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Full Length Review Article

Agricultural Land Use and Crop Production in Haryana: A Geographical Analysis

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ABSTRACT
Haryana is one of the most agriculturally advanced states of India, contributing significantly to the national food grain pool. Despite its small geographical area, the state records high cropping intensity and substantial agricultural output owing to widespread irrigation and favourable topography. This paper examines the spatial pattern of agricultural land use, cropping intensity, and major crop production across selected districts of Haryana for the period 2001 to 2019. Primary and secondary data from government sources including the Statistical Abstract of Haryana, District Census Handbooks, and Haryana Agricultural Statistics were used. Analysis was performed using Microsoft Excel for tabulation, graphical representation, and statistical computation. Results reveal that the net sown area constitutes over 62% of the total geographical area, with districts of Sirsa, Hisar, Bhiwani, and Karnal showing the highest agricultural land use. Cropping intensity has increased from 172% in 2001 to 189% in 2018, driven by expansion of canal and tube-well irrigation. Wheat and paddy dominate the cropping pattern, accounting for nearly 70% of total crop area. However, over-reliance on these two crops has raised ecological concerns including groundwater depletion, soil degradation, and loss of crop diversity. The paper concludes with policy-oriented suggestions for sustainable agricultural development in the region.

Keywords: *Agricultural land use, Cropping intensity, Haryana, Crop production, Wheat-paddy cycle, Geographical Analysis*

1. INTRODUCTION

Agriculture is the backbone of India's economy and remains the primary occupation of a large section of the population. Among all Indian states, Haryana occupies a unique position in the agricultural landscape. Though it covers only 1.34% of the total geographical area of the country, it contributes approximately 10-12% of the wheat and 4-5% of the rice procurement to the central pool (Sharma, 2015). The state has witnessed a remarkable agricultural transformation since the Green Revolution of the 1960s. Adoption of high-yielding variety (HYV) seeds, increased use of fertilizers, and rapid expansion of irrigation infrastructure have collectively pushed the state's food grain production to impressive heights.

Geographically, Haryana is situated in the northwestern part of India, bounded by Punjab to the north and west, Himachal Pradesh and Uttarakhand to the northeast, Uttar Pradesh to the east, and Rajasthan to the south. The state covers an area of about 44,212 sq. km and is divided into 22 districts. The Indo-Gangetic plain, which covers most of the state, provides a flat, fertile terrain highly suitable for mechanised farming. The semi-arid climate with moderate rainfall (450-700 mm annually) necessitates supplemental irrigation, which has been extensively developed through canals originating from the Yamuna and Sutlej rivers and through a dense network of tube-wells (Singh, 2017).

Despite impressive growth in production, Haryana's agriculture faces serious structural challenges. The dominance of the wheat-paddy rotation has led to ecological degradation, particularly groundwater depletion in the Kandi belt and central districts. Studies by the Central Ground Water Board (CGWB) indicate

that water tables are falling at an alarming rate in districts such as Kurukshetra, Karnal, and Ambala (CGWB, 2017). Other concerns include declining soil health, stubble burning, and economic vulnerability of small farmers. These issues necessitate a geographical examination of the current agricultural land use pattern and crop production trends.

The present study attempts to analyse the spatial distribution of agricultural land use and the temporal trend in major crop production across selected districts of Haryana for the period 2001 to 2019. By combining tabular, graphical, and cartographic analysis, the paper aims to identify regional disparities and suggest evidence-based policy directions.

2. OBJECTIVES OF THE STUDY

The study is guided by the following specific objectives:

1. To examine the spatial pattern of agricultural land use across selected districts of Haryana.
2. To analyse the trend of cropping intensity and irrigated area coverage during 2001–2018.
3. To study the production trend of major crops (wheat, paddy, and mustard) over time.
4. To identify key agro-ecological challenges and suggest policy-level recommendations.

