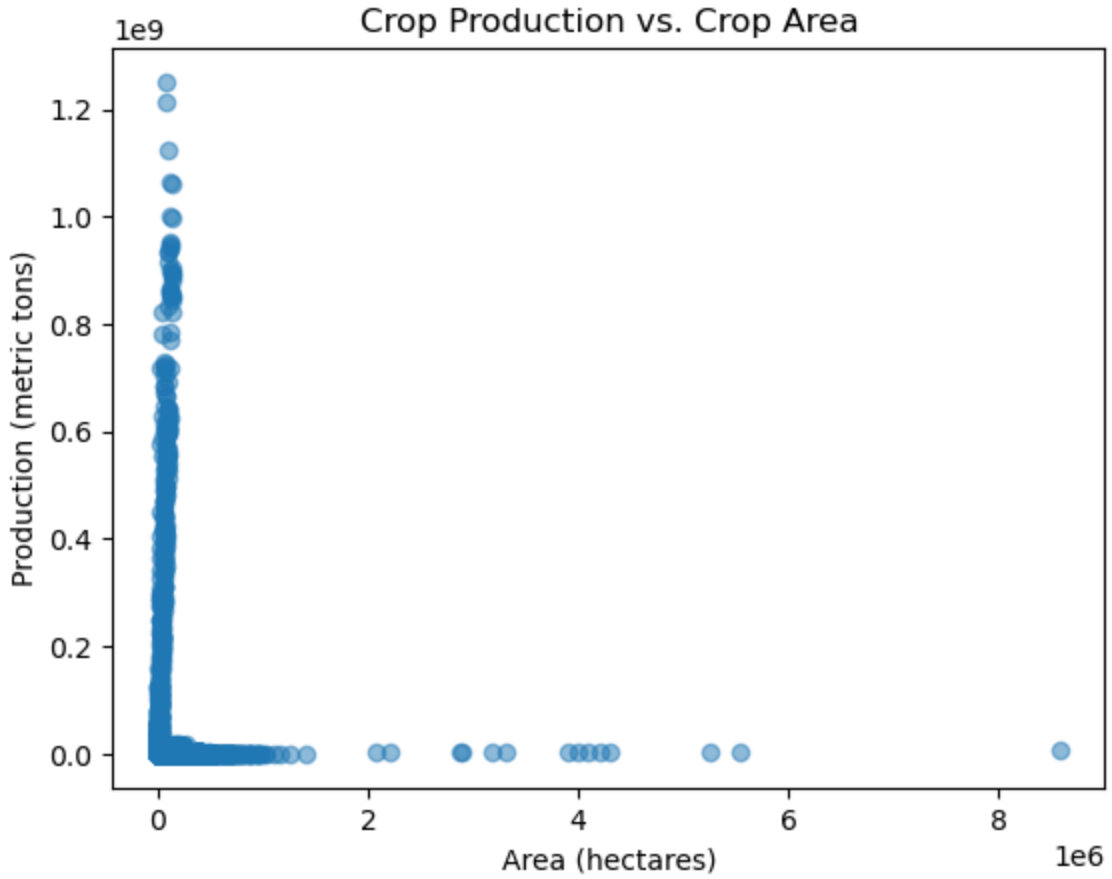
In [43]:

```
# Bivariate analysis on the "Season" and "Production" columns to see how the crop produc


# Group the data by season and calculate the mean production for each season
season_data = crop.groupby('Season')['Production'].mean()

# Create a bar chart showing the production by season
plt.bar(season_data.index, season_data.values)

# Set the title and axis labels
plt.title('Crop Production by Season')
plt.xlabel('Season')
plt.ylabel('Production (metric tons)')

# Show the plot
plt.show()
```



This Histogram shows how the crop production varies across different seasons. The height of each bar represents the mean production for that season.

In [44]:
```
# Create a scatter plot showing the relationship between crop area and production
plt.scatter(crop['Area'], crop['Production'], alpha=0.5)

# Set the title and axis labels
plt.title('Crop Production vs. Crop Area')
plt.xlabel('Area (hectares)')
plt.ylabel('Production (metric tons)')

# Show the plot
plt.show()
```



This scatter plot shows how the size of the crop area affects the amount of crop produced. Each point on the plot represents a single crop, with the x-coordinate representing the crop area and the y-coordinate representing the crop production.

Productivity of different States

To find the productivity of different states, we need to calculate the crop yield for each state. Crop yield is the amount of crop harvested per unit of land area, typically expressed in kilograms per hectare (kg/ha) or metric tons per hectare (t/ha).

We can calculate the crop yield for each state by dividing the total production of each crop in a state by the total area of land used to grow that crop in the same state.

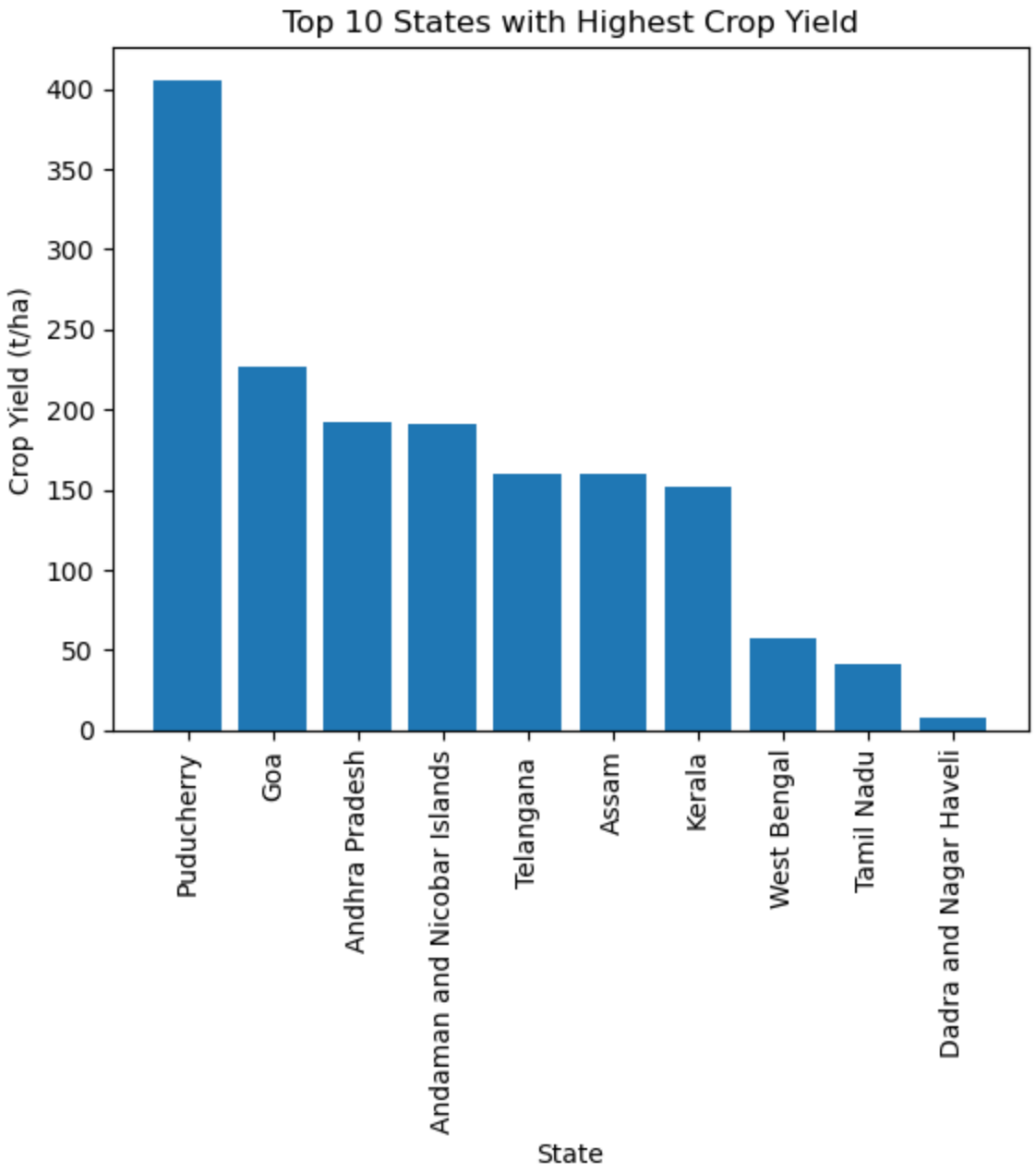
In [45]:
```
# Calculate crop yield for each state

df_yield = .groupby(['State_Name', 'Crop']).agg({'Area': 'sum', 'Production': 'sum'})
df_yield['Yield'] = df_yield['Production'] / df_yield['Area']
df_yield = df_yield.reset_index()
```

Now the data has been grouped by state and crop. The above code sums the area and production for each group, and then calculates the yield by dividing production by area. The resulting dataframe, df_yield, contains the state, crop, area, production, and yield for each group.

