Journal of Social Sciences
ISSN – 2984-9691, Vol 04, Issue 03, 42-49

Temporal Trends and Spatial Variations in Cropping Patterns of Haryana (2011–2026)

Sushma[1], Ramphul[2]
Research scholar IMSAR Mdu Rohtak[1], IMSAR Mdu Rohtak[2]

ABSTRACT
The present study, entitled "Temporal Trends and Spatial Variations in Cropping Patterns of Haryana (2011–2026)," examines changes in crop cultivation over time and across districts of Haryana. Cropping patterns are influenced by agro-climatic conditions, soil characteristics, irrigation facilities, technological advancements, market demand, government policies, and farmers' socioeconomic conditions. The study aims to analyse temporal trends in the area and relative share of major crops, examine district-level variations, and assess changes in crop concentration and diversification. It is based on secondary data obtained from official agricultural statistics, the Statistical Abstract of Haryana, the Department of Agriculture and Farmers Welfare, and relevant government reports and research publications. Percentage share, absolute and percentage change, compound annual growth rate, and crop diversification indices are proposed to analyse changes in cropping patterns. Preliminary figures for 2010–11 to 2024–25 indicate an increase in paddy and oilseed areas, a modest increase in wheat area, and declines in cotton and sugarcane areas. Spatial variations reveal the importance of rice–wheat cultivation in northern and central Haryana, while cotton, pearl millet, mustard, and wheat are significant in western, south-western, and southern districts. The study also highlights the growing importance of crop diversification, groundwater conservation, and sustainable agricultural practices. It emphasizes the need for region-specific agricultural planning and effective policy interventions to promote resource-efficient and economically viable cropping systems. The findings are subject to verification against consistent official data, particularly for the latest years of the study period.
Keywords: Cropping patterns, temporal trends, spatial variations, crop diversification, crop concentration, Haryana, district-level analysis, agricultural sustainability, groundwater management.

I. INTRODUCTION

Agriculture plays a significant role in India's economic development by providing employment, ensuring food security, and supplying raw materials to agro-based industries. Despite the growing contribution of the industrial and service sectors, agriculture remains an important source of livelihood for a substantial proportion of the rural population. Cropping patterns, which indicate the distribution of cultivated land among different crops, are important indicators of agricultural development. They are influenced by climatic conditions, soil characteristics, irrigation facilities, technological advancements, market demand, government policies, and farmers' socioeconomic conditions.

Haryana is one of India's important agricultural states, where the adoption of modern agricultural technology, irrigation facilities, high-yielding varieties, and government procurement systems has contributed to the development of intensive farming. Wheat and rice constitute the dominant components of the state's agricultural system, while mustard, cotton, pearl millet, pulses, and sugarcane also contribute to regional agricultural diversity. However, the increasing pressure on groundwater resources, changing climatic conditions, rising cultivation costs, and environmental concerns have created a need to examine changes in cropping patterns and promote sustainable agricultural practices.

Several researchers have examined the transformation of agricultural systems and crop diversification in Haryana. Singh (1976), in *Agricultural Geography*, provided a geographical foundation for understanding agricultural land use and the factors influencing the distribution of crops. Building on the regional perspective of agricultural geography, Pinki et al. (2013) examined crop diversification patterns in Haryana, highlighting the importance of regional differences in agricultural development. Similarly, Bhatia et al. (2020) analysed the extent of crop diversification in the state, providing an empirical basis for understanding changes in crop distribution and agricultural specialization.

More recent research has focused on the relationship between crop diversification, farming practices, and environmental sustainability. Kumar and Jaglan

(2022) investigated crop diversification among organic and conventional farmers in Haryana and highlighted differences in diversification associated with farming practices and agricultural conditions**.** Chahal and Kumar (2024) examined changes in crop diversification at the district level, demonstrating the importance of geographical variations in understanding agricultural transformation. Their work provides a useful foundation for analysing spatial differences in cropping patterns across Haryana.

The sustainability of dominant cropping systems has also received considerable attention. Poswal et al. (2015) examined the sustainability of the rice–wheat cropping system through natural resource management in Haryana, emphasizing the importance of resource conservation in intensive agriculture**.** Chikkalaki et al**. (2023)** focused on assessing the sustainability of the rice–wheat cropping system, while Bagaria and Jatav (2025) examined the growth dynamics and sustainability of major crops in Haryana using agricultural growth and instability measures. These studies highlight the need to consider crop-area changes alongside resource-use efficiency and the long-term sustainability of agricultural production.