3. STUDY AREA

Haryana state, covering an area of 44,212 sq. km, constitutes the study area for this research. It is located between 27°39' N to 30°55' N latitude and 74°28' E to 77°36' E longitude. The state is characterised by three distinct physiographic regions: (i) the Shivalik foothills in the northeast, (ii) the fertile Yamuna-Ghaggar plain covering most of the state, and (iii) the semi-arid sandy tract in the south and southwest near Mahendragarh and southern Bhiwani. The study covers 10 major agricultural districts selected to represent the full physiographic and agro-climatic diversity of the state (see Table 1 for district profiles).

The state experiences a continental monsoon climate with hot summers (May-June), monsoon (July-September), and cold winters (December-January). Average annual rainfall ranges from below 300 mm in the southern districts to about 1,000 mm in the Shivalik foothills. About 80% of rainfall occurs during the Kharif (summer) season from July to September. The Rabi (winter) season crops, especially wheat, rely predominantly on irrigation. The Yamuna canal system, the Western Yamuna Canal, and Bhakra canals are the principal surface irrigation sources, supplemented by an extensive groundwater network (Kumar, 2016).

Table 1: Profile of Selected Districts in Haryana (2018–19)

District	Region	Geog. Area (000 ha)	Net Sown Area (000 ha)	Irrigated Area (%)	Cropping Intensity (%)	Main Crops
Hisar	South-West	379.8	245.8	88.4	191	Wheat, Cotton
Sirsa	South-West	433.4	282.6	82.1	186	Wheat, Paddy, Cotton
Karnal	Central	271.8	201.3	96.2	196	Wheat, Paddy
Kurukshetra	North	166.8	157.2	97.8	198	Paddy, Wheat
Bhiwani	South	499.2	218.5	71.3	172	Wheat, Bajra, Mustard
Fatehabad	South-West	256.8	196.7	86.5	188	Cotton, Wheat
Rohtak	Central	176.0	148.3	91.4	194	Wheat, Paddy
Ambala	North-East	163.2	126.4	92.6	193	Wheat, Paddy, Sugarcane
Mahendragarh	South	190.7	135.6	58.4	161	Wheat, Mustard, Bajra

District	Region	Geog. Area (000 ha)	Net Sown Area (000 ha)	Irrigated Area (%)	Cropping Intensity (%)	Main Crops
Rewari	South	154.8	122.9	63.7	165	Wheat, Mustard

Source: Statistical Abstract of Haryana (2018-19), Department of Economics & Statistics, Haryana Government

4. DATA SOURCES AND METHODOLOGY

The present study is based entirely on secondary data collected from various official government publications and institutional reports. The main data sources include:

- Statistical Abstract of Haryana, 2001–2019 (Department of Economics and Statistics, Haryana)
- Season and Crop Reports of Haryana (Directorate of Agriculture, Haryana)
- District Census Handbooks, Census of India (2001, 2011)
- Central Ground Water Board (CGWB) Annual Reports (2010–2018)
- National Sample Survey Office (NSSO) Reports on Agricultural Land Use

Data pertaining to net sown area, gross cropped area, irrigated area, and crop production were compiled for 10 selected districts. All analysis, including calculation of cropping intensity, computation of percentage shares, and preparation of charts and graphs, was performed using Microsoft Excel (version 2016). Bar charts, line graphs, and pie charts were created using Excel's built-in charting tools. Cropping intensity was calculated using the standard formula:

Cropping Intensity (%) = (Gross Cropped Area / Net Sown Area) × 100

Trend analysis was performed for the period 2001 to 2019 using five reference years: 2001-02, 2006-07, 2011-12, 2016-17, and 2018-19. Simple growth rates were computed and displayed using line charts for temporal comparison. Spatial patterns were interpreted district-wise and compared with the state average.

5. RESULTS AND ANALYSIS

5.1 Agricultural Land Use Pattern

The total geographical area of Haryana is approximately 44.21 lakh hectares. Of this, the net sown area accounts for the largest share at 62.4% (Table 2 and Figure 3). This is significantly higher than the national average of about 46%, which reflects Haryana's high agricultural dependence. Fallow land constitutes about 8.2% of the total area, while non-agricultural uses (settlements, roads, industry) account for 12.1%. Forest cover remains very low at only 3.9%, which is a major ecological concern given the increasing pressure on land and water resources.