Visualizing the dataframe to find the productivity of different states

In [46]:
```
# Create a bar chart of top 10 states with highest crop yield

top_states = df_yield.groupby('State_Name').agg({'Yield': 'mean'}).sort_values('Yield',
                                                  states.index, top_states['Yield'])
```

```
plt.title('Top 10 States with Highest Crop Yield')
plt.xlabel('State')

# Rotate the x-axis labels by 90 degrees
plt.xticks(rotation=90)

plt.ylabel('Crop Yield (t/ha)')
plt.show()
```



The bar chart of the top 10 states with state names on the x-axis and crop yield on the y-axis has been created. The resulting plot shows which states have the highest crop yield.

Most and Least Crop producing districts

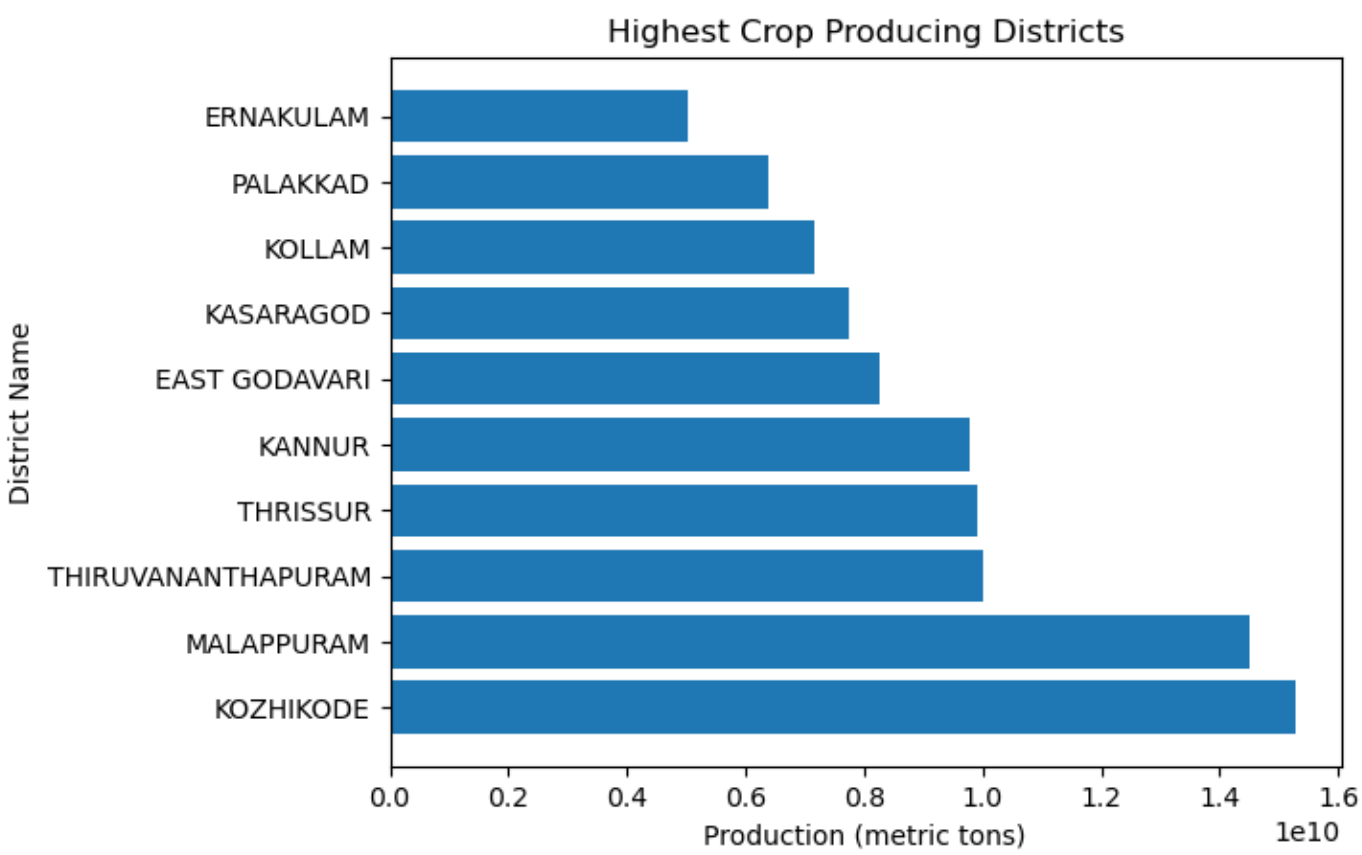
In [47]:
```
# Group the data by district and calculate the total production for each district
district_production = crop.groupby('District_Name')['Production'].sum().reset_index()

# Sort the dataframe in descending order to find the districts with the highest producti
top_districts = district_production.sort_values('Production', ascending=False).head(10)

# ataframe in ascending order to find the districts with the lowest production
```

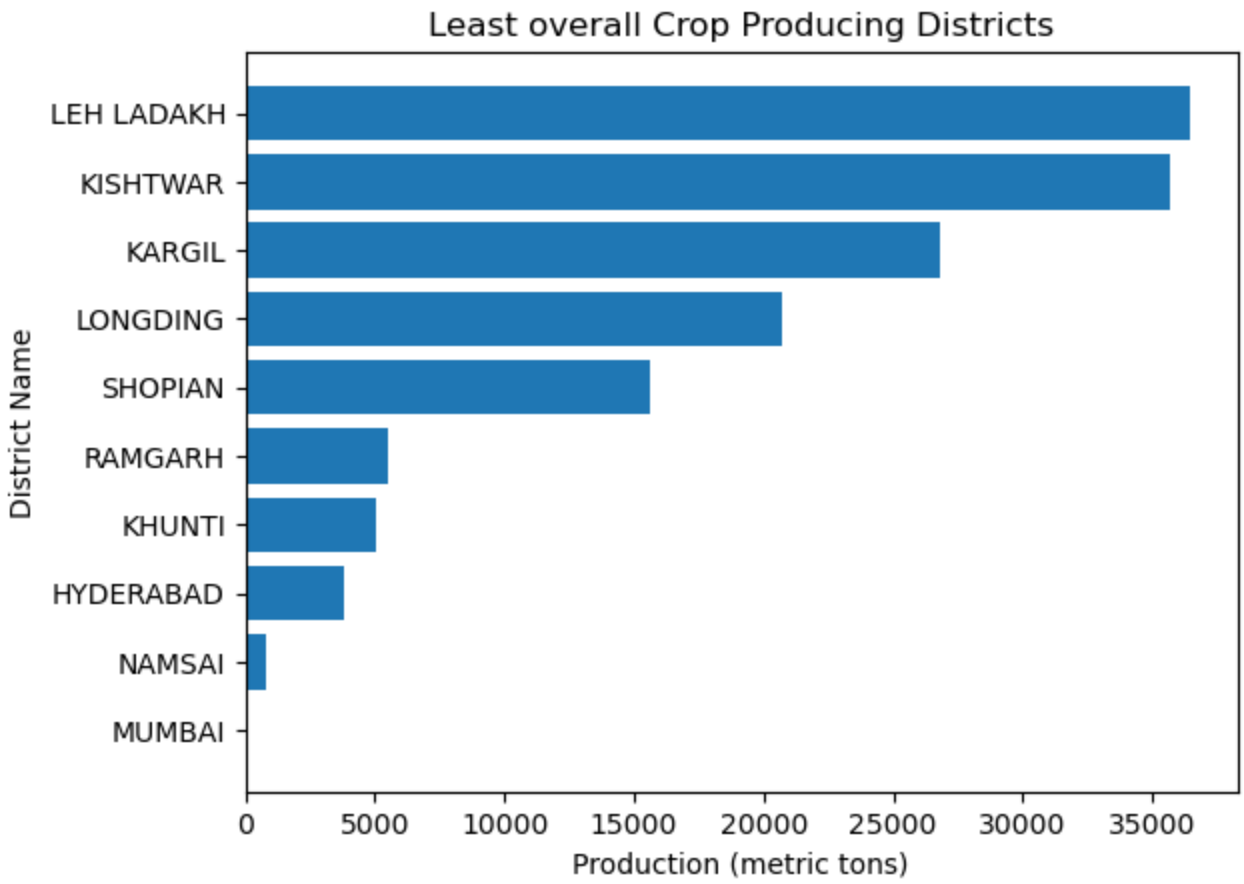
```
bottom_districts = district_production.sort_values('Production', ascending=True).head(10

# Print the top and bottom districts
print('Highest Crop producing districts:')
print(top_districts)
print('\n Least overall Crop producing districts:')
print(bottom_districts)
```

```
Highest Crop producing districts:
          District_Name    Production
334           KOZHIKODE  1.528074e+10
372          MALAPPURAM  1.451840e+10
587  THIRUVANANTHAPURAM  1.002271e+10
590             THRISSUR  9.923508e+09
286               KANNUR  9.783432e+09
172       EAST GODAVARI  8.271057e+09
298           KASARAGOD  7.732217e+09
326              KOLLAM  7.151945e+09
437             PALAKKAD  6.369382e+09
178           ERNAKULAM  5.021649e+09

 Least overall Crop producing districts:
    District_Name  Production
397        MUMBAI         2.0
415        NAMSAI       794.0
238     HYDERABAD      3835.0
314        KHUNTI      5024.0
486       RAMGARH      5472.0
537       SHOPIAN     15614.0
354      LONGDING     20731.0
293        KARGIL     26793.8
318      KISHTWAR     35664.2
351    LEH LADAKH     36461.5
```