The period from 2011 to 2026 is particularly relevant for examining recent changes in Haryana's agricultural landscape. During these years, agricultural development has increasingly intersected with concerns about groundwater depletion, climate variability, changing input costs, market fluctuations, and the promotion of crop diversification. Although wheat and rice continue to dominate large parts of the state, the role of alternative crops, including oilseeds, pulses, and millets, is important for evaluating opportunities to improve resource-use efficiency and agricultural sustainability.

Temporal analysis helps identify changes in the area and relative share of individual crops over time, whereas spatial analysis reveals variations in crop distribution and specialization among districts. Combining these approaches makes it possible to identify crops gaining or losing importance, examine regional concentration, and assess the extent of agricultural diversification. Official publications such as the *Statistical Abstract of Haryana* and agricultural statistics published by the Government of India provide important sources of data for undertaking such an analysis.

Despite the contribution of previous studies to understanding crop diversification, agricultural sustainability, and regional agricultural differences, there remains scope for an integrated assessment of temporal trends and district-level spatial variations over the period 2011–2026. In particular, a systematic analysis using comparable annual and district-wise crop-area data can help clarify the changing importance of major crops and the relationship between agricultural specialization and diversification.

Against this background, the present study, entitled "Temporal Trends and Spatial Variations in Cropping Patterns of Haryana (2011–2026)," examines changes in the area and relative share of major crops across the state. It seeks to analyse temporal trends in crop cultivation, investigate district-level variations, and assess changes in crop concentration and diversification. The study is expected to contribute to a better understanding of agricultural transformation in Haryana and provide insights for region-specific agricultural planning, groundwater conservation, and the promotion of economically viable and environmentally sustainable cropping systems. The analysis of the latest years will depend on the availability and verification of consistent official agricultural statistics.

II. Review of Literature

The review of literature provides a theoretical and empirical foundation for understanding temporal changes and spatial variations in Haryana's cropping patterns. Previous studies have examined crop diversification, agricultural specialization, irrigation, and environmental sustainability. The present review focuses on these aspects, particularly during 2011–2026.

Kebebe et al. (2006), in *Structural Changes in Haryana Agriculture and Crop Diversification*, examined changes in agricultural resources and cropping patterns using time-series data and compound growth rates. The study associated shifts towards rice, wheat, cotton, and rapeseed–mustard with irrigation, mechanization, and modern agricultural inputs. However, it focused on an earlier period rather than district-level changes during 2011–2026.

ICAR's agricultural research framework highlights the dominance of rice–wheat, cotton–wheat, and pearl millet–wheat systems in Haryana. It identifies groundwater depletion, soil salinity, and declining

soil health as major challenges, emphasizing crop diversification and resource conservation.

Chahal and Kumar (2024), in *Changes in the Patterns of Crop Diversification in Haryana*, analysed district-level diversification for 2011, 2015, and 2021 using the Gibbs–Martin Index and geographical mapping. The study found higher diversification in districts such as Bhiwani and Mahendragarh, while Kaithal, Karnal, and Jind showed comparatively lower diversification. However, it did not provide a continuous annual analysis for 2011–2026.

Kumar and Jaglan (2022), in *Crop Diversification Pattern in Haryana: A Comparative Study of Organic and Inorganic Farmers*, studied 234 farm households using the Doi method and Herfindahl Index. The findings showed that organic farmers generally practised greater diversification than conventional farmers. The study also highlighted regional differences associated with irrigation and agro-ecological conditions.

Kumar and Singh (2022), in *The Perspective of Climate-Smart Agricultural Practices in the Rice-Wheat Cropping System in Haryana, India*, examined climate-smart farming practices using primary and secondary data. The study highlighted groundwater depletion, excessive agrochemical use, and soil degradation associated with intensive rice–wheat cultivation. It emphasized conservation practices and sustainable agricultural management.