Table 2: Land Use Pattern in Haryana (2018–19)

S.No.	Land Use Category	Area (000 Hectares)	% of Total Geog. Area	Rank
1	Net Sown Area	2,760.3	62.4	1
2	Fallow Land (Current + Other)	362.5	8.2	3
3	Culturable Waste Land	256.0	5.8	5
4	Pasture and Misc. Tree Crops	335.8	7.6	4
5	Forest Area	172.2	3.9	6
6	Non-Agricultural Uses	534.9	12.1	2
Total	Total Geographical Area	4,421.7	100.0	-

Source: Statistical Abstract of Haryana (2018-19); Compiled and analysed by author using MS Excel

District-wise analysis (Figure 1) shows that Sirsa (282.6 thousand ha), Hisar (245.8 thousand ha), Bhiwani (218.5 thousand ha), and Karnal (201.3 thousand ha) have the highest net sown areas among the ten districts studied. Sirsa and Hisar are characterised by extensive flatlands and well-developed canal irrigation from the Indira Gandhi and Bhakra canal systems. In contrast, Mahendragarh (135.6 thousand ha) and Rewari (122.9 thousand ha) in the south have relatively lower agricultural land, partly due to undulating terrain and limited irrigation availability.

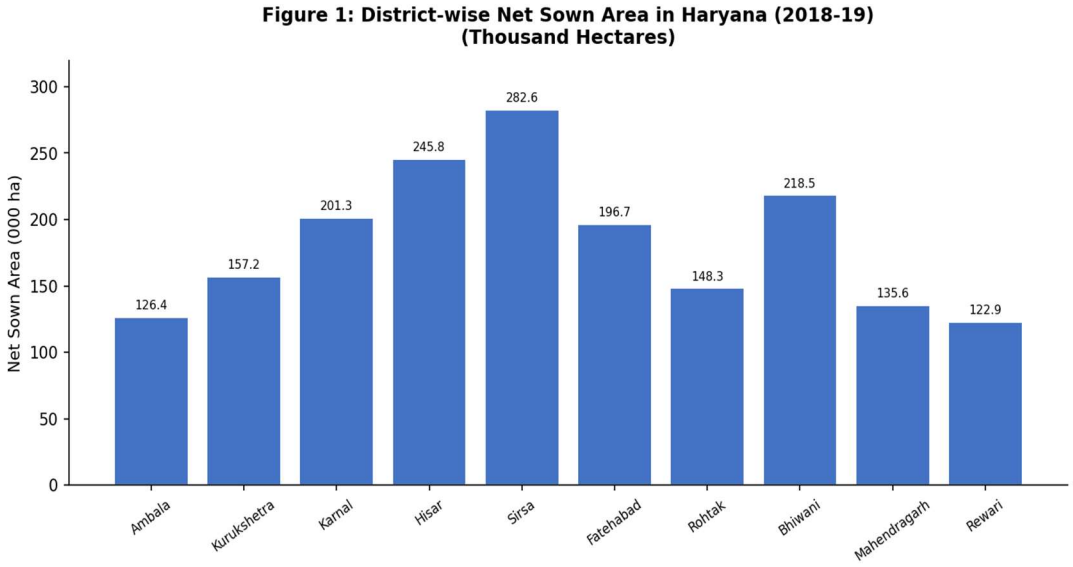

Figure 1: District-wise Net Sown Area in Haryana (2018–19) — Analysed using MS Excel

The proportion of irrigated area to net sown area is very high in the northern districts. Kurukshetra (97.8%) and Karnal (96.2%) have near-total irrigation coverage due to dense canal networks and high tube-well density. However, this intensive irrigation, especially for paddy cultivation, has led to rapid depletion of groundwater in these districts, as documented by CGWB (2017). Mahendragarh (58.4%) and Rewari (63.7%) in the south show the lowest irrigation ratios, making them more dependent on rainfall and therefore more vulnerable to drought.

