INDIAN AGRICULTURE ANALYSIS

This is a comprehensive analysis of Indian agriculture, focusing on district-wise and year-wise data. The dataset provides detailed information on various crops, their areas, production, and yields across different districts and years. The goal is to leverage Power BI to create interactive visualizations that uncover trends, patterns, and disparities in agricultural practices, enabling stakeholders to make informed decisions for sustainable farming and resource allocation.

By Fanen Solomon Iorwuese

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Introduction

The agriculture sector is a crucial pillar of the Indian economy, contributing significantly to the country's food security, employment, and economic growth. This analysis aims to provide a comprehensive understanding of the agricultural landscape in India, focusing on district-wise and year-wise trends, crop patterns, and regional disparities.

Data Preparation:

The dataset underwent a transformation process using Python to ensure data quality and compatibility with Power BI. During this process, it was observed that approximately five crops, namely fodder, fruits, fruits and vegetables, onion, and potatoes, did not have data on production and yield. While the idea of discarding these columns was considered, they were ultimately retained, as the problem statement emphasized the importance of analyzing fruits and vegetables. However, it is essential to note that these crops only have area data available for analysis.

Data Exploration:

The dataset encompasses a wide range of agricultural variables, including crop areas, production quantities, and yields for various crops such as rice, wheat, sorghum, millets, pulses, oilseeds, and sugarcane. The data spans across multiple districts and years, allowing for a detailed analysis of spatial and temporal patterns.

Python

In [1]:
```
import numpy as np
import pandas as pd
```

In [2]:
```
df = pd.read_csv('ICRISAT_District_Level_Data.csv')
#df.info()
```

In [3]:
```
crop = []
dist_code = []
year = []
state_code = []
state_name = []
dist_name = []
area = []
production = []
yields = []
cols_to_rows = ['RICE', 'WHEAT', 'KHARIF SORGHUM', 'RABI SORGHUM', 'SORGHUM', 'PEARL MILLET', 'MAIZE', 'FINGER MILLET',
                'BARLEY', 'CHICKPEA', 'PIGEONPEA', 'MINOR PULSES', 'GROUNDNUT', 'SESAMUM', 'RAPESEED AND MUSTARD',
                'SAFFLOWER', 'CASTOR', 'LINSEED', 'SUNFLOWER', 'SOYABEAN', 'OILSEEDS', 'SUGARCANE', 'COTTON']

extra_cols = ['FRUITS', 'VEGETABLES', 'FRUITS AND VEGETABLES', 'POTATOES', 'ONION', 'FODDER']
```

In [4]:
```
for i in range(len(cols_to_rows)):
    for j in range(len(df)):
        crop.append(cols_to_rows[i])
        dist_code.append(df['Dist Code'][j])
        year.append(df['Year'][j])
        state_code.append(df['State Code'][j])
        state_name.append(df['State Name'][j])
        dist_name.append(df['Dist Name'][j])
        area.append(df[cols_to_rows[i]+' AREA (1000 ha)'][j])
        production.append(df[cols_to_rows[i]+' PRODUCTION (1000 tons)'][j])
        yields.append(df[cols_to_rows[i]+' YIELD (Kg per ha)'][j])

for i in range(len(extra_cols)):
    for j in range(len(df)):
        crop.append(extra_cols[i])
        dist_code.append(df['Dist Code'][j])
        year.append(df['Year'][j])
        state_code.append(df['State Code'][j])
        state_name.append(df['State Name'][j])
        dist_name.append(df['Dist Name'][j])
        area.append(df[extra_cols[i]+' AREA (1000 ha)'][j])
        production.append('')
        yields.append('')
```

In [5]:
```
df2 = pd.DataFrame({'Plant':crop, 'Dist Code':dist_code, 'Year':year, 'State Code':state_code, 'State Name':state_name,
                    'Dist Name':dist_name, 'Area (1000 ha)':area, 'Production (1000 tons)':production, 'Yield (Kg per ha)':yi
```