The Indian Council of Agricultural Research (ICAR) emphasizes efficient irrigation, soil conservation, and diversification towards less water-intensive crops. Its research highlights the importance of water availability and soil conditions in shaping regional cropping patterns and agricultural sustainability.

Bagaria and Jatav (2025), in *Growth Dynamics and Sustainability of Major Crops in Haryana, India*, examined crop area, production, productivity, and instability using growth rates, decomposition analysis, and the Cuddy–Della Valle Index. The study reported continued growth in wheat and rice production, declining gram and cotton production, and improvements in bajra and rapeseed–mustard after 2015. It emphasized crop diversification and better water management.

Ranga (2024), in *Crop Diversification in the Agriculture Sector: A Study of Haryana*, analysed diversification trends from the late 1960s to 2022–23 using the Simpson Index. The study identified a shift towards wheat–rice specialization, followed by renewed diversification in selected crops. It also highlighted the influence of environmental pressures, markets, and government policies on farmers' crop choices.

The research programme on Pattern and Extent of Crop Diversification in Haryana (2013–2016) examined cropping systems across agricultural zones using secondary data. It identified paddy–wheat dominance in several northern and central districts, cotton–wheat systems in Hisar and Sirsa, and greater importance of oilseeds and pulses in parts of southern Haryana. The findings emphasized regional differences in agricultural specialization.

The Haryana Water Resources Atlas 2025 provides geographical information on cropping intensity and crop distribution in relation to water resources. Such official sources help explain the relationship between irrigation, environmental conditions, and agricultural land use and support the analysis of cropping-pattern changes during 2011–2026.

III. Research Objectives

To strengthen the introduction, you can include the following objectives in a separate section of your paper:

- To analyse temporal trends in the area and relative share of major crops in Haryana from 2011 to 2026.
- To examine spatial variations in cropping patterns across the districts of Haryana.
- To identify changes in crop concentration, specialization, and diversification during the study period.

Research Gap

The reviewed literature highlights significant changes in Haryana's cropping patterns driven by irrigation, mechanization, crop specialization, and environmental pressures. Previous studies have examined crop diversification, regional differences, and agricultural sustainability; however, a comprehensive analysis integrating temporal trends and district-level spatial variations during 2011–2026 remains relevant.

The present study addresses this gap by analysing crop-wise area, relative crop shares, and district-level variations to identify emerging trends in agricultural specialization and diversification. It aims to provide insights for regional agricultural planning, efficient resource management, and sustainable agricultural development, subject to the

availability of reliable official data for the latest years.Research Methodology

Research Design

The study adopts a quantitative, descriptive, and analytical research design to examine temporal trends and spatial variations in cropping patterns in Haryana during 2011–2026. It uses secondary agricultural data, statistical techniques, and district-level comparisons to analyse changes in crop area, relative crop shares, concentration, and diversification.

Study Area

The study covers the entire state of Haryana, northern India. The state has diverse agro-climatic conditions, irrigation facilities, and farming systems, resulting in regional variations in crop cultivation. Major crops include wheat, rice, mustard, cotton, pearl millet (bajra), sugarcane, and gram. Districts serve as the principal units of spatial analysis.

Period of the Study

The study covers 2011–2026 to examine recent changes in cropping patterns. Agricultural-year data, preferably from 2011–12 to 2025–26, are used wherever available. Provisional or unavailable data for the latest years are acknowledged, and analysis is restricted to reliable, comparable observations.

Sources of Data

The study relies on secondary data collected from the following sources:

- Statistical Abstract of Haryana.
- Department of Agriculture and Farmers Welfare, Haryana.
- Directorate of Economics and Statistics, Haryana.
- Government of India agricultural statistics and reports.
- Agricultural research publications, ICAR reports, and official district maps.

The main variables include crop-wise area, gross cropped area, net sown area, production, productivity, and district-level crop distribution.

Data Collection and Classification

Crop-wise and district-wise data are compiled into a structured database and classified into cereals, pulses, oilseeds, fibre crops, commercial crops, and other crops. Major crops are also analysed individually. Data are checked for missing values, inconsistencies, and changes in administrative boundaries to ensure comparability across years and districts.

Methods of Data Analysis

The following statistical techniques are used to examine temporal and spatial changes in cropping patterns.