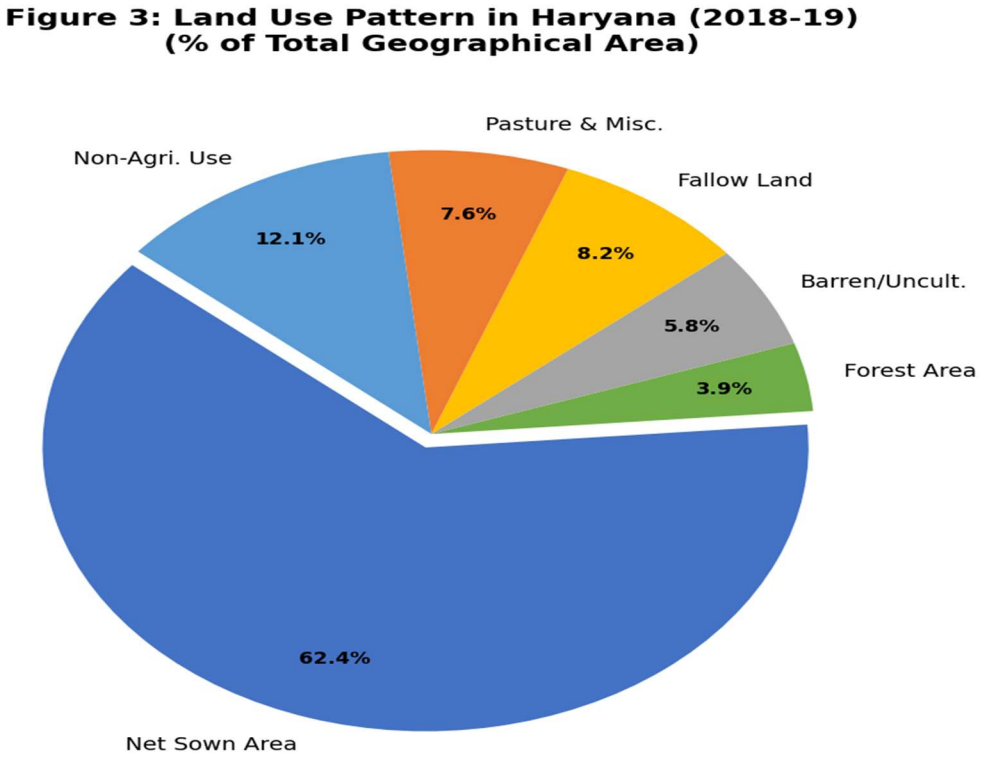

Figure 3: Land Use Pattern in Haryana (2018–19) — Pie Chart prepared using MS Excel

5.2 Cropping Intensity and Irrigation Trend

Cropping intensity is a key indicator of land productivity. It reflects how many times the same piece

of land is cropped during a year. Table 3 presents the decadal trend of cropping intensity and irrigated area for Haryana from 2001 to 2018.

Table 3: Trend of Cropping Intensity and Irrigated Area in Haryana (2001–2018)

Year	Net Sown Area (000 ha)	GCA (000 ha)	Irrigated Area (000 ha)	Irrigated (% NSA)	Cropping Intensity (%)
2001-02	2,698.4	4,638.3	1,942.8	72.0	172
2004-05	2,714.2	4,778.9	2,062.8	76.0	176
2007-08	2,728.6	4,911.5	2,155.6	79.0	180
2010-11	2,739.8	5,014.4	2,246.6	82.0	183
2013-14	2,748.1	5,086.9	2,309.2	84.0	185
2016-17	2,755.4	5,152.6	2,342.7	85.0	187
2018-19	2,760.3	5,217.0	2,397.8	87.0	189

Note: GCA = Gross Cropped Area; NSA = Net Sown Area. Source: Season and Crop Reports, Directorate of Agriculture, Haryana; Analysed using MS Excel

The data in Table 3 and Figure 2 clearly show a consistent upward trend in both cropping intensity and irrigated area over the study period. Cropping intensity increased from 172% in 2001-02 to 189% in 2018-19, representing a gain of 17 percentage points over 17 years. The irrigated area percentage grew from 72% to 87% during the same period. Both trends are closely correlated, suggesting that expansion of irrigation has been the primary driver of enhanced cropping intensity. A higher cropping intensity enables farmers to cultivate two to three crops per year on the same land, improving farm income but also placing greater stress on soil and water resources.