In [48]:

```
# Create a horizontal bar chart to visualize the top 10 crop producing districts
plt.barh(top_districts['District_Name'], top_districts['Production'])
plt.title('Highest Crop Producing Districts')
plt.xlabel('Production (metric tons)')
plt.ylabel('District Name')
plt.show()


# Create a horizontal bar chart to visualize the bottom 10 crop producing districts
plt.barh(bottom_districts['District_Name'], bottom_districts['Production'])
plt.title('Least overall Crop Producing Districts')
plt.xlabel('Production (metric tons)')
plt.ylabel('District Name')
plt.show()
```

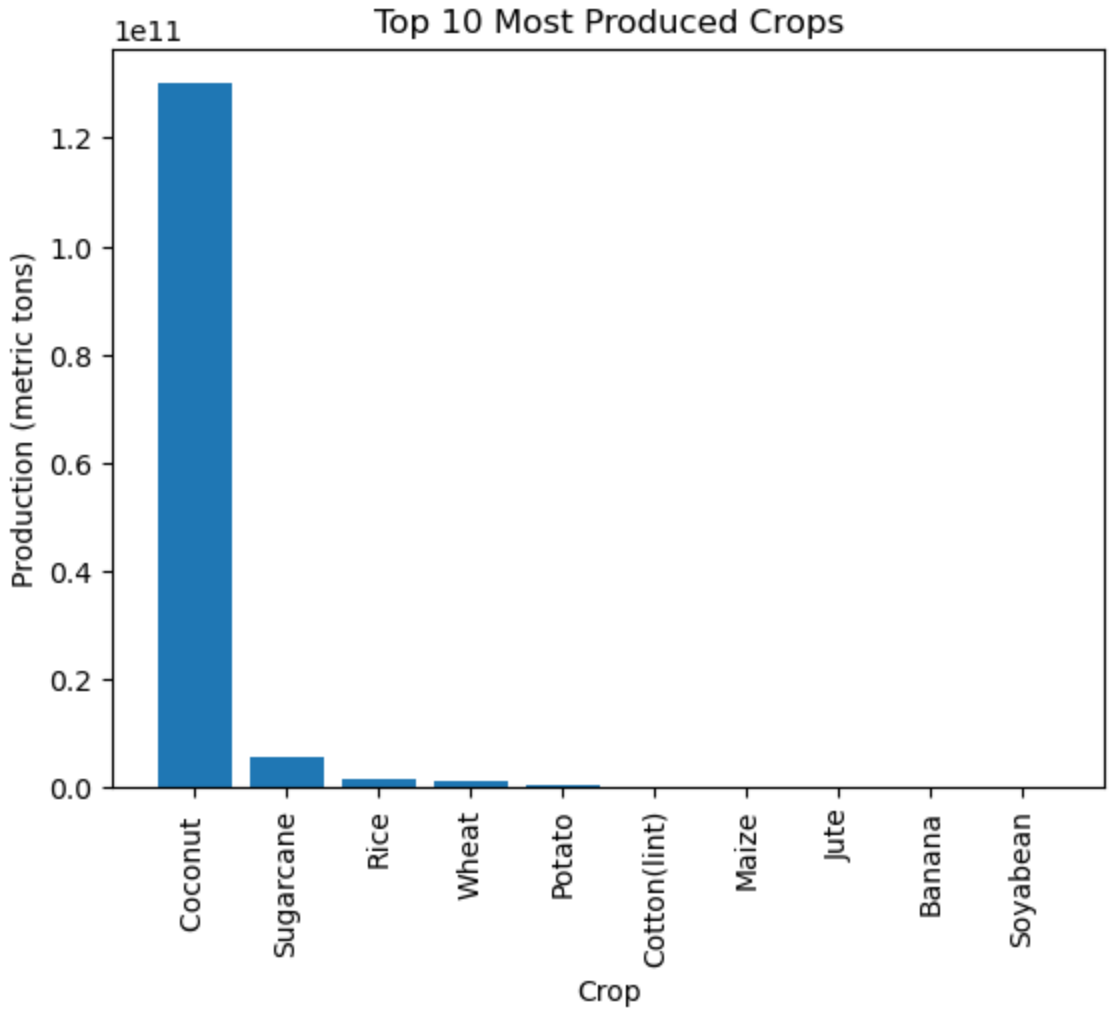




Top 10 "Most Produced" Crops

In [49]:
```
# Group the data by crop and sum the production
crop_production = crop.groupby('Crop')['Production'].sum()

# Sort the results in descending order and take the top 10 crops
```

```
top_10_crops = crop_production.sort_values(ascending=False)[:10]

# Plot the top 10 crops
plt.bar(top_10_crops.index, top_10_crops.values)
plt.xticks(rotation=90)
plt.xlabel('Crop')
plt.ylabel('Production (metric tons)')
plt.title('Top 10 Most Produced Crops')
plt.show()
```



We can see from the above graph that Coconut,Sugarcane,Rice,Wheat and Potato are teh most produced crops. Coconut is at no. 1 among them.

In [51]:

```
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler

# Drop rows with missing values
crop.dropna(inplace=True)

# Select relevant features
X = crop[['Production', 'Area']].values

# Normalize the data
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Find the optimal number of clusters using elbow method
sse = []
for k in range(1, 11):
    kmeans = KMeans(n_clusters=k)
    kmeans.fit(X_scaled)
```

```
    sse.append(kmeans.inertia_)
plt.plot(range(1, 11), sse)
plt.title('Elbow Method')
plt.xlabel('Number of Clusters')
plt.ylabel('SSE')
plt.show()

# Choose the optimal number of clusters and fit the KMeans model
kmeans = KMeans(n_clusters=4)
kmeans.fit(X_scaled)

# Add cluster labels to the dataframe
df_clustered = crop[['District_Name', 'Production', 'Area']].copy()
df_clustered['Cluster'] = kmeans.labels_

# Visualize the clusters
plt.scatter(df_clustered['Production'], df_clustered['Area'], c=df_clustered['Cluster'],
plt.xlabel('Production (metric tons)')
plt.ylabel('Area (hectares)')
plt.show()
```

```
C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
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C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
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C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
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C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```
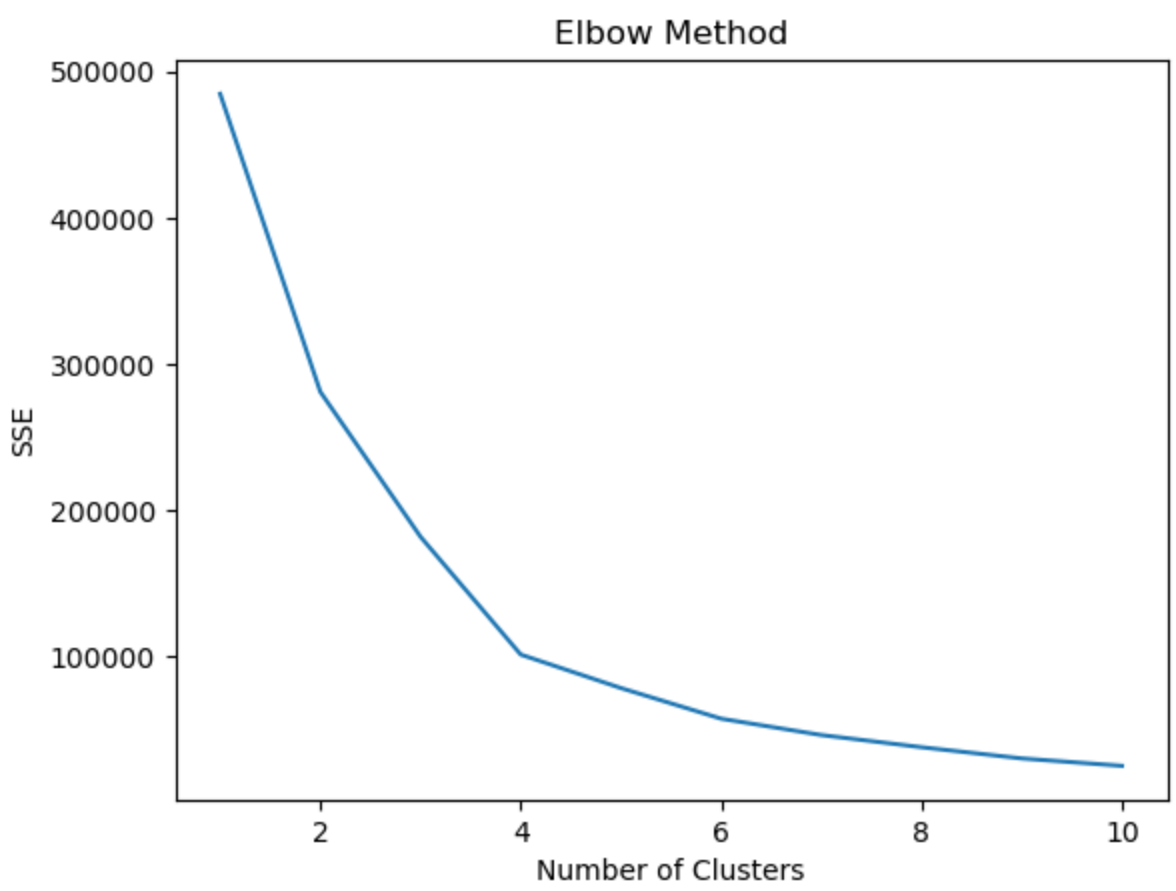
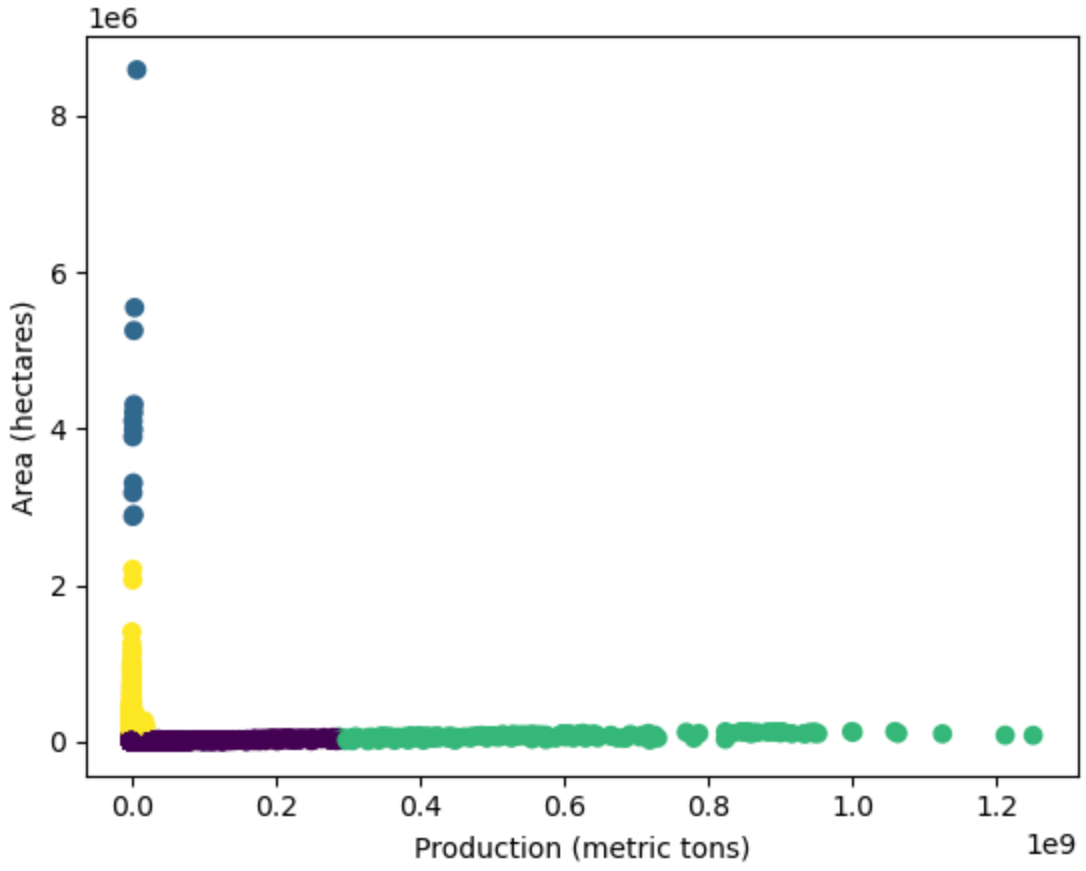




