JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Comprehensive Analysis of Indian Agriculture Sector

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Abstract: The Indian agriculture sector is one of the largest and most diverse in the world playing a vital role in the country's economy and employment. Despite the availability of extensive datasets on crop production, area and regional trends, data visualization still remains limited due to poor accessibility and lack of visualization tools. This study aims to conduct a comprehensive analysis of the Indian Agriculture Sector using Power BI, a powerful business intelligence tool that enables data transformation into interactive and insightful visuals. The study adopts a descriptive and analytical approach to identify the production trends, seasonal patterns and other factors related to agriculture. The findings highlight the potential of Power BI to simplify complex datasets and support data-driven decision-making in agriculture. This research demonstrates the significance of integrating data-analytics in the agriculture sector to enhance planning, monitoring and policy development.

***Keywords* - Agriculture, Business Intelligence, Data Analytics, Power BI.**

I. INTRODUCTION

Agriculture is the backbone of Indian economy supporting all the livelihood, food security and the rural development. With vast regional diversity, crop production in India varies significantly across states, seasons and year. The sector not only contributes to the Gross Domestic Product but also provides employment opportunities to the major portion of the population especially in rural areas. Despite the availability of extensive amounts of data on crop production, areas of cultivation and seasonal patterns where most of the information remains underutilized due to limitations in traditional data analysis methods. These approaches often lack the capability to present the data in an accessible and visually meaningful manner hindering effective interpretation and decision-making. In this context, data visualization tools such as Power BI offers significant potential to bridge this gap. It facilitates the transformation of raw agricultural data into interactive dashboards and reports enabling stakeholders to identify the trends, uncover the insightful insights and make informed decisions.

This study aims to conduct a comprehensive analysis of the Indian agriculture sector using Power BI with the objective of enhancing data usability, promoting evidence-based planning and supporting the overall development of the sector.

II. LITERATURE REVIEW

1. **Amit Kumar et al. (2024)** conducted a study titled “Analysing district-level climate vulnerability pattern in Madhya Pradesh, India, based on agricultural and socio-economic indicators” exploring district-wise vulnerability in Madhya Pradesh, India to the climate change by assessing composite vulnerability index using agricultural vulnerability index and socio-economic vulnerability index. The analysis was done using Mann-Kendall’s test and Sen slope in order to present the vulnerability profile using MATLAB R2023b.The study was to understand how agricultural and socio-economic factors lead to variations in vulnerability across the districts and influence targeted adaptation as well mitigation strategies. The findings from the trend analysis results provided present declining rainfall and inclining temperature from 1951 to 2021 in Madhya Pradesh directly affecting the agriculture sector and human.

2. **Tyagi et al. (2023)** conducted a study titled "Visualization and analysis of key performance indicators for agricultural cold supply chain in Indian context using fuzzy DEMATEL approach," with the objective of identifying critical performance indicators in India's agricultural cold supply chain (ACSC). Drawing from both global and Indian contexts and expert input from supply chain professionals, the authors used fuzzy DEMATEL method to explore the interdependencies and causal relationships among key performance indicators. The findings provided that product waste costs and operational/performance costs were the most influential factors impacting supply chain effectiveness, followed by government policies and cold chain equipment efficiency. Although expert opinion may reflect some regional bias, the study contributes significantly to the optimization of ACSC by offering practical insights into cost management, food security, and farmer profitability.

3. **Liu (2022),** in the study titled "Application of Data Visualization and Big Data Analysis in Intelligent Agriculture," introduced a data-driven framework for enhancing agricultural productivity through visualization and predictive modelling. He proposed a comprehensive data visualization system based on the RadViz method and also employed principal component analysis (PCA) for dimensionality reduction and K-means clustering for data segmentation. Additionally, the study also developed a crop yield prediction model using multiple regression and residual principal component regression algorithms. Experimental results validated the model’s effectiveness, emphasizing the role of big data tools in making agriculture more intelligent, scientific, and efficient.