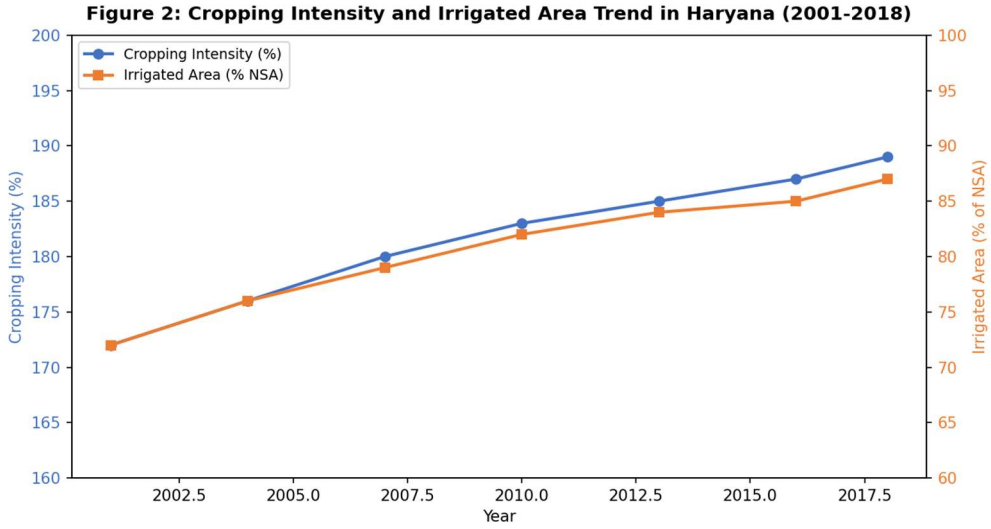

Figure 2: Trend of Cropping Intensity and Irrigated Area in Haryana (2001–2018) — Line Graph prepared using MS Excel

District-level data (Table 1) shows that Kurukshetra (198%) and Karnal (196%) have the highest cropping intensities among the 10 districts studied. These districts have near-complete irrigation coverage and a well-established paddy-wheat rotation, which facilitates two crops per year with minimal fallow period. In contrast, Mahendragarh (161%) and Rewari (165%) record the lowest cropping intensities, reflecting the constraints imposed by limited irrigation and drier climatic conditions in the southern part of the state.

5.3 Major Crop Production Trend

Haryana's cropping pattern is dominated by wheat (Rabi season) and paddy (Kharif season). These two crops together occupy nearly 65-70% of the gross cropped area. Mustard is the third most important Rabi crop, particularly in the southern and semi-arid districts where paddy cultivation is limited by water scarcity. Table 4

and Figure 4 present the production trends of these three major crops from 2001-02 to 2018-19.

Table 4: Major Crop Production in Haryana (Million Tonnes)

Year	Wheat (MT)	Paddy (MT)	Mustard (MT)	Total Foodgrain (MT)
2001-02	9.80	8.20	4.10	22.10
2006-07	10.60	9.10	4.40	24.10
2011-12	11.40	9.70	4.80	25.90
2016-17	12.10	10.40	5.00	27.50
2018-19	12.80	11.20	5.30	29.30
Growth (%)	30.6	36.6	29.3	32.6

Note: MT = Million Tonnes. Source: Season and Crop Reports, Directorate of Agriculture, Haryana; Compiled and computed using MS Excel

Wheat production has increased from 9.80 MT in 2001-02 to 12.80 MT in 2018-19, a growth of approximately 30.6% over 17 years. Paddy shows an even higher growth rate of 36.6%, with production rising from 8.20 MT to 11.20 MT. Mustard production grew at a slightly slower pace of 29.3%, from 4.10 MT to 5.30 MT. Total foodgrain production from these three crops alone increased by 32.6% during the study period. The consistent growth in production is attributable to improvements in seed technology, increased fertilizer use, and expanded irrigation coverage.