Python

In [5]:
```
df2 = pd.DataFrame({'Plant':crop, 'Dist Code':dist_code, 'Year':year, 'State Code':state_code, 'State Name':state_name,
                    'Dist Name':dist_name, 'Area (1000 ha)':area, 'Production (1000 tons)':production, 'Yield (Kg per ha)':yi
```

In [6]:
```
crop_production  = ['RICE', 'WHEAT']

coarse_grains  = ['KHARIF SORGHUM', 'RABI SORGHUM', 'SORGHUM', 'PEARL MILLET', 'MAIZE', 'FINGER MILLET']

pulses  = ['CHICKPEA', 'PIGEONPEA', 'MINOR PULSES']

oilseeds   = ['GROUNDNUT', 'SESAMUM', 'RAPESEED AND MUSTARD', 'SAFFLOWER', 'CASTOR', 'LINSEED', 'SUNFLOWER', 'SOYABEAN', 'OIL

other_crops = ['SUGARCANE', 'COTTON','FRUITS', 'VEGETABLES', 'FRUITS AND VEGETABLES', 'POTATOES', 'ONION', 'FODDER']
```

In [8]:
```
category = []
for i in range(len(df2)):
    if df2['Plant'][i] in crop_production:
        category.append('crop production')
    elif df2['Plant'][i] in coarse_grains:
        category.append('coarse grains')
    elif df2['Plant'][i] in pulses:
        category.append('pulses')
    elif df2['Plant'][i] in oilseeds:
        category.append('oilseeds')
    else:
        category.append('other crops')
```

In [11]:
```
df2['category'] = category
```

In [12]:
```
df2.tail()
```

Out[12]:

	Plant	Dist Code	Year	State Code	State Name	Dist Name	Area (1000 ha)	Production (1000 tons)	Yield (Kg per ha)	category
468229	FODDER	917	2013	15	Jharkhand	Singhbhum	0.0			other crops
468230	FODDER	917	2014	15	Jharkhand	Singhbhum	0.0			other crops
468231	FODDER	917	2015	15	Jharkhand	Singhbhum	0.0			other crops
468232	FODDER	917	2016	15	Jharkhand	Singhbhum	0.0			other crops
468233	FODDER	917	2017	15	Jharkhand	Singhbhum	0.0			other crops

In [13]:
```
df2.to_csv('ICRISAT_data.csv', index = False)
```

In [ ]:
```
```

Indian Agriculture Dashboard

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Summary Overview

1966 - 2017

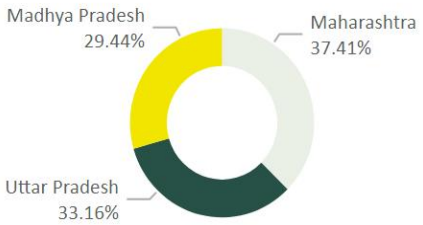
State: All | Type of Crop: All | Crop: All