- **Percentage Share of Crops**

The relative importance of each crop is calculated using:

Si=AiGCA×100*Si=GCAAi*×100

Where Ai*Ai* is the area under crop i*i*, and GCA is the gross cropped area.

- **Absolute and Percentage Change**

Changes in crop area between the initial and final years are measured using:

ΔA=At−A0Δ*A=At−A*0

PC=At−A0A0×100*PC=A*0*At−A*0×100

Where A0*A*0 and At*At* represent crop area in the initial and final years.

- **Compound Annual Growth Rate (CAGR)**

CAGR measures the average annual growth or decline in crop area:

CAGR=[(AtA0)1/n−1]×100*CAGR=A*0*At*

1/*n*−1×100

Where n*n* is the number of years between observations.

- **Presentation of Data**

The findings are presented through tables, line graphs, bar charts, and thematic maps. These illustrate changes in crop area, growth rates, crop diversification, and district-level variations during the study period.

4. Results and Discussion

- **Temporal Trends in Cropping Patterns in Haryana (2011–2026)**

The temporal analysis of cropping patterns in Haryana highlights changes in the relative importance of major crops during the study period. Wheat and rice dominate the state's agriculture, supported by irrigation, mechanization, high-yielding varieties, and procurement systems. Other important crops include mustard, cotton, pearl millet, sugarcane, and pulses.Changes in cropping patterns are influenced by production costs, water availability, market demand, technology, and government policies. The analysis compares crop-wise cultivated area and percentage share to identify crops that have expanded, declined, or maintained their importance during the study period.

- **Changes in the Area Under Major Crops**

Wheat

Wheat is one of the principal crops of Haryana and plays a vital role in the state's agricultural economy. Its cultivation is supported by irrigation, mechanization, and well-developed procurement systems. The analysis for 2011–2026 should examine changes in area, percentage share, production, and productivity, along with district-level variations. Its importance should also be considered in relation to the sustainability of rice–wheat cropping systems.

Rice

Rice is an important crop in Haryana, particularly in irrigated districts where rice–wheat cultivation is common. Its distribution depends on water availability, soil conditions, irrigation, and market facilities. The study should analyse changes in rice area and percentage share from 2011 to 2026, with special attention to district-level variations and groundwater sustainability.

Mustard and Other Oilseeds

Mustard is an important oilseed crop in Haryana, influenced by climatic conditions, market prices, and production costs. The study should examine changes in its cultivated area and percentage share during 2011–2026. These trends can help assess crop diversification and the role of oilseeds in sustainable agriculture.

Cotton

Cotton is an important commercial crop in western and south-western Haryana. Its cultivation depends on climate, irrigation, pest management, and market prices. The analysis should identify changes in cotton area and percentage share during the study period, highlighting district-level variations and shifts in commercial agriculture.

Pearl Millet, Pulses, and Other Crops

Pearl millet, pulses, and other crops contribute to agricultural diversity in Haryana. Their cultivation is influenced by rainfall, soil conditions, irrigation, and market opportunities. The study should examine changes in their cultivated area and percentage share between 2011 and 2026 to understand regional cropping patterns and the potential for crop diversification.

Table 1. Changes in the area under principal crops in Haryana

Crop / indicator	2010–11	2024–25	Change (%)
Wheat	2,504	2,568	+2.56%
Paddy (rice)	1,243	1,837	+47.79%
Sugarcane	85	72	−15.29%
Cotton	493	398	−19.27%
Oilseeds	521	706	+35.51%
Gross area sown	6,499	6,683	+2.83%

Source: Haryana Economic Survey 2025–26

Area in thousand hectares; percentage change calculated from 2010–11 to 2024–25.

Interpretation

The figures indicate a substantial increase in the area under paddy and oilseeds between 2010–11 and 2024–25, while wheat showed a comparatively modest increase. Cotton and sugarcane recorded declines over the same period. These changes suggest that the relative importance of individual crops has evolved unevenly rather than through a uniform expansion of all agricultural crops.

The increase in paddy area is particularly relevant to discussions of groundwater sustainability, while the rise in oilseed area warrants further investigation in relation to crop diversification. However, these figures alone do not establish the causes of the changes.

Spatial Variations in Cropping Patterns Across Districts

District-level cropping patterns in Haryana vary due to differences in climate, soil, irrigation, and groundwater availability. Therefore, district-wise analysis is essential for understanding regional agricultural variations.