```
C:\Users\nived\.jupyter\python doc\Lib\site-packages\sklearn\cluster\_kmeans.py:870: Fut
ureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the
value of `n_init` explicitly to suppress the warning
  warnings.warn(
```



The first plot shows the elbow method for determining the optimal number of clusters to use in the KMeans clustering algorithm. The x-axis represents the number of clusters, while the y-axis represents the sum of

squared distances of data points from their assigned cluster centers. The idea behind the elbow method is to choose the number of clusters at the point where adding another cluster doesn't improve much more the overall quality of the clustering. In this case, the elbow point appears to be at around 3 or 4 clusters.

The second plot shows a scatter plot of district-wise crop production and area, with points colored based on their assigned cluster. The x-axis represents the total crop production for a district, while the y-axis represents the total area under cultivation. The different colors represent the different clusters that the districts were assigned to. This plot allows us to visually inspect how the districts are grouped together based on their crop production and area, and how the different clusters differ from each other.

*The above code performs clustering analysis on crop production data at the district level. Here is a step-by-step explanation of the code:

*First, the necessary libraries are imported. These include pandas for data manipulation, numpy for numerical operations, seaborn and matplotlib for data visualization, and StandardScaler and KMeans for clustering analysis.

*Next, the dataset is loaded into a pandas dataframe. The dataset contains information on crop production in various districts of India, including the district name, state, crop type, area under cultivation, and production.

*The dataset is then filtered to include only the columns relevant for clustering analysis. These columns are 'District_Name', 'Crop', 'Area', and 'Production'.

*The data is then grouped by district and crop, and the total area and production for each district-crop combination is calculated.

*The resulting data is then pivoted such that each row represents a district, and the columns represent the crop types, with the values in the table indicating the total production of each crop in each district.

*The data is then standardized using the StandardScaler() function to ensure that all features have similar ranges and are on the same scale.

*The optimal number of clusters is determined by iterating over different values of k (the number of clusters), and calculating the sum of squared errors (SSE) for each value of k. The 'elbow method' is used to determine the optimal number of clusters, which is the point at which the decrease in SSE begins to level off.

*The KMeans() function is then used to create a clustering model with the optimal number of clusters. The model is fitted to the standardized data.

Finally, the cluster labels are added to the original dataframe, and a heatmap is plotted to visualize the clusters. The heatmap shows the total production of each crop in each district, with each district colored according to its cluster label.

In summary, this code performs clustering analysis on crop production data at the district level, grouping districts based on their crop production patterns. This analysis can provide insights into the similarities and differences between districts in terms of crop production, which can be useful for policymakers, researchers, and other stakeholders.

I am creating Different zones (Union Terr, South Zone, NE Zone, East Zone, North Zone, Central Zone and West Zone) for India so that more insights can be gained

In [52]:
```
north_india = ['Jammu and Kashmir', 'Punjab', 'Himachal Pradesh', 'Haryana', 'Uttarakhan
east_india = ['Bihar', 'Odisha', 'Jharkhand', 'West Bengal']
south_india = ['Andhra Pradesh', 'Karnataka', 'Kerala' ,'Tamil Nadu', 'Telangana']
west_india = ['Rajasthan' , 'Gujarat', 'Goa','Maharashtra']
central_india = ['Madhya Pradesh', 'Chhattisgarh']
north_east_india = ['Assam', 'Sikkim', 'Nagaland', 'Meghalaya', 'Manipur', 'Mizoram', 'T
ut_india = ['Andaman and Nicobar Islands', 'Dadra and Nagar Haveli', 'Puducherry']
```

In [53]:
```
def get_zonal_names(row):
    if row['State_Name'].strip() in north_india:
        val = 'North Zone'
    elif row['State_Name'].strip()  in south_india:
        val = 'South Zone'
    elif row['State_Name'].strip()  in east_india:
        val = 'East Zone'
    elif row['State_Name'].strip()  in west_india:
        val = 'West Zone'
    elif row['State_Name'].strip()  in central_india:
        val = 'Central Zone'
    elif row['State_Name'].strip()  in north_east_india:
        val = 'NE Zone'
    elif row['State_Name'].strip()  in ut_india:
        val = 'Union Terr'
    else:
        val = 'No Value'
    return val