Total Area (ha)
10,478,231

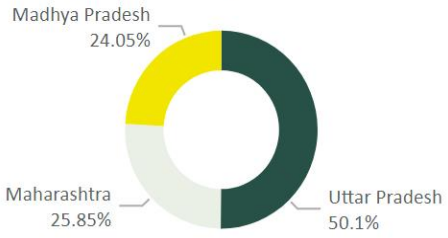
Total Production (tons)
12,369,816

Total Yield (Kg)
271,702,500

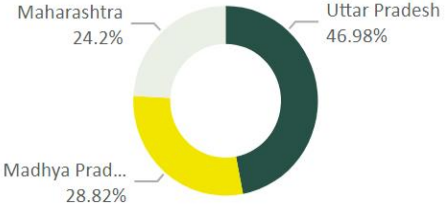
Top 3 State by Area



Top 3 State by Production



Top 3 State by Yield



Production, Yield and Area Trend over the Years

Area Insights

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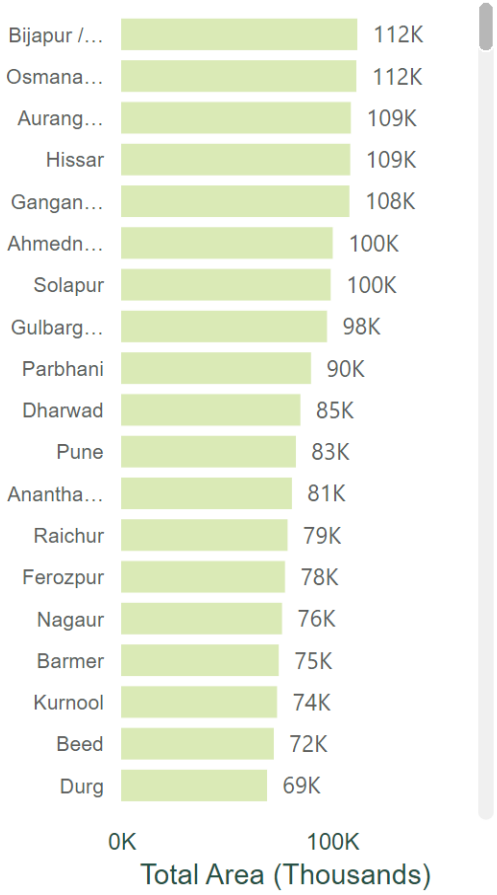
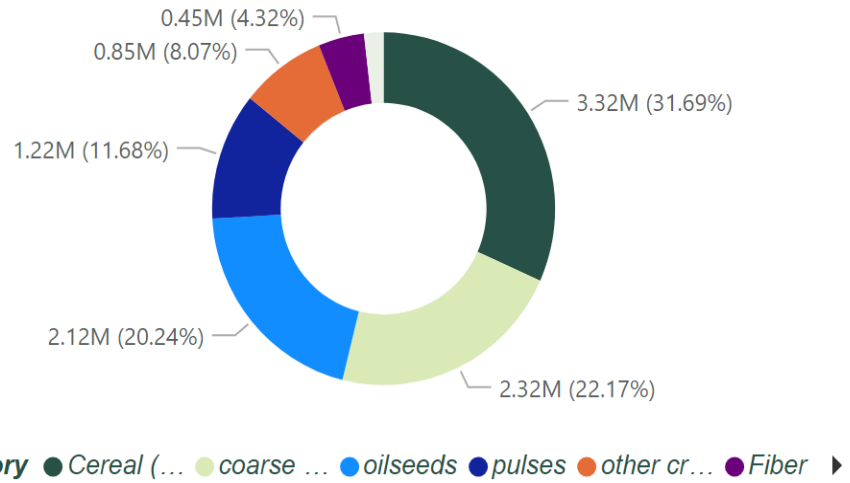
State: All | Type of Crop: All | Crop: All | Year: All