4. **Badapanda et al. (2022),** in their study "Agriculture Data Visualization and Analysis Using Data Mining Techniques," addressed the problem of improving crop yield prediction through advanced analytics. The authors had used unsupervised learning methods such as K-means clustering and PCA to uncover trends in large agricultural datasets and visualize them using distplot and kernel density estimation (KDE).

   Their framework revealed meaningful patterns in crop production data and suggested its utility in optimizing crop planning decisions, especially for agricultural policymakers and planners.

5. **Rajkumar et al. (2020)** conducted a web-based agricultural visualization tool in their study "Intelligent Smart Farming and Crop Visualization." The system provides district-level insights on crop types, area, and productivity to aid farmers in selecting appropriate crops. Though it doesn't use IoT devices or real-

time data, it leverages historical data to support informed decision-making. The platform is designed as a low-cost, accessible solution for enhancing planning efficiency in Indian agriculture amid challenges like climate variability and rising demand.

III. OBJECTIVES

- To understand seasonal patterns in cultivation of crops across India.
- To analyze whether crop production varies across different states.
- To evaluate the differences in average crop production across different crop years.

IV. HYPOTHESES

- H_0: There is no significant variation in types of crops cultivated across different seasons.
  H_1: There is significant variation in types of crops cultivated across different seasons.
- H_0: There is no difference in crop production across different states.
  H_1: There is difference in crop production across different states.
- H_0: There is no difference in average crop production across crop years.
  H_1: There is difference in average crop production across crop years.

V. METHODOLOGY

Quantitative research was conducted. The study is based entirely on secondary data obtained from available sources. The data was compiled and organized in spreadsheets. Descriptive statistical methods were applied to analyze the data. Power BI tool was used to clean, transform and analyze the data for inconsistencies. It was also used to generate visualizations and interactive dashboards. These visual tools helped in effectively presenting key trends and insights related to the study.

VI. LIMITATIONS OF THE STUDY

- The study does not include the influence of government policies, subsidies, or crop market prices.
- Basic variables like crop, season, district, year, production, and area were used leaving other important factors like rainfall, irrigation, or soil type.
- This study is based entirely on the secondary data which may have gaps or inconsistencies.

VII. DATA ANALYSIS AND INTERPRETATION

Hypothesis 1 Testing:

The below table titled "Crop Distribution across Seasons" illustrates the cultivation for the top 10 crops across six distinct agricultural seasons: Kharif, Rabi, Summer, Whole Year, Autumn, and Winter.

Table 1: Crop Distribution across Seasons

Crop	Autumn	Kharif	Rabi	Summer	Whole Year	Winter	Total
Arhar/Tur	18	6798	447	28	256	31	**7578**
Groundnut	379	5359	1116	1446	276	258	**8834**
Maize	934	7320	2735	2522	240	196	**13947**
Moong (Green Gram)	190	5577	1943	2064	209	335	**10318**
Rapeseed & Mustard		110	6978		120	384	**7592**
Rice	2091	6878	797	2956	128	2254	**15104**
Sesamum	312	6493	539	552	712	438	**9046**
Sugarcane	6	1159	13	2	6297	444	**7921**
Urad	291	5947	1872	1158	173	409	**9850**
Wheat		7	7520	300	55	17	**7899**
Total	**4221**	**45648**	**23960**	**11028**	**8466**	**4766**	**98089**

The above table clearly shows that crop production varies significantly by season. Maize, rice, arhar/tur and sesamum are among the 45,648 crops that are most prominently grown during the Kharif season. Wheat, Rapeseed and Mustard, Maize are commonly grown during Rabi season. High activity is also seen in the summer, especially with rice, maize, and moong. Conversely, Autumn and Winter have relatively low crop counts, though crops like Rice, Maize, and Sesamum are still present. Sugarcane is mostly cultivated crop under Whole Year. Overall, Rice and Maize are the most consistently cultivated crops across seasons. This clearly indicate that cultivation of crops is season-dependent with distinct sets of crops dominating specific seasons based on agronomic and climatic conditions. Thus, this analysis strongly supports rejection of null hypothesis and validates alternative hypothesis.