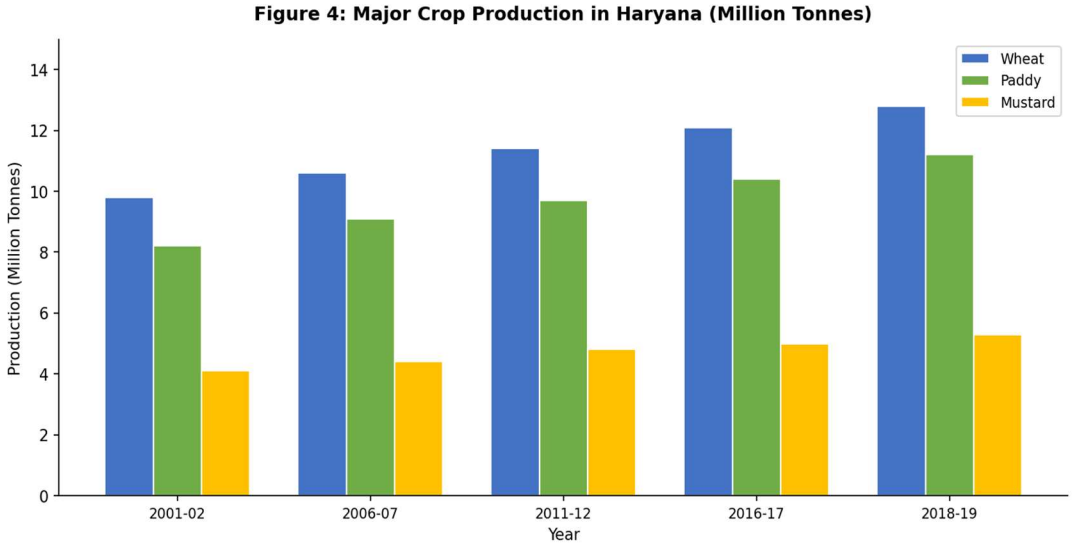

Figure 4: Major Crop Production Trends in Haryana (Million Tonnes) — Grouped Bar Chart prepared using MS Excel

However, the near-exclusive focus on wheat and paddy raises important questions about long-term sustainability. Paddy is a water-intensive crop that requires 1,200–1,500 mm of water per season, far exceeding the annual rainfall of most districts. This gap is bridged almost entirely by groundwater pumping, which has resulted in critical overexploitation of the aquifer in 14 out of 22 districts (CGWB, 2017). The stubble burning of paddy residues after harvest is another major environmental problem, contributing to air pollution in the Indo-Gangetic Plain (Jain et al., 2014).

6. DISCUSSION

The analysis of agricultural land use and crop production data reveals a clear pattern of agricultural intensification in Haryana over the period 2001 to 2019. The high net sown area (62.4% of total geographical area) and consistently rising cropping intensity (189% in 2018-19)

indicate that the state has successfully achieved agricultural extensification and intensification simultaneously. This has been made possible by massive public investment in irrigation infrastructure and the adoption of the Green Revolution package of technologies.

However, the geographical analysis also uncovers significant regional disparities within the state. The northern and central districts — Kurukshetra, Karnal, Ambala, and Rohtak — show higher cropping intensity, higher irrigation ratios, and greater reliance on paddy cultivation. These districts also face more acute groundwater stress. In contrast, the southern districts — Mahendragarh, Rewari, and parts of Bhiwani — have lower irrigation coverage and lower cropping intensity. Here, dryland crops like bajra and mustard are still cultivated, and the agricultural system retains some diversification.