Total Area (ha)
10,478,231

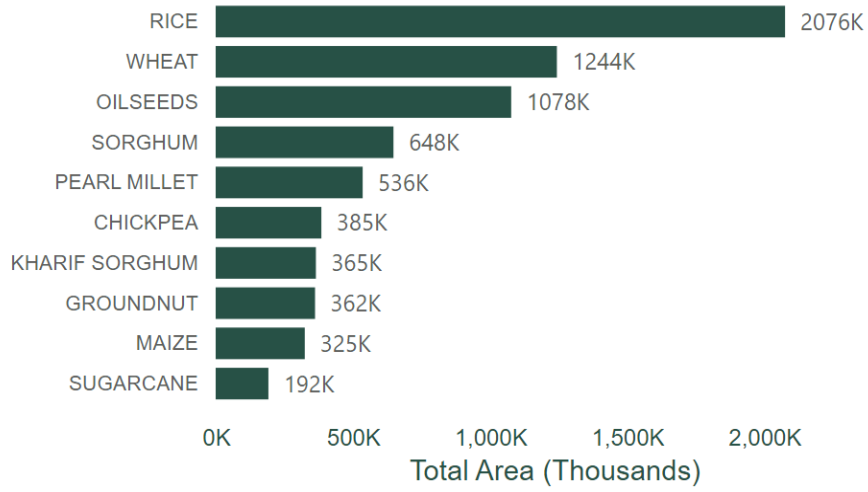
Areaby District



Area by Type of Crop



Top 10 Crop by Area



Production Insights

State: All | Type of Crop: All | Crop: All | Year: All

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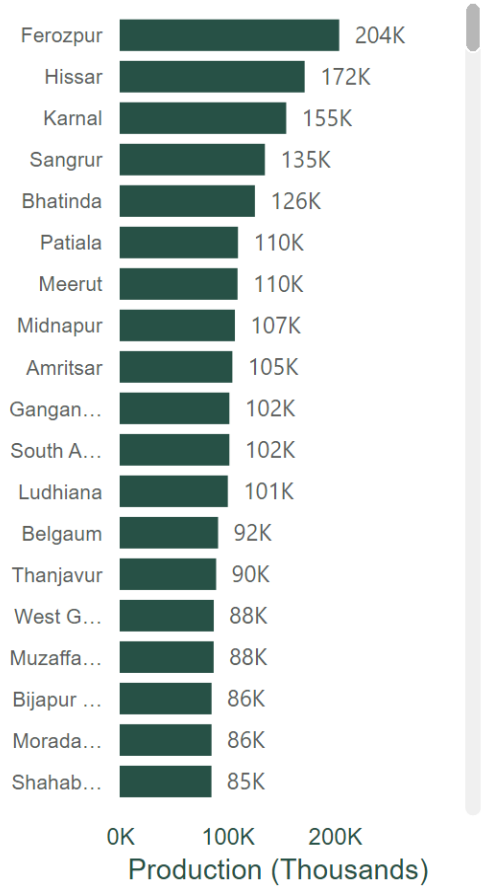
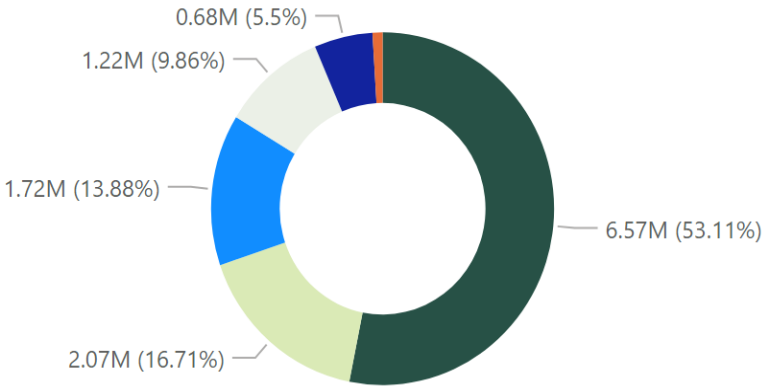
Total Production (tons)
12,369,816