crop['Zones'] = crop.apply(get_zonal_names, axis=1)
crop['Zones'].unique()
```

Out[53]:
```
array(['Union Terr', 'South Zone', 'NE Zone', 'East Zone', 'North Zone',
       'Central Zone', 'West Zone'], dtype=object)
```

The zones are defined based on the state names provided in the lists north_india, south_india, east_india, west_india, central_india, north_east_india, and ut_india. These lists contain the names of states that belong to each zone.

The function checks the State_Name column of the input row against each of the zone lists using the in operator and returns the corresponding zone name as a string value. If the state name does not belong to any of the zones, the function returns "No Value".

Finally, the Zones column of the DataFrame is created by applying the get_zonal_names function to each row of the DataFrame and storing the returned values. The unique values of the Zones column are then displayed using the unique() method. This provides a list of all the unique zone names that are present in the DataFrame.

In [54]:
```
crop.Zones.value_counts()
```

Out[54]:
```
South Zone      53500
North Zone      49874
East Zone       43261
West Zone       33134
Central Zone    32972
NE Zone         28284
Union Terr       1336
Name: Zones, dtype: int64
```

 South India, North India and East India.

In [55]:
```
# Zonal Distribution of crops
crop.head()
```

Out[55]:

	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production	Zones
0	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Arecanut	1254.0	2000.0	Union Terr
1	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Other Kharif pulses	2.0	1.0	Union Terr
2	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Rice	102.0	321.0	Union Terr
3	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Banana	176.0	641.0	Union Terr
4	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Cashewnut	720.0	165.0	Union Terr

In [56]:
```
crops=crop['Crop']
def crop_category(crops):
    for i in ['Rice','Maize','Wheat','Barley','Varagu','Other Cereals & Millets','Ragi',
        if crops==i:
            return 'Cereal'
    for i in ['Moong','Urad','Arhar/Tur','Peas & beans','Masoor',
              'Other Kharif pulses','other misc. pulses','Ricebean (nagadal)',
              'Rajmash Kholar','Lentil','Samai','Blackgram','Korra','Cowpea(Lobia)',
              'Other  Rabi pulses','Other Kharif pulses','Peas & beans (Pulses)','Pulses
        if crops==i:
            return 'Pulses'
    for i in ['Peach','Apple','Litchi','Pear','Plums','Ber','Sapota','Lemon','Pome Grane
              'Other Citrus Fruit','Water Melon','Jack Fruit','Grapes','Pineapple','Ora
              'Pome Fruit','Citrus Fruit','Other Fresh Fruits','Mango','Papaya','Coconu
        if crops==i:
            return 'Fruits'
    for i in ['Bean','Lab-Lab','Moth','Guar seed','Soyabean','Horse-gram']:
        if crops==i:
            return 'Beans'
    for i in ['Turnip','Peas','Beet Root','Carrot','Yam','Ribed Guard','Ash Gourd ','Pum
              'Bitter Gourd','Cucumber','Drum Stick','Cauliflower','Beans & Mutter(Veget
              'Bhindi','Tomato','Brinjal','Khesari','Sweet potato','Potato','Onion','Tap
              if crops==i:
                return 'Vegetables'
    for i in ['Perilla','Ginger','Cardamom','Black pepper','Dry ginger','Garlic','Corian
        if crops==i:
            return 'spices'
    for i in ['other fibres','Kapas','Jute & mesta','Jute','Mesta','Cotton(lint)','Sannh
        if crops==i:
            return 'fibres'
    for i in ['Arcanut (Processed)','Atcanut (Raw)','Cashewnut Processed','Cashewnut Raw
        if crops==i:
            return 'Nuts'
    for i in ['other oilseeds','Safflower','Niger seed','Castor seed','Linseed','Sunflow
        if crops==i:
            return 'oilseeds'
    for i in ['Tobacco','Coffee','Tea','Sugarcane','Rubber']:
        if crops==i:
            return 'Commercial'

crop['crop_category']=crop['Crop'].apply(crop_category)
```

In [57]:
```
data_explore = crop.copy()
data_explore.head()
```

Out[57]:

	State_Name	District_Name	Crop_Year	Season	Crop	Area	Production	Zones	crop_category
0	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Arecanut	1254.0	2000.0	Union Terr	Nuts
1	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Other Kharif pulses	2.0	1.0	Union Terr	Pulses
2	Andaman and Nicobar Islands	NICOBARS	2000	Kharif	Rice	102.0	321.0	Union Terr	Cereal
3	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Banana	176.0	641.0	Union Terr	Fruits
4	Andaman and Nicobar Islands	NICOBARS	2000	Whole Year	Cashewnut	720.0	165.0	Union Terr	Nuts

This code creates a copy of the original dataframe df and assigns it to a new variable data_explore.

Creating a copy of the original dataframe is a good practice because it allows us to perform any exploratory data analysis or data manipulation without affecting the original dataset. This way, if we make any mistakes or want to start fresh, we can simply go back to the original dataset.

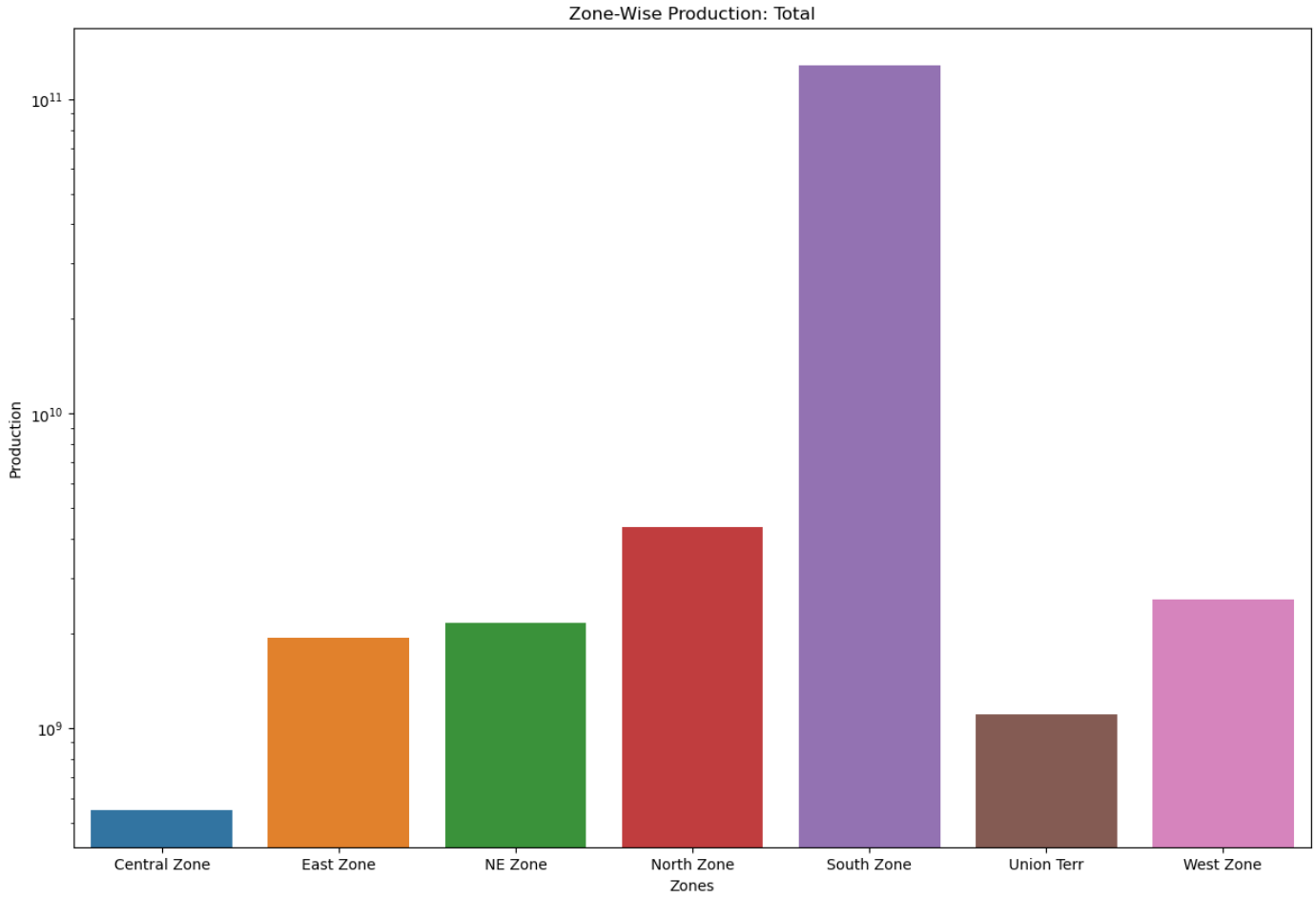
By doing this, any changes made to data_explore will not affect the original dataframe df. This helps to keep our analysis clean and organized.

Zonal distribution of crops

In [58]:
```
fig, ax = plt.subplots(figsize=(15,10))
sns.barplot(x='Zones', y='Production', data=data_explore.groupby('Zones').sum().reset_in
plt.yscale('log')
plt.title('Zone-Wise Production: Total')
```