North-eastern and central Haryana: Karnal, Kurukshetra, Kaithal, Panipat, and Sonipat are important for rice–wheat cultivation.

Western and south-western Haryana: Sirsa, Hisar, Bhiwani, and Fatehabad are relevant for cotton, pearl millet, and wheat.

Southern Haryana: Mahendragarh and Rewari are important for mustard, pearl millet, and diversified cropping systems.

Comparing district-level crop areas and percentage shares from 2011 to 2026 can identify regional crop specialization and changes in agricultural land use.

Thematic maps for selected years can further show whether these changes are widespread or concentrated in specific districts.

Table 2. District-level spatial variations

The Haryana Water Resources Atlas 2025 provides district-level cropping data for 2023–24,

Calculated concentration ratios, 2023–24				
District	Wheat area (ha)	Mustard area (ha)	Wheat ratio (%)	Mustard ratio (%)
Karnal	1,88,990	4,480	97.68	2.32
Kurukshetra	1,10,280	5,780	95.02	4.98
Sirsa	2,86,160	78,820	78.41	21.59
Hisar	2,46,930	78,820	75.8	24.2
Bhiwani	98,430	1,61,600	37.85	62.15
Mahendragarh	29,730	1,13,920	20.7	79.3

Crop Concentration and Diversification

Table 3. Crop diversification and concentration

Indicator	2010–11	2024–25	Interpretation
Wheat area share (%)	38.53%	38.43%	Wheat contributed more to crop concentration than paddy.
Paddy area share (%)	19.13%	27.49%	Paddy's contribution increased substantially, while wheat's contribution declined slightly.
Herfindahl Index	18.51	22.33	the combined HHI contribution increased by 20.64%, mainly due to the increased contribution of paddy
Diversification Index (1 − H)	0.8149	0.7767	The diversification index decreased, reflecting an increase in the combined HHI contribution of wheat and paddy.

IV. Conclusion

The study, entitled *"Temporal Trends and Spatial Variations in Cropping Patterns of Haryana (2011–2026),"* examines changes in crop cultivation over time and across districts. Cropping patterns in Haryana are influenced by agro-climatic conditions, irrigation facilities, technological advancements, market demand, government policies, and farmers' decisions. Their analysis helps understand agricultural transformation and identify opportunities for sustainable development.

Haryana's agriculture has traditionally been dominated by wheat and rice, supported by irrigation, mechanization, and established procurement systems. The preliminary figures examined in this study indicate variations in crop-wise cultivated area, with increases reported in paddy and oilseeds, a decline in cotton and sugarcane, and a relatively modest increase in wheat between 2010–11 and 2024–25. These trends suggest changes in agricultural land use, although their extent should be confirmed through consistent official statistics.

Spatial analysis highlights significant regional differences in cropping patterns. Northern and central Haryana are important for rice–wheat cultivation, while western and south-western districts support crops such as cotton, pearl millet, mustard, and wheat. These variations reflect differences in soil, rainfall, irrigation, groundwater availability, and market access. District-level comparisons are therefore essential for identifying regional crop specialization, concentration, and diversification.

The study also emphasizes the importance of sustainable agricultural development. Intensive cultivation of water-intensive crops can increase pressure on groundwater resources, making efficient water management and suitable crop diversification important priorities. However, diversification requires remunerative prices, reliable markets, appropriate technology, and effective government support to ensure economic benefits for farmers.

From a policy perspective, the findings highlight the need for region-specific agricultural planning, groundwater conservation, soil management, and promotion of suitable alternative crops. Regular monitoring of crop-wise and district-wise statistics can further strengthen agricultural planning and policy implementation.

In conclusion, the study provides a framework for understanding the temporal and spatial transformation of Haryana's cropping patterns during 2011–2026. Integrating crop-area trends with district-level analysis helps assess changes in agricultural land use and the potential for diversification. However, final conclusions must be based on verified official data, using the latest available figures where complete data for 2025–26 are unavailable. Future research incorporating groundwater conditions, climatic variations, crop prices, and farmers' decisions would provide deeper insights into these changes and support the development of a productive, diversified, and environmentally sustainable agricultural system in Haryana.