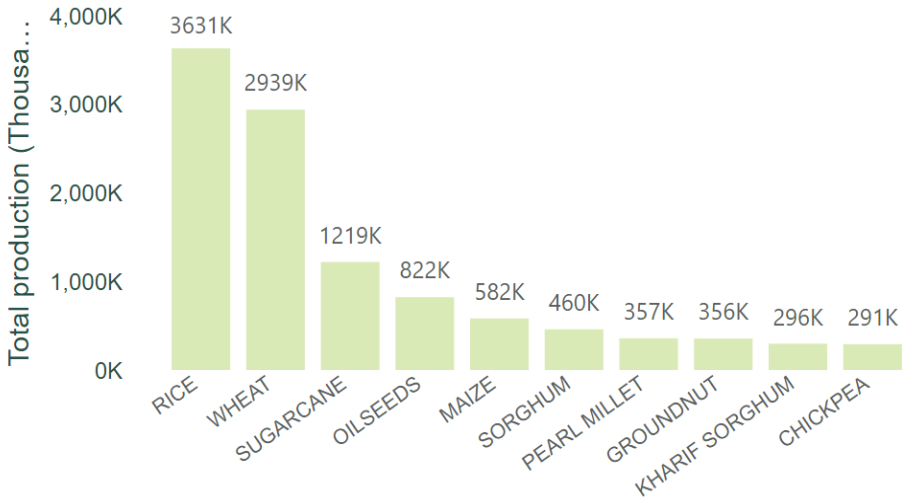
Production by District



Production by Type of Crop



Top 10 Crop by Production



Yield Insights

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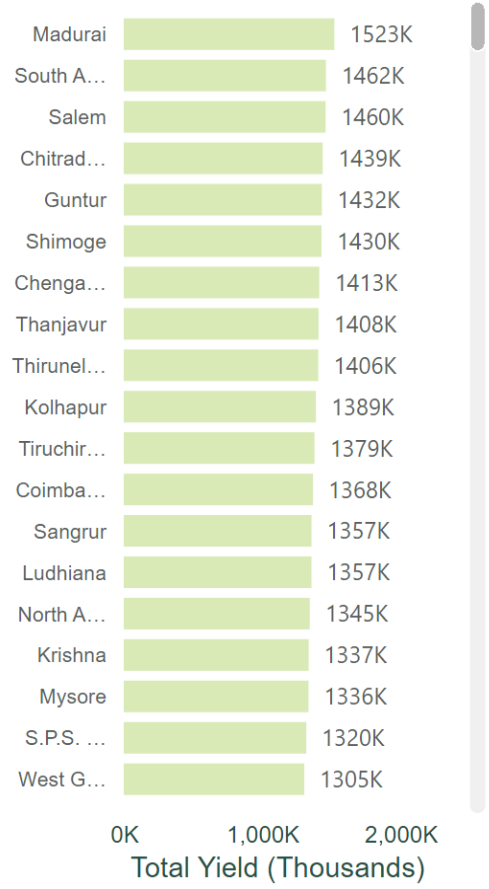
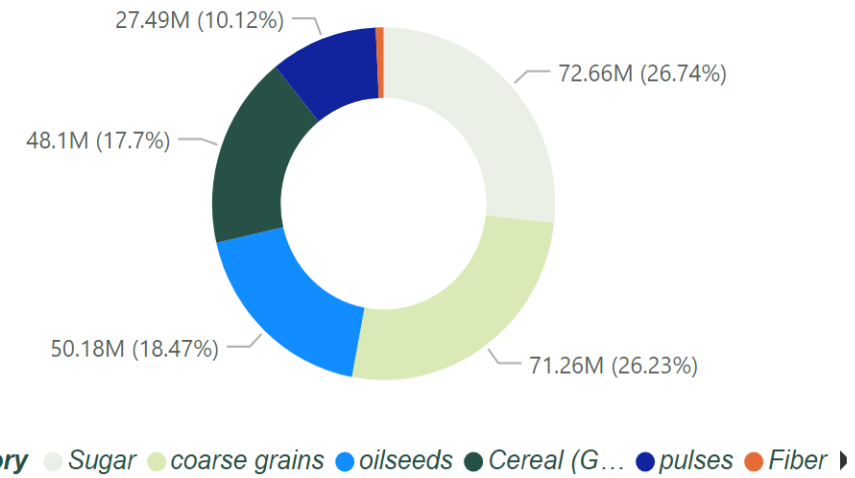
State: All | Type of Crop: All | Crop: All | Year: All