Hypothesis 2 Testing:

The below chart titled "Total Production by Crops and States" illustrates the percentage contribution of the top five Indian states Kerala, Andhra Pradesh, Tamil Nadu, Uttar Pradesh, and Assam to the overall production of the top five crops: Coconut, Sugarcane, Rice, Wheat, and Potato.

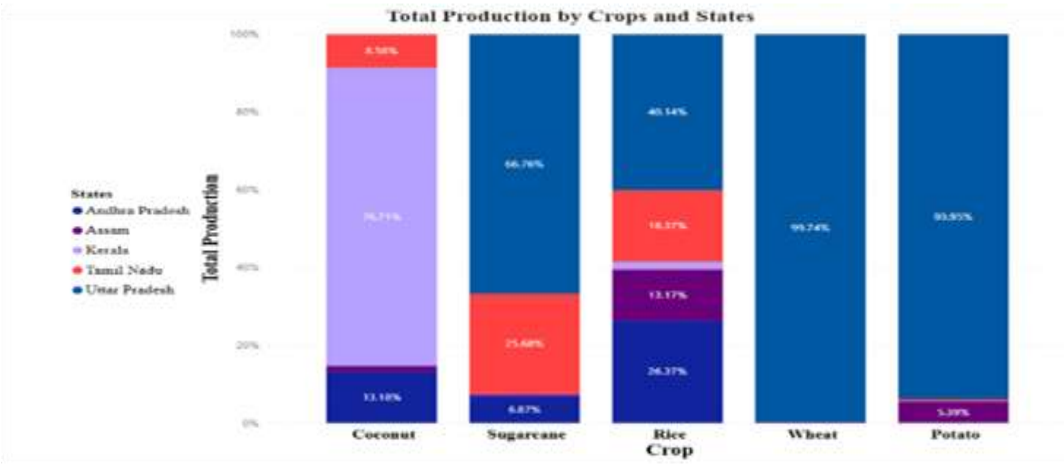

Figure 1: Total Production by Crops and States

From the above chart it clearly indicates that crop production is not evenly distributed across the states which supports the alternative hypothesis. Kerala has a high regional domination, accounting for about 76.71% of the overall coconut production. In a comparable pattern, Tamil Nadu (25.68%) and Uttar Pradesh (66.76%) produce the most sugarcane. While more states share production of rice, Uttar Pradesh (40.14%) and Andhra Pradesh (26.37%) make the largest contributions indicating differences between regions even among staple crops. The distribution becomes even more concentrated for Wheat and Potato where Uttar Pradesh alone accounts for 99.74% and 93.95% respectively. This distribution highlights regional specialization in agriculture. Certain states are clearly more productive in specific crops than others. Hence it effectively supports the objective of analyzing crop distribution across states and provides visual evidence to accept the alternative hypothesis that there is a difference in crop production across different states.

Hypothesis 3 Testing:

The below chart titled "Average Production by Crop Year" illustrates the trend of agricultural production in India from around 1997 to 2015.

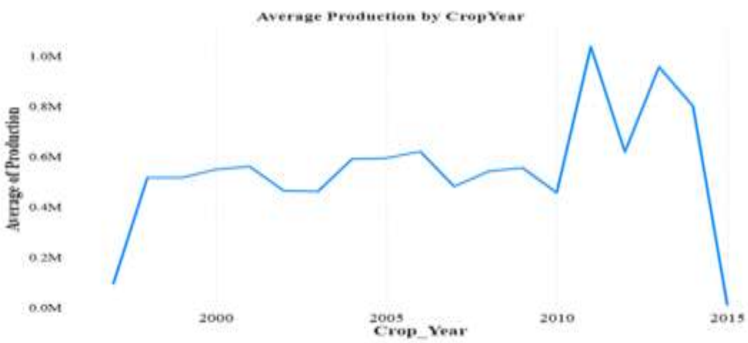

Figure 2: Average Production by Crop Year

From the above chart it is clear that from 1997 to 2002, average production saw initial rise followed by a period of relative stability with minor fluctuations. Production had a significant increase from 2004 to 2006 followed by a decline and eventual recovery. According to the above graph, average production peaked about 2011 then fell abruptly in 2012, recovered and peaked again around 2014, and then fell abruptly to its lowest point by 2015 which shows considerable variations in output throughout time. These variations suggest that crop production has not remained consistent year over year. Thus, based on this visual evidence, we can reject the null hypothesis and accept the alternative that there is a significant difference in average crop production across crop years.