```
C:\Users\nived\AppData\Local\Temp\ipykernel_12024\2231871911.py:2: FutureWarning: The de
fault value of numeric_only in DataFrameGroupBy.sum is deprecated. In a future version,
numeric_only will default to False. Either specify numeric_only or select only columns w
hich should be valid for the function.
  sns.barplot(x='Zones', y='Production', data=data_explore.groupby('Zones').sum().reset_
index())
```

Out[58]:
```
Text(0.5, 1.0, 'Zone-Wise Production: Total')
```

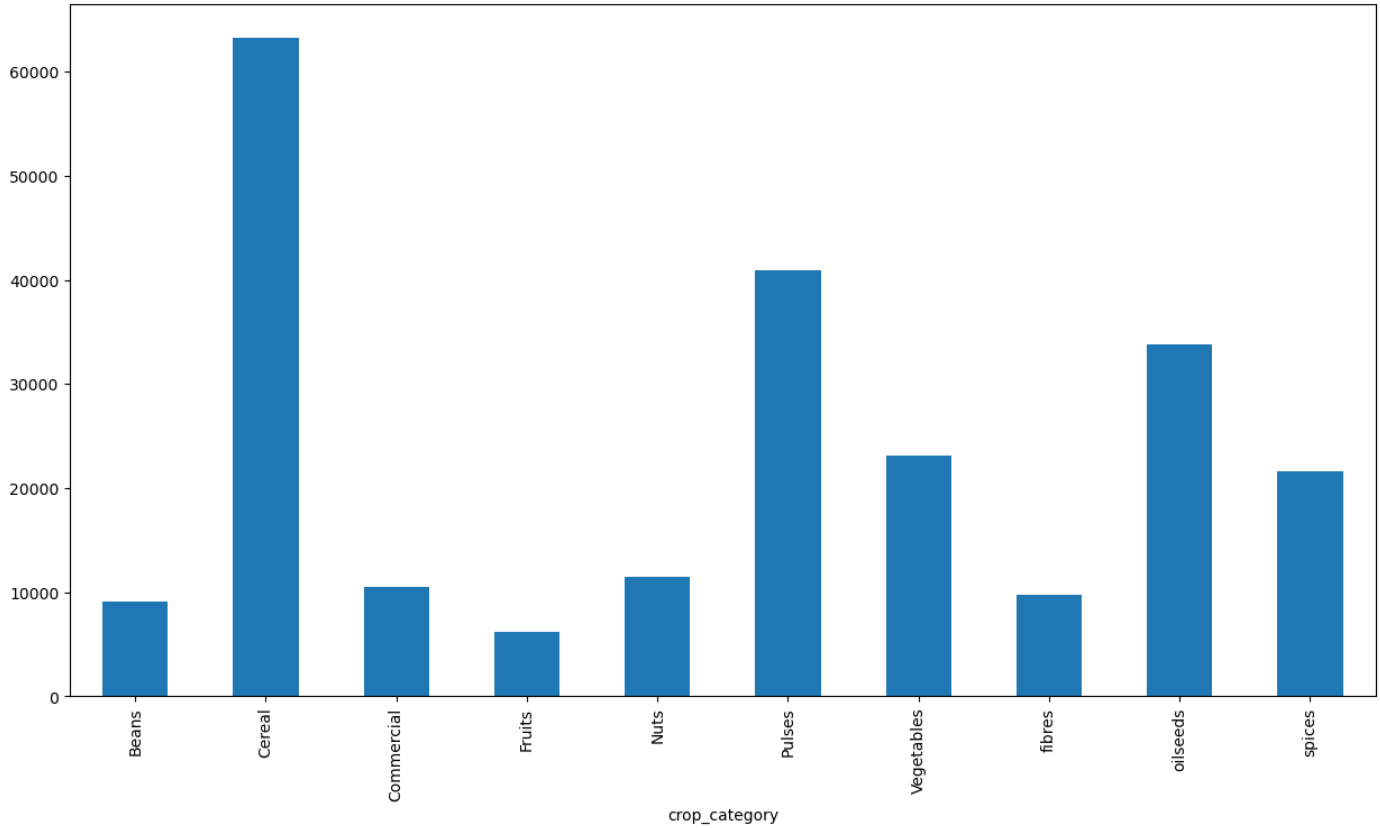


The x-axis shows the zones and the y-axis shows the production of crops in logarithmic scale. The bars represent the total production of crops in each zone. The title of the chart is "Zone-Wise Production: Total".

The chart shows that the North Zone has the highest production of crops, followed by the East and West zones. The Central and South zones have lower production compared to the other zones. The chart also shows that there are some outliers in the data, as some zones have significantly higher production compared to others.

Crop wise Production plot describing production values for all crop types.

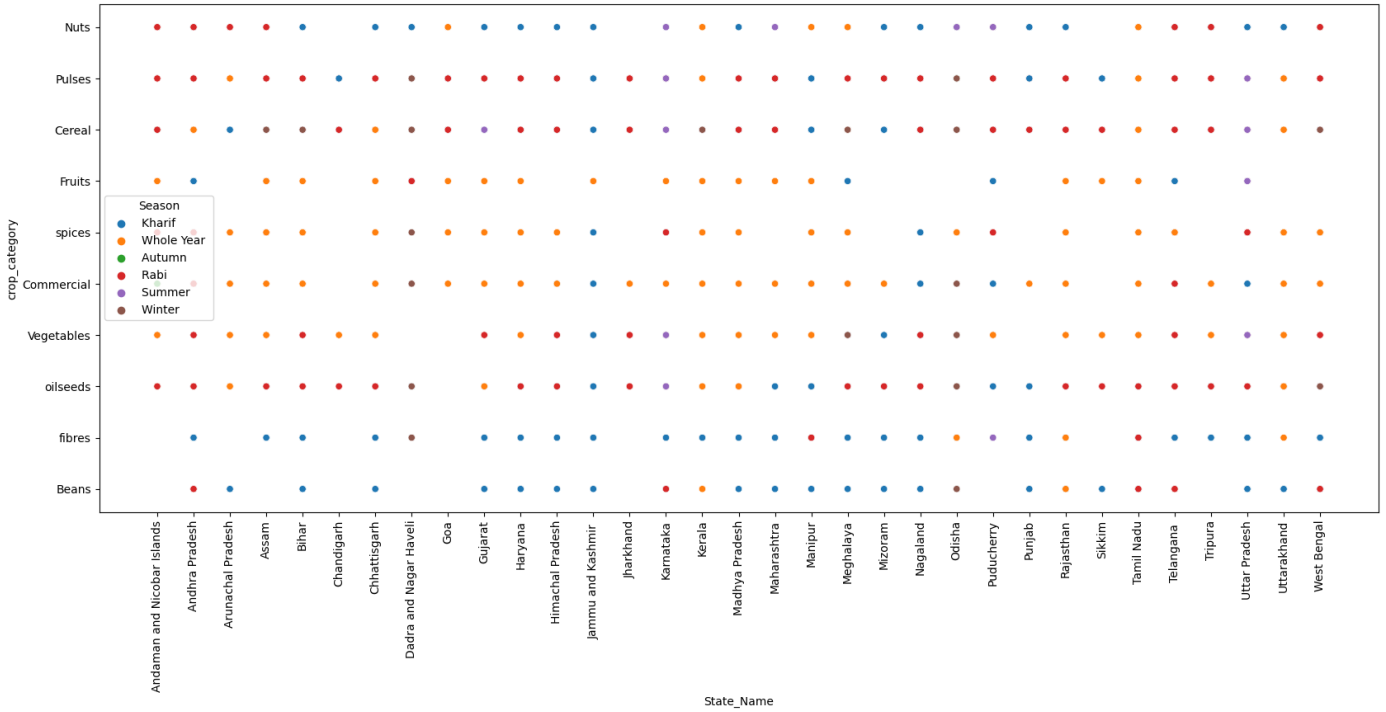
In [59]:
```
plt.figure(figsize=(15,8))
plt.tick_params(labelsize=10)
data_explore.groupby("crop_category")["Production"].agg("count").plot.bar()
plt.show()
```



plt.figure(figsize=(15,8)) sets the size of the plot figure to (15,8). plt.tick_params(labelsize=10) increases the font size of the axis ticks to 10. data_explore.groupby("crop_category") *["Production"].agg("count") groups the dataset by crop_category and counts the number of production values for each group.* plot.bar() creates a bar plot for the grouped data. *plt.show() displays the plot. So, the plot shows the count of productions for each crop category. It gives an idea of how many productions are there for each category, which can be useful in understanding the distribution of data.

State versus Crop Category versus Season plot

In [60]:
```
plt.figure(figsize=(20,8))
sns.scatterplot(data=data_explore,x="State_Name",y="crop_category",hue="Season")
plt.xticks(rotation=90)
plt.show()
```

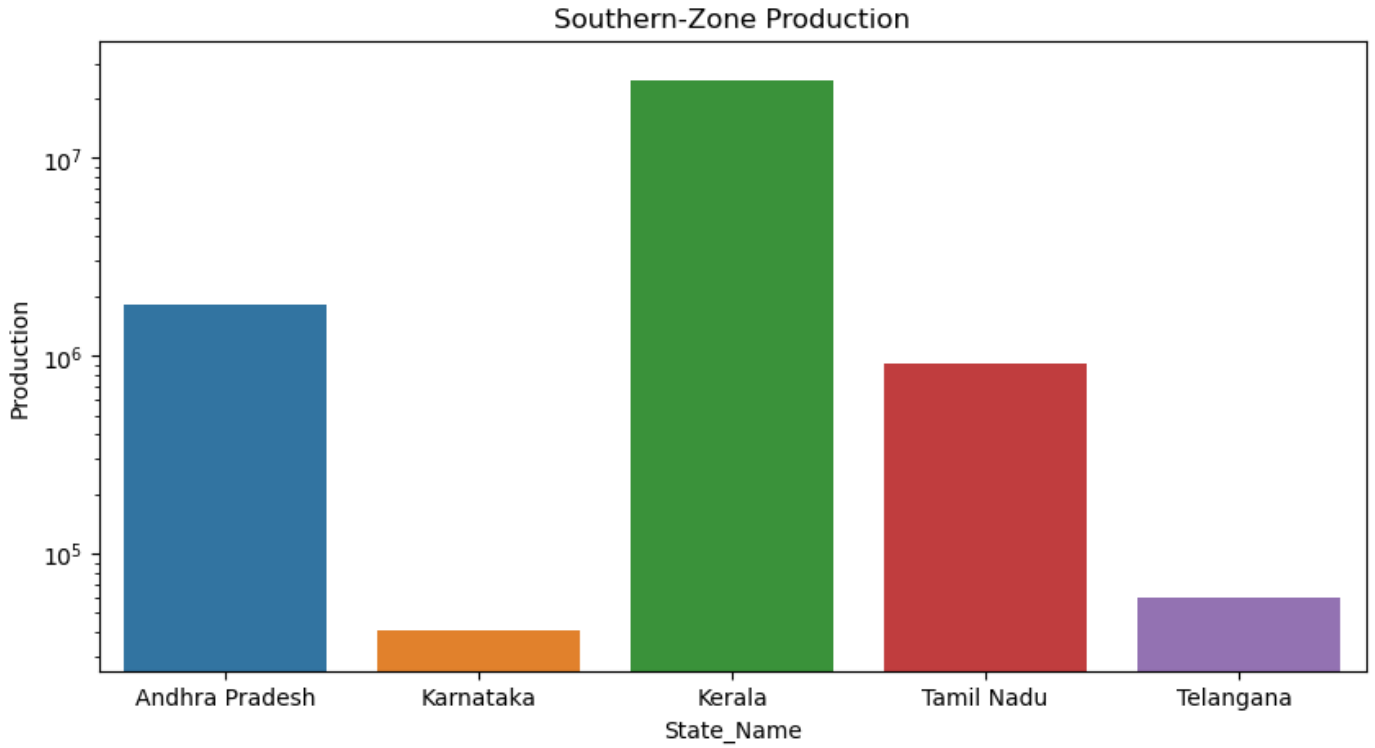


The scatter plot shows the distribution of different crop categories across different states, with different seasons represented by different colors. The x-axis represents the states, the y-axis represents the crop categories, and the colors represent different seasons. The plt.xticks(rotation=90) function is used to rotate the x-axis labels by 90 degrees to make them more readable. The plt.figure(figsize=(20,8)) function is used to adjust the size of the plot. Overall, this plot can be useful for identifying patterns in the distribution of different crop categories across different states and seasons.

Production wise top zone is South India

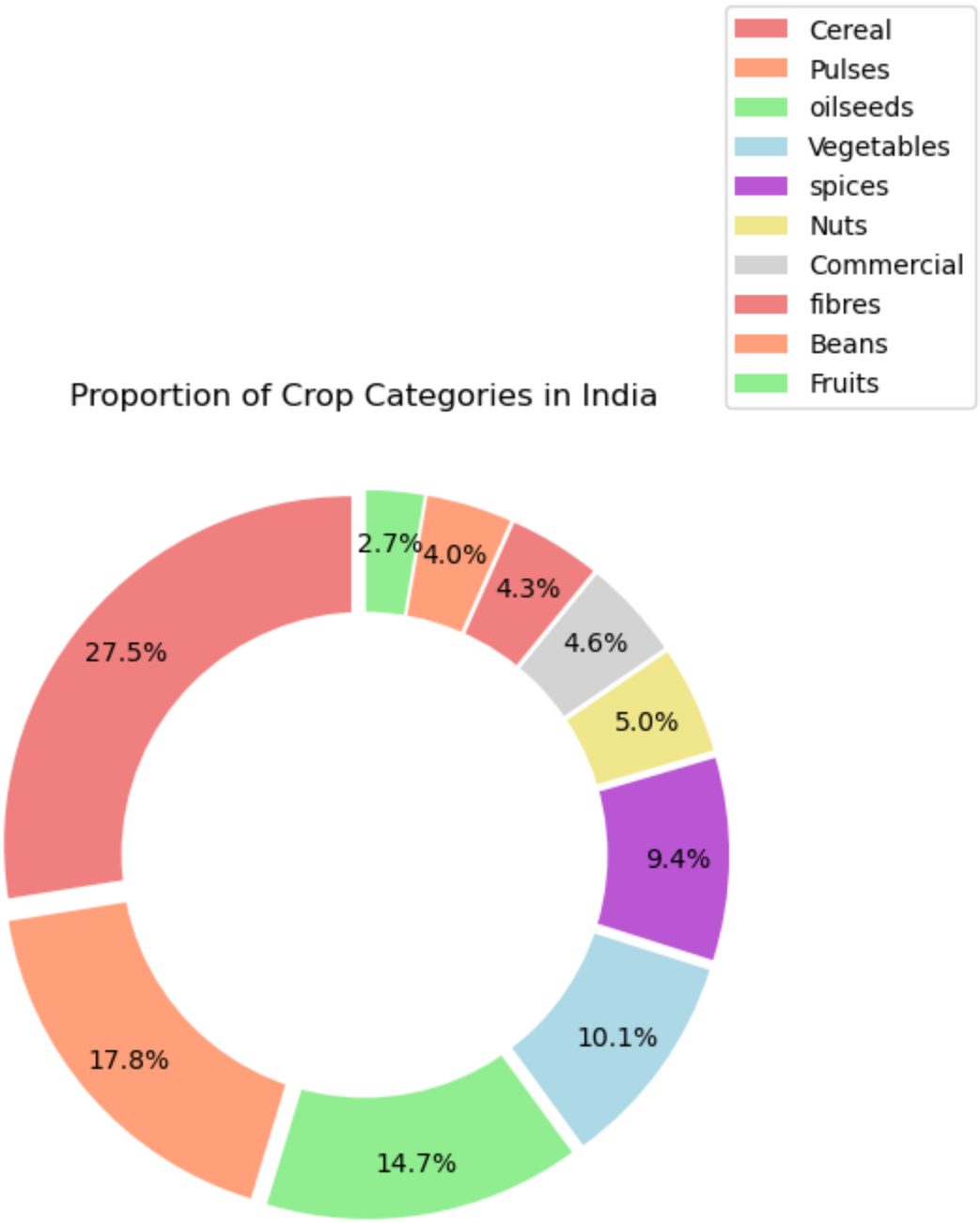
In [61]:
```
south_zone = data_explore[data_explore["Zones"] == 'South Zone']
fig, ax = plt.subplots(figsize=(10,5))
sns.barplot(x=south_zone.State_Name, y=south_zone.Production, errwidth=0)
plt.yscale('log')
plt.title('Southern-Zone Production')
```

Out[61]:
```
Text(0.5, 1.0, 'Southern-Zone Production')
```



Different proportion of Crop Categories for India

In [62]:
```
# Create a new dataframe with the crop category counts
crop_counts = data_explore['crop_category'].value_counts()