Total Yield(ha)
271,702,500

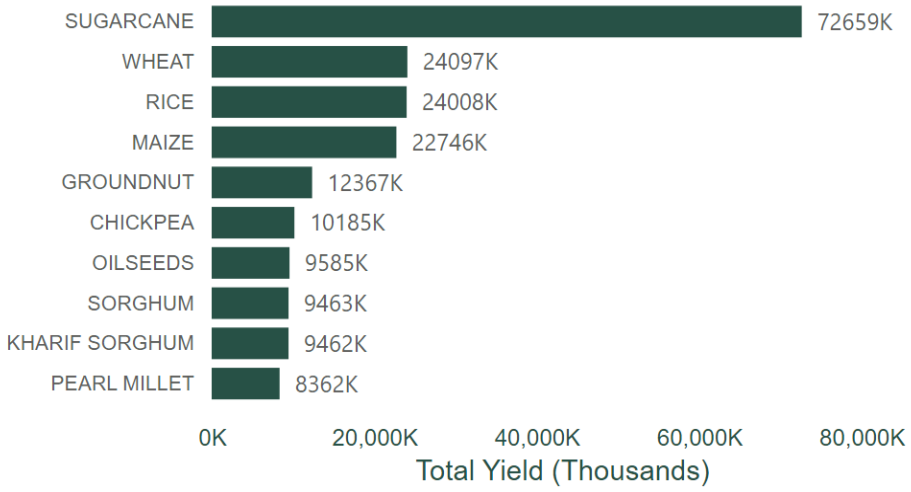
Yield by District



Yield by Type of Crop



Top 10 Crop byYield



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Summary Overview

1966 - 2017

State: All | Type of Crop: All | Crop: All | Year: All

Total Area (ha)
10,478,231

Total Production (tons)
12,369,816

Total Yield (Kg)
271,702,500

Plant	Dist Name	State Name	Total Area (1000 ha)	Total Production (1000 tons)	Total Yield (Kg per ha)	Year
WHEAT	24 Parganas	West Bengal	1.16	1.04	896.55	1966
WHEAT	24 Parganas	West Bengal	2.29	1.98	864.63	1967
WHEAT	24 Parganas	West Bengal	3.92	4.86	1,239.80	1968
WHEAT	24 Parganas	West Bengal	5.43	6.19	1,139.96	1969
WHEAT	24 Parganas	West Bengal	9.09	11.27	1,239.82	1970
WHEAT	24 Parganas	West Bengal	12.37	12.12	979.79	1971
WHEAT	24 Parganas	West Bengal	14.69	20.27	1,379.85	1972
WHEAT	24 Parganas	West Bengal	10.86	13.57	1,249.54	1973
WHEAT	24 Parganas	West Bengal	17.85	31.42	1,760.22	1974
WHEAT	24 Parganas	West Bengal	17.78	26.14	1,470.19	1975
WHEAT	24 Parganas	West Bengal	14.99	25.48	1,699.80	1976
WHEAT	24 Parganas	West Bengal	10.15	23.95	2,359.61	1977
WHEAT	24 Parganas	West Bengal	11.54	19.85	1,720.10	1978
WHEAT	24 Parganas	West Bengal	15.08	21.26	1,409.81	1979
WHEAT	24 Parganas	West Bengal	8.97	14.26	1,589.74	1980
WHEAT	24 Parganas	West Bengal	8.64	12.14	1,405.09	1981
WHEAT	24 Parganas	West Bengal	10.79	24.34	2,255.79	1982
WHEAT	24 Parganas	West Bengal	9.94	27.40	2,756.54	1983
WHEAT	24 Parganas	West Bengal	10.12	25.09	2,479.25	1984
WHEAT	24 Parganas	West Bengal	7.50	16.54	2,205.33	1985
WHEAT	24 Parganas	West Bengal	14.57	34.02	2,334.93	1986
WHEAT	24 Parganas	West Bengal	15.52	32.86	2,117.27	1987
Total			10,478,230.72	12,369,815.51	271,702,499.55	

Analysis - Crop-specific Analysis

Rice: Rice is a staple crop in India, and the analysis reveals that it has the highest production (3631K tons), a significant area under cultivation (2076K ha), and a high yield of 24,008K kg/ha. Districts like Ferozpur, Hissar, and Karnal in Punjab and Haryana are major contributors to rice production.