FINDINGS

The following are the key findings from the comprehensive analysis of Indian agricultural data using Power BI:

- Crop cultivation in India shows clear seasonal variation, with Kharif having the highest (Maize, rice, arhar/tur and sesamum), while Rabi and Summer also feature frequent cultivation of crops like Moong, Maize, and Rice.
- Sugarcane is mostly grown all year round, with comparatively less activity in the autumn and winter.

- Maize and rice are the most commonly produced crops in every season, showing how crop choice is influenced by seasonal climate conditions.
- States' share in agricultural output is unequal, with some clearly dominating in particular crops, such as Kerala in coconut (76.71%) and Uttar Pradesh in sugarcane (66.76%), wheat (99.74%), and potatoes (93.95%).
- This pattern illustrates that regional specialization in agriculture supporting alternative hypothesis and demonstrating that crop output varies significantly between states which is consistent with the objective of studying regional crop distribution.
- Average crop production has fluctuated significantly over the years, with noticeable peaks around 2006, 2011, and 2014, and sharp declines in 2012 and 2015, indicating inconsistency in year-to-year production trends.

SUGGESTIONS

- By giving farmers timely support and guidance, encourage them to plant crops that are suitable for each season.
- By enhancing market accessibility, processing, and storage, states may concentrate on the products they cultivate best.
- To manage fluctuations in productivity, use early warning systems, insurance, and climate-smart farming.

CONCLUSION

The comprehensive analysis of the Indian agriculture sector using Power BI provides critical insights into different factors like crops cultivated in different states, production and area of different crops cultivated and the seasons in which these crops were grown. The insights provide regarding crops been grown across different seasons, total production across states and average production across different crop years. It provides the opportunities of how the land can be used efficiently, optimization of resources contributing to long term agricultural resilience and better planning. The advanced tools and technologies can be used for analyzing larger data.

REFERENCES

[1] Kunal Badapanda, D. P. (2022, February). Agriculture data visualization and analysis using data mining techniques: application of unsupervised machine learning. TELKOMNIKA Telecommunication Computing Electronics and Control, 20, 98-108. doi:10.12928/TELKOMNIKA.v20i1.18938

[2] Neeraj Kumar, M. T. (2023, July). Visualization and analysis of key performance indicators for agricultural cold supply chain in Indian context using fuzzy DEMATEL approach. Journal of Agribusiness in Developing and Emerging Economies. doi:10.1108/JADEE-10-2022-0223

[3] Liu, W. (2022, December). Application of Data Visualization and Big Data Analysis in Intelligent Agriculture. Journal of Computing and Information Technology, 251-263. doi:10.20532/cit.2021.1005390

[4] Amit Kumar, A. K. (2024, June). Analysing district-level climate vulnerability pattern in Madhya Pradesh, India based on agricultural and socio-economic indicators. Environment Monitoring & Assessment. doi :10.1007/s10661-024-12646-7

[5] Rajkumar Rajasekaran, R. A. (2020, November). Intelligent Smart Farming and Crop Visualization. Independent Journal of Management & Production, 11. doi:10.14807/ijmp. v11i9.1420

[6] Kumar, P. (n.d.). Indian crop production-state wise [Dataset]. Data World. https://dataworld/thatzprem/agriculture-india

[7] Abhinand. (n.d.). Crop production in India [Dataset]. Kaggle. https://www.kaggle.com/datasets/abhinand05/crop-production-in-india