The dominance of the wheat-paddy system is a product of market incentives (minimum support price for both crops), availability of water for paddy, and relatively assured procurement by government agencies. While this has ensured food security and stable farm incomes, it has locked the agricultural system into an ecologically damaging cycle. The cost of this intensification is now clearly visible in falling water tables, declining soil organic matter, and increased incidence of soil salinity and waterlogging in low-lying areas (Dhankar & Kumar, 2015).

These findings are consistent with the broader literature on Green Revolution legacies in Punjab and Haryana. Singh (2017) noted that the wheat-paddy belt of the Indo-Gangetic plain is approaching biophysical limits of productivity growth, and that further increases will require either a shift in crop mix or transformative technological change. Hooda and Singh (2013) documented that small and marginal farmers in Haryana are increasingly substituting paddy for other crops under distress, while large farmers continue to benefit from the paddy-wheat system through government support.

7. CHALLENGES AND POLICY RECOMMENDATIONS

7.1 Key Challenges

Based on the geographical analysis carried out in this paper, the following key challenges are identified for Haryana's agricultural sector:

- Groundwater depletion due to paddy cultivation: 14 out of 22 districts are in the over-exploited or critical category for groundwater (CGWB, 2017).
- Crop diversification deficit: Wheat and paddy occupy over 65% of gross cropped area, leaving little room for nutritious or commercially valuable alternative crops.
- Soil health degradation: Continuous paddy-wheat rotation with heavy chemical inputs has reduced soil organic carbon and disrupted soil biology in many districts.
- Air pollution from stubble burning: Post-paddy stubble burning contributes significantly to the seasonal air quality crisis in northern India.
- Regional imbalance: Southern districts with lower irrigation coverage are relatively underdeveloped and do not benefit equally from state agricultural support systems.

7.2 Policy Recommendations

Based on the findings of this study, the following policy-level recommendations are offered:

- Crop Diversification Policy: State government should introduce area-specific incentives to promote cultivation of less water-intensive crops like maize, sunflower, pulses, and horticulture in the districts with critical groundwater conditions.
- Micro-irrigation Promotion: Expansion of drip and sprinkler irrigation in southern arid districts can help increase cropping intensity without additional groundwater stress.
- In-situ Stubble Management: Subsidising Happy Seeder and rotavator machinery for paddy stubble incorporation into soil can reduce burning and improve soil organic matter.
- Balanced MSP Policy: Revising the Minimum Support Price (MSP) structure to cover a wider basket of crops will incentivise farmers to shift away from paddy in water-scarce areas.
- Regional Development Plans: Special agricultural development packages for the southern districts of Mahendragarh, Rewari, and Mewat should be formulated to reduce the intra-state agricultural divide.

8. CONCLUSION

This study has provided a comprehensive geographical analysis of agricultural land use and crop production in Haryana for the period 2001 to 2019. Using district-level data and analysis through MS Excel, the study found that Haryana maintains an exceptionally high proportion of net sown area (62.4% of total geographical area) and a high cropping intensity (189%), both well above the national average. Irrigation coverage has expanded considerably, reaching 87% of the net sown area by 2018-19, which has been the primary enabler of agricultural intensification.

The major crop production trend shows consistent growth in wheat, paddy, and mustard, with total foodgrain production from these three crops reaching 29.3 MT in 2018-19. However, the concentration of agriculture around the wheat-paddy system raises serious sustainability concerns, particularly related to groundwater depletion, soil health, and crop diversity. Regional disparities between the intensively irrigated northern districts and the relatively dry southern districts

highlight the need for spatially differentiated agricultural development strategies.

Haryana's agricultural transformation over the past five decades is a story of impressive achievement but also of growing ecological risk. A shift towards sustainable intensification — producing more with less water and fewer chemicals — is essential for the long-term food security of the state. This will require coordinated policy action encompassing irrigation reform, crop diversification incentives, and farmer-friendly technology extension. The geographical approach adopted in this paper, combining spatial analysis with temporal trend examination, offers a useful template for evidence-based agricultural planning at the sub-state level.

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