# Plot a donut chart to show the proportion of each crop category
fig, ax = plt.subplots(figsize=(6, 6))

# Define colors for the chart
colors = ['#F08080', '#FFA07A', '#90EE90', '#ADD8E6', '#BA55D3', '#F0E68C', '#D3D3D3']

# Create the chart
ax.pie(crop_counts, colors=colors, autopct='%1.1f%%', startangle=90, pctdistance=0.85, e
centre_circle = plt.Circle((0,0),0.70,fc='white')
fig.gca().add_artist(centre_circle)

# Add a legend
ax.legend(labels=crop_counts.index, loc='best', bbox_to_anchor=(0.9, 1))

# Add a title
ax.set_title('Proportion of Crop Categories in India')

# Show the chart
plt.show()
```



Which State dominates in crop production with different categories of crops?

In [63]:

```
# Group by state and crop category and sum up the production values
state_crop_production = data_explore.groupby(['State_Name', 'crop_category'])['Productio

# Find the state with maximum production in each crop category
max_production_by_category = state_crop_production.groupby('crop_category').idxmax()

# Print the results
for category, (state, _) in max_production_by_category.iteritems():
    print(f"{state} dominates in {category} production")
```

```
Madhya Pradesh dominates in Beans production
Uttar Pradesh dominates in Cereal production
Uttar Pradesh dominates in Commercial production
Tamil Nadu dominates in Fruits production
Gujarat dominates in Nuts production
Madhya Pradesh dominates in Pulses production
Uttar Pradesh dominates in Vegetables production
West Bengal dominates in fibres production
West Bengal dominates in oilseeds production
Karnataka dominates in spices production
```