V. References

[1] The following sources are relevant to the literature review. Verify the complete bibliographic details and citation style required by your university or journal before submission.

[2] Bagaria, N., & Jatav, S. S. (2025). *Growth dynamics and sustainability of major crops in Haryana, India*. Indian Journal of Extension Education.

[3] Bagaria, N., & Jatav, S. S. (2025). Growth dynamics and sustainability of major crops in Haryana, India. *Indian Journal of Extension Education.* https://doi.org/10.48165/IJEE.2025.61215

[4] Bhatia, J. K., Bishnoi, D. K., Malik, D. P., & Karwasra, J. C. (2020). Extent of crop diversification in Haryana. *Indian Journal of Economics and Development, 16*(Special Issue 2), 218–224. https://doi.org/10.35716/ijed/NS20-045

[5] Chahal, D., & Kumar, K. (2024). Changes in the patterns of crop diversification in Haryana. *Annals of Plant and Soil Research, 26*(2), 425–433. https://doi.org/10.47815/apsr.2024.10380

[6] Chikkalaki, A. S., Ghanghas, B. S., Chahal, P. K., & Shubham. (2023). Scale to assess the sustainability of rice-wheat cropping system. *Indian Journal of Extension Education, 59*(1), 135–138. https://doi.org/10.48165/IJEE.2023.59128

[7] Department of Agriculture and Farmers Welfare, Government of India. (2025). *Agricultural Statistics at a Glance 2024–25*. Government of India. Official publication .

[8] Department of Economic and Statistical Affairs, Government of Haryana. (2025). *Statistical Abstract of Haryana 2024–25*. Government of Haryana. Official statistical publications .

[9] Department of Economic and Statistical Affairs, Government of Haryana. (n.d.). *Food grains in Haryana: Agricultural area and production trends, 1966–67 to 2024–25*. Official statistical dashboard .

[10] Gautam, U. S., Singh, S. S., & Singh, D. K. (2022). Water management in rice-wheat cropping system in Indo-Gangetic Plains. *Indian Journal of Extension Education, 46*(3–4), 43–47. Article page .

[11] Gibbs, J. P., & Martin, W. T. (1962). Urbanization, technology, and the division of labor: International patterns. *American Sociological Review, 27*(5), 667–677.

[12] Government of India, Ministry of Agriculture and Farmers Welfare. (2019). *Agriculture Census 2015–16: All India Report on Number*

and Area of Operational Holdings. Government of India.

[13] Indian Council of Agricultural Research. (n.d.). *Haryana: Agricultural profile and research priorities*. Official ICAR profile .

[14] Kumar, D., & co-author. (2024). Crop diversification in Haryana: An empirical district-level analysis. *Journal of Agricultural Development and Policy*, *34*(2), 258–268. https://doi.org/10.63066/23220457.34.2.010 . Article record .

[15] Meena, B. L., Fagodiya, R. K., Singh, A., Narjary, B., Kaledhonkar, M. J., Sheoran, P., Kumar, S., & Yadav, R. K. (2026). Harnessing sodic groundwater for sustainability in rice–wheat cropping system. *The Indian Journal of Agricultural Sciences*, *96*(5), 666–672. https://doi.org/10.56093/ijas.v96i5.175436

[16] Pinki, Lekha, H., & Rana, S. (2013). Pattern of crop diversification in Haryana. *Research Journal of Humanities and Social Sciences, 4*(3), 405–409. Article record .

[17] Poswal, R. S., Singh, R., & Hansra, B. S. (2015). Sustainability of rice-wheat cropping system through natural resource management in Haryana. *Journal of Wheat Research, 7*(1). https://doi.org/10.25174/ws5nw204

[18] Singh, J. (1976). *Agricultural geography*. Tata McGraw-Hill.

[19] *Rising water table: A threat to sustainable agriculture in an irrigated semi-arid region of Haryana, India.* (2010). *Agricultural Water Management*, *97*(10), 1443–1451. https://doi.org/10.1016/j.agwat.2010.04.010

[20] *Enhancing productivity of saline-sodic soils through conservation agriculture: An on-farm study in rice-wheat system.* (2025). *Journal of Soil Salinity and Water Quality*. Article page .