Wheat: Wheat is another essential crop, with a total production of 2939K tons, an area of 1244K ha, and a yield of 24,097K kg/ha. Districts like Ferozpur, Hissar, and Karnal in Punjab and Haryana are also significant producers of wheat, highlighting their agricultural importance.

Pulses: Pulses play a crucial role in ensuring nutritional security. Chickpea stands out as a major pulse crop, with a total production of 291K tons, an area of 385K ha, and a yield of 10,185K kg/ha. Districts like Guna and Sehore in Madhya Pradesh are notable producers of chickpea.

Oilseeds: Oilseeds, such as groundnut and mustard, are essential for cooking and industrial purposes. The analysis shows that groundnut has a total production of 356K tons, an area of 362K ha, and a yield of 12,367K kg/ha, with districts like Ahmednagar in Maharashtra and Bijapur in Karnataka being major contributors.

Sugarcane: Among the crops analyzed, sugarcane exhibits the highest yield of 72,659K kg/ha. This high yield can be attributed to several factors, including the crop's perennial nature, efficient photosynthesis process, and the ability to accumulate high levels of sucrose in its stem. Additionally, sugarcane cultivation often involves intensive farming practices, such as irrigation and fertilization, which contribute to increased yields.

Analysis - Year-wise Analysis

Year-wise Analysis of Production

The analysis reveals significant year-on-year variations in crop production across different districts and states. For instance, the total production of rice, one of the major crops, fluctuated from 113K tons in 2014 to 99K tons in 2015, representing a decrease of 3.9%. Similarly, wheat production increased from 2,939K tons to 3,072K tons, reflecting a 4.5% increase over the same period.

These variations in production can be attributed to various factors, such as weather conditions, availability of resources (e.g., water, fertilizers), and adoption of modern agricultural practices.

Year-wise Analysis of Area

The area under cultivation for various crops also displayed year-on-year changes. For example, the total area dedicated to rice cultivation decreased from 2,076K hectares to 2,041K hectares, representing a 1.7% reduction. In contrast, the area under wheat cultivation increased from 1,244K hectares to 1,278K hectares, reflecting a 2.7% increase over the same period.

Year-wise Analysis of Yield

Yield, which represents the productivity per unit area, is a crucial metric for assessing agricultural efficiency and resource utilization. The analysis reveals year-wise variations in yield for different crops. For instance, the yield for sugarcane increased from 72,659K kg/hectare to 74,182K kg/hectare, representing a 2.1% increase, while the yield for groundnut decreased from 12,367K kg/hectare to 12,101K kg/hectare, reflecting a 2.2% decrease.

Analysis - Regional Disparities

The analysis reveals significant regional disparities in agricultural practices and outcomes across different districts and states. For instance, Maharashtra (37.41%), Uttar Pradesh (33.16%), and Madhya Pradesh (29.44%) are the top three states in terms of total area under cultivation. However, in terms of production, Uttar Pradesh (50.1%), Maharashtra (25.85%), and Madhya Pradesh (24.05%) take the lead.

These disparities can be attributed to various factors, including soil fertility, irrigation facilities, climatic conditions, and access to agricultural inputs and technology. Identifying these regional variations is crucial for developing targeted strategies and policies to address specific challenges faced by different regions.

Analysis - Seasonal Patterns

The dataset used for an analysis of seasonal patterns in crop cultivation, considering the kharif (monsoon) and rabi (winter) seasons. Certain crops, like kharif sorghum and pearl millet, are predominantly grown during the kharif season, while others, like wheat and mustard, are cultivated during the rabi season. Understanding these seasonal patterns is essential for optimizing resource allocation, such as water management and labor distribution.

Analysis - Impact of External Factors

External factors like weather conditions, rainfall patterns, and climate change can significantly impact crop performance. While this analysis does not delve into specific weather data, it provides a foundation for further investigation into the correlation between environmental factors and agricultural outcomes. By integrating relevant data sources, stakeholders can better understand and mitigate the effects of these external factors on crop yields and production

Analysis - Sustainable Farming Insights

This analysis highlights the need for promoting sustainable farming practices to ensure long-term agricultural productivity and environmental conservation. By identifying regions with low yields or inefficient resource utilization, stakeholders can develop targeted interventions, such as promoting precision agriculture, integrated pest management, and soil conservation techniques. Furthermore, the analysis can inform policymakers on the allocation of resources for research, extension services, and infrastructure development to support sustainable farming practices

Findings and Recommendations

Crop Production Fluctuations

The production of major crops, such as rice, wheat, and sugarcane, exhibited significant year-on-year fluctuations.

For instance, rice production decreased by 3.9% from one year to another, while wheat production increased by 4.5% during the same period. These fluctuations can be attributed to factors like weather conditions, resource availability, and adoption of modern agricultural practices.

Regional Disparities in Crop Cultivation

Substantial regional disparities were observed in the cultivation of various crops across different districts and states.

For example, while Ferozpur district in Punjab experienced a 5.2% increase in rice production, Bijapur district in Karnataka saw a 3.8% decrease in groundnut production over the same period.

These disparities highlight the need for region-specific interventions and strategies.

Yield Variations

The analysis revealed year-wise variations in crop yields, indicating differences in agricultural efficiency and resource utilization. For instance, the yield for sugarcane increased by 2.1%, while the yield for groundnut decreased by 2.2% in a given year. Identifying these yield variations can help target interventions for improving agricultural extension services, access to better inputs, and promoting sustainable farming practices.

Impact of External Factors

External factors, such as weather conditions and soil quality, play a crucial role in influencing agricultural outcomes.

Integrating relevant data sources, such as weather data and soil analysis, can provide a better understanding of the interplay between environmental factors and agricultural productivity.

Recommendations

Targeted Interventions and Resource Allocation

Develop region-specific strategies and interventions to address the disparities in crop cultivation and yields across different districts and states. Allocate resources, such as agricultural inputs, extension services, and infrastructure, based on the identified needs and challenges of each region.

Promote Sustainable Farming Practices

Encourage the adoption of sustainable farming practices, such as precision agriculture, integrated pest management, and soil conservation techniques, to improve yields and resource utilization. Provide training and support to farmers to facilitate the transition towards more sustainable agricultural methods.

Climate-Smart Agriculture

Integrate climate data and forecasting models into agricultural decision-making processes to mitigate the impact of weather fluctuations and climate change on crop production. Invest in research and development of climate-resilient crop varieties and agricultural technologies to enhance adaptation strategies.

Data-Driven Decision Making

Leverage the power of data analytics and visualizations to monitor agricultural trends, identify patterns, and make informed decisions. Encourage collaboration between policymakers, researchers, and farming communities to share knowledge and adopt data-driven approaches for improving agricultural productivity and sustainability.

Crop Diversification and Value Addition

Explore opportunities for crop diversification and the cultivation of high-value crops to enhance economic opportunities for farmers and promote nutritional security. Invest in value addition processes, such as food processing and packaging, to increase the shelf life and marketability of agricultural products.

By these recommendations, stakeholders can address the challenges faced by the Indian agriculture sector, promote sustainable farming practices, and ensure long-term food security and economic growth for the nation.

FANEN SOLOMON IORWUESE

Data Analyst Intern