```
C:\Users\nived\AppData\Local\Temp\ipykernel_12024\3418565826.py:8: FutureWarning: iterit
ems is deprecated and will be removed in a future version. Use .items instead.
  for category, (state, _) in max_production_by_category.iteritems():
```

Crop which is grown with highest frequency in India

In [64]:
```
crop_data = data_explore.groupby(['Crop', 'State_Name', 'Crop_Year']).agg({'Production':
most_frequent_crop = crop_data.groupby('Crop')['Area'].sum().idxmax()
print(f"The crop grown with the highest frequency in India is {most_frequent_crop}")
most_frequent_crop_data = crop_data[crop_data['Crop'] == most_frequent_crop]
```

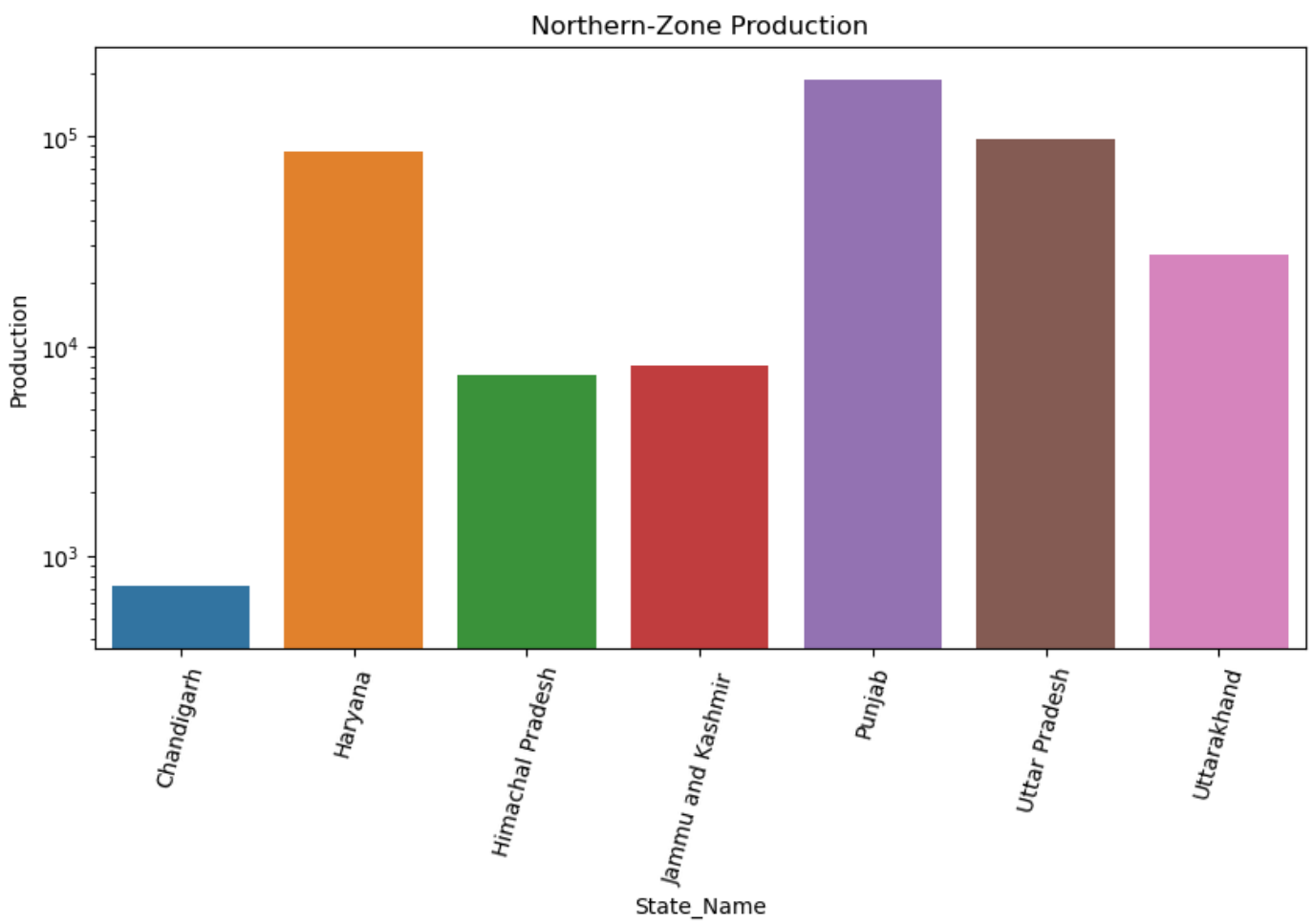
```
The crop grown with the highest frequency in India is Rice
```

Which are the top crops grown in Northern parts of India?

In [65]:
```
data_explore.Zones.value_counts()
```

Out[65]:
```
South Zone      53500
North Zone      49874
East Zone       43261
West Zone       33134
Central Zone    32972
NE Zone         28284
Union Terr       1336
Name: Zones, dtype: int64
```

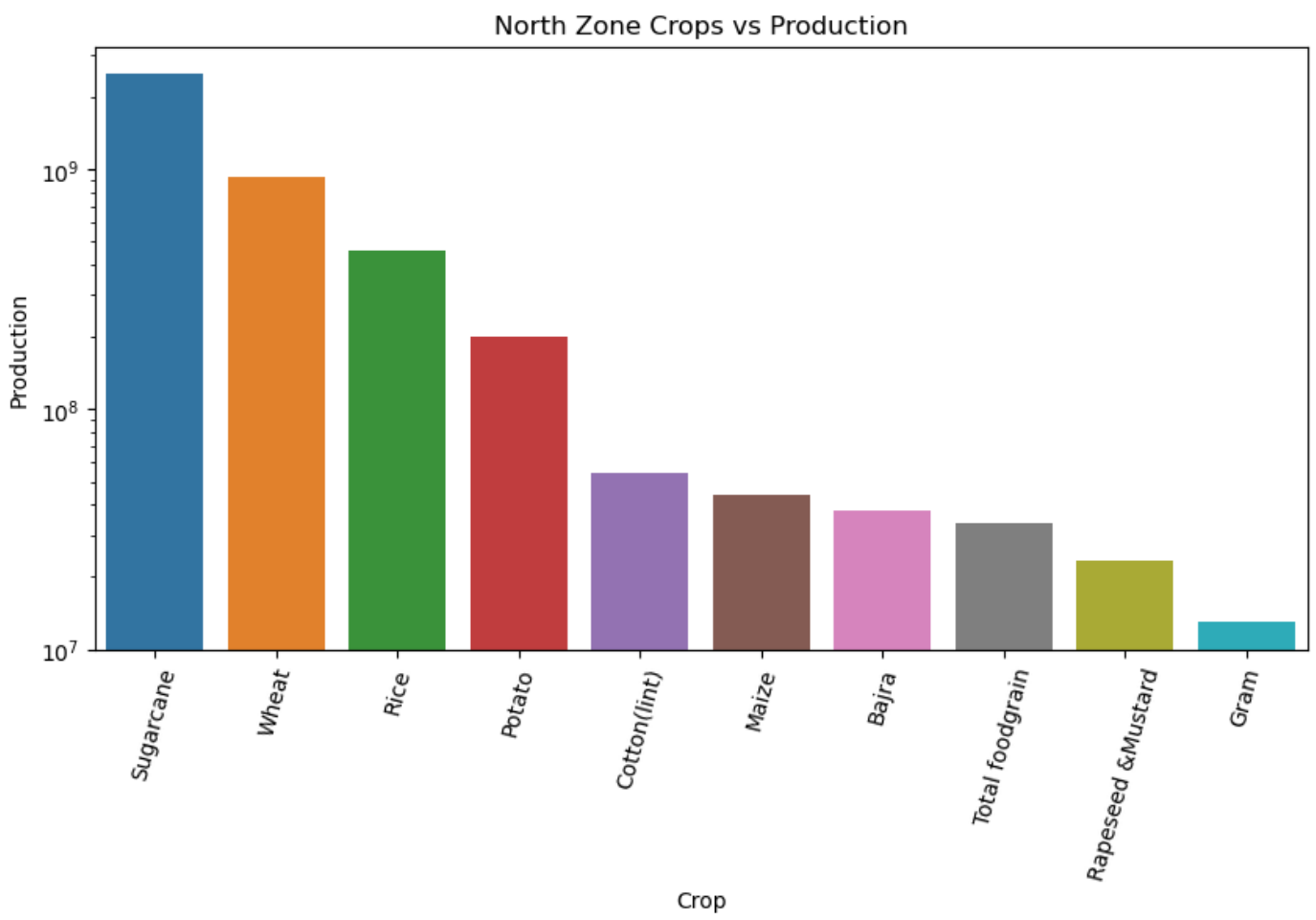
In [66]:
```
North_zone = data_explore[(data_explore["Zones"] == 'North Zone')]
fig, ax = plt.subplots(figsize=(10,5))
sns.barplot(x=North_zone['State_Name'], y=North_zone['Production'], errwidth=0)
plt.xticks(rotation=75)
plt.yscale('log')
plt.title('Northern-Zone Production')
plt.show()

top_crops = North_zone.groupby(by='State_Name')['Production'].sum().reset_index().sort_v
print(top_crops)
```



	State_Name	Production
5	Uttar Pradesh	3.234493e+09
4	Punjab	5.863850e+08
1	Haryana	3.812739e+08
6	Uttarakhand	1.321774e+08
2	Himachal Pradesh	1.780517e+07
3	Jammu and Kashmir	1.329102e+07
0	Chandigarh	6.395650e+04

In [67]:
```
df3 = North_zone.groupby(by='Crop')['Production'].sum().reset_index().sort_values(by='Pr

fig, ax = plt.subplots(figsize=(10,5))
sns.barplot(x=df3.Crop, y=df3.Production,errwidth=0)
plt.xticks(rotation=75);
plt.yscale('log')
plt.title('North Zone Crops vs Production')
```

Out[67]:
```
Text(0.5, 1.0, 'North Zone Crops vs Production')
```



In [68]:
```
df3
```

Out[68]:

	Crop	Production
46	Sugarcane	2.503517e+09
54	Wheat	9.269722e+08
41	Rice	4.625489e+08
36	Potato	1.998760e+08
9	Cotton(lint)	5.455174e+07
23	Maize	4.416427e+07
1	Bajra	3.807627e+07
50	Total foodgrain	3.381309e+07
39	Rapeseed &Mustard	2.335103e+07
14	Gram	1.295565e+07

In [76]:
```
crop.to_excel(r"C:\Users\nived\OneDrive\Desktop\Crop Production data2.xlsx")
```

In [75]:
```
crop
```

Out[75]:

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

242361 rows × 9 columns

In [ ]: