

## **Using High Resolution Satellite data for monitoring long-term changes of kharif cropping pattern in the agriculture of North-western Haryana**

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### **Abstract:**

The purpose of this study is to examine spatial-temporal variations in kharif cropping pattern in the agriculture of North-western Haryana. Satellite based remote sensing data Landsat-5 and Sentinel-2 has been used for extracting basic information for the analysis of kharif cropping pattern in North-western Haryana. Kharif cropping pattern maps was generated for the year 1990-91 and 2021-22 using high resolution satellite data. Cotton and rice were the leading kharif crops in North-western Haryana during 1990-91 and 2021-22, accounting more than 64 percent of total cropped land and other prominent kharif crops grown in the region included sugarcane, and bajra. The findings demonstrate that cotton and rice areas has expanded, whereas bajra and sugarcane areas has dropped during kharif cropping season in North-western Haryana.

**Keywords:** Supervised classification approach, Kharif season, identification of kharif crop

### **1. Introduction**

Agriculture remains the primary mover and core of Haryana's economy, contributing 15.6 percent of the state's gross domestic product (SGDP) (Economic Survey of Haryana,2014) and employing almost 70 percent of the state's population directly or indirectly. Because of the expanding population, as well as the need to produce more and more of our fast-diminishing per capita land resources, pressure on India's limited natural resources is increasing. Due to the scarcity of agricultural land and the increasing need for food, multiple cropping even on the same piece of land is becoming more prevalent. As a result, better agricultural systems management, particularly cropping patterns, must be prioritized (N. J. Singh,2011).

Cropping pattern refers to the proportional share of total cropped area taken up by various crops in a given region during a certain agricultural year (Koshal, 2012), while cropping pattern changes represent the change in proportional area used by various crops between two periods (Bhatia, 1965). Cropping pattern is one of agriculture's most important aspects, as well as its most dynamic idea, because no cropping pattern is excellent or appropriate for all times or all regions. Physical and socio-economic variables have an impact on cropping patterns. Physical factors influence plant development and establish limits on crop selection, whereas socio-economic variables influence how farmers cultivate crops based on their preferences and habits. Modern technology has expanded the range of crops that can be grown in areas where the climate is unsuitable. On the other hand, use of advanced irrigation systems, farm machinery and fertiliser are examples of contemporary inputs that make crop selection easier.

## 2. Study Area-Location & Extent

The North-western Haryana lies in the Indo-Gangetic plain and comprises three major districts of north-western part of Haryana are Hisar, Fatehabad, and Sirsa that make up the state's north-western region as shown in figure 1. This region accounts for 24.42 percent of Haryana's total land area, with 10798 km<sup>2</sup>. Longitudes range from 74°28'E to 76°19'E, and the latitude area spans 28°54'N to 29°59'N as shown in figure 1. The major crops like Cotton, paddy, sugarcane and bajra are produced in the kharif cropping patterns in the North-western Haryana. The current study, which uses geospatial technology to identify kharif cropping patterns, can help to boost food grain output while also ensuring that our land resources are used sustainably. Because temporal-spatial analysis services deliver geospatial technologies in a timely and cost-effective manner.

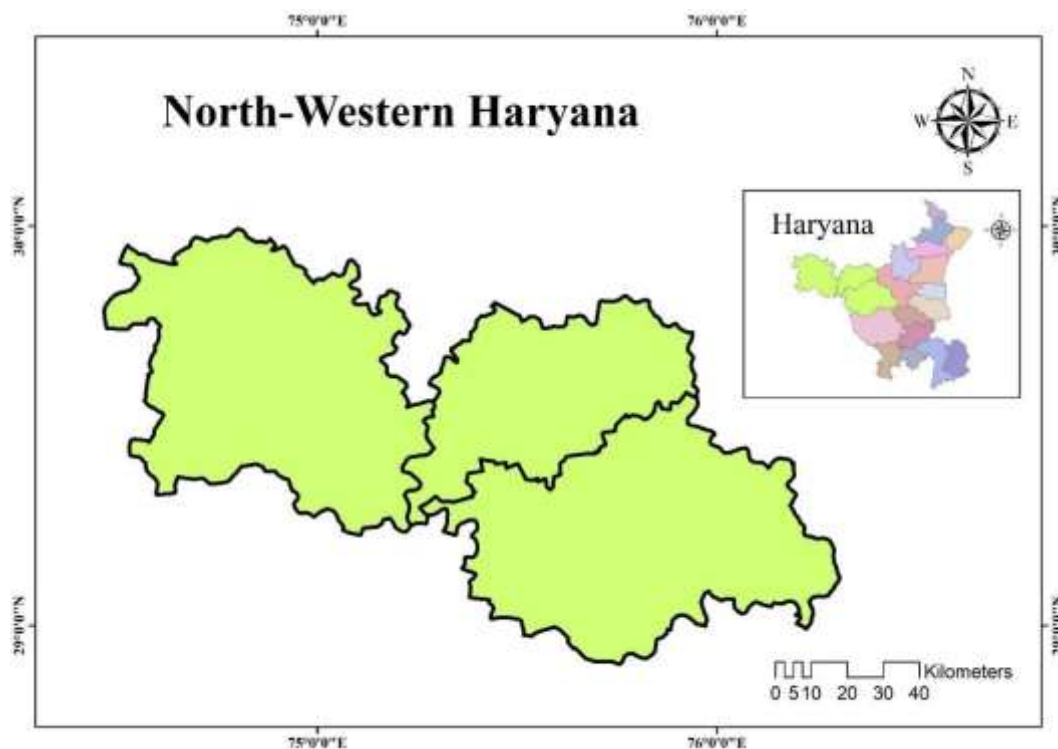


Figure: 1 Study Area location map (North-western Haryana consists three major districts).

## 3. Aims & Objectives of study

- To examine the current kharif cropping pattern in space.
- To examine the evolution of kharif cropping patterns across time.

## 4. Database

The current study is based on primary source of data and make the research more effective & meaningful.

### 4.1 Software Used

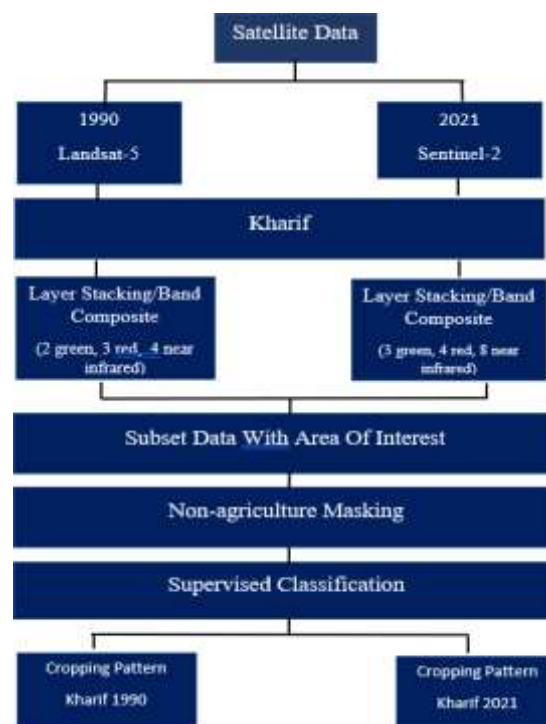
- Arc GIS
- ERDAS (Earth Resource Data Analysis System).

#### 4.2 Satellite Data acquisition

High resolution satellite data from the landsat-5 and sentinel-2 were obtained for the analysis of crops during kharif season. Three major bands of landsat-5 such as band 2 green, band 3 red, band 4 near infrared and sentinel-2 such as band 3 green, band 4 red, band 8 near infrared has been composite.

#### 4.3 Research methodology

The information for the major kharif seasons has been evaluated using satellite-based remote sensing data from landsat-5 (band 2 green, band 3 red, band 4 near infrared) and sentinel-2 (band 3 green, band 4 red, band 8 near infrared). The kharif seasons data were further processed for layer stacking and subset data from interest area. For increasing accuracy, the masking of non-agriculture classes excised from maps, such built-up areas waterbody etc. Supervised image classification approach has been used for the identification of kharif crops. Thus, the kharif crops maps of north-western Haryana is generated of two years 1990 kharif seasons map and 2021 kharif seasons map.



**Fig 2:** Methodology Flow Chart.

### 5. Discussion and Results

Crop cultivation is the most common occupation in the state's (Haryana) north-western region, and it is also the state's most important economic activity. The overall kharif cropped area, on the other hand, has grown from 91.74 % in 1990 to 92.55 during 2021 as shown in table 1 & figure 3 & 4. According to remote sensing satellite data estimations cotton was the single most dominating crop in the research area during the kharif season, occupying an area of around

45.31 percent in 1990 and 51.34% in 2021 (as shown in table 1 & figure 3 & 4) of the entire geographical area of north-western Haryana. Cotton is raised on about half of the agricultural land in north-western Haryana due to suitable soil characteristics and climatic conditions. Rice is the second most important crop according to remote sensing assessments, covering accounting for 15.99 percent and 37.31 % during 1990 and 2021 as shown in table 1 & figure 3 & 4. Rice is grown in the western, north-eastern and north central parts of northwestern Haryana, where the Ghaggar and Western Yamuna Canal drain the area. In decreasing order of significance, alternative crops like bajra and sugarcane are grown at a minimal level.

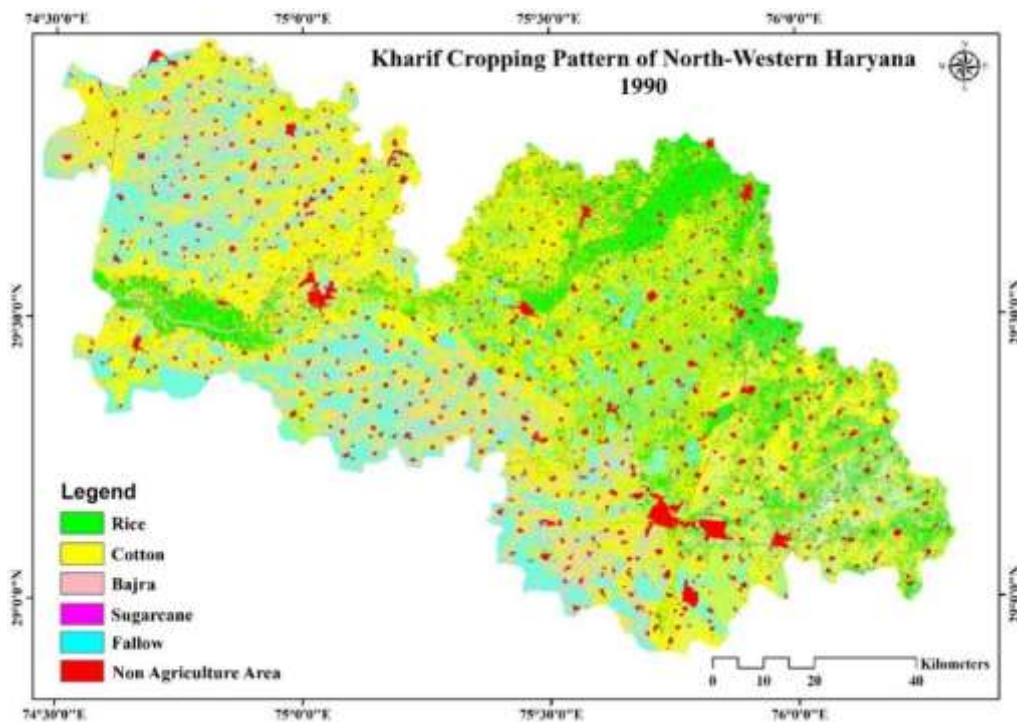


Figure:3 Kharif crops and others classes in north-western Haryana (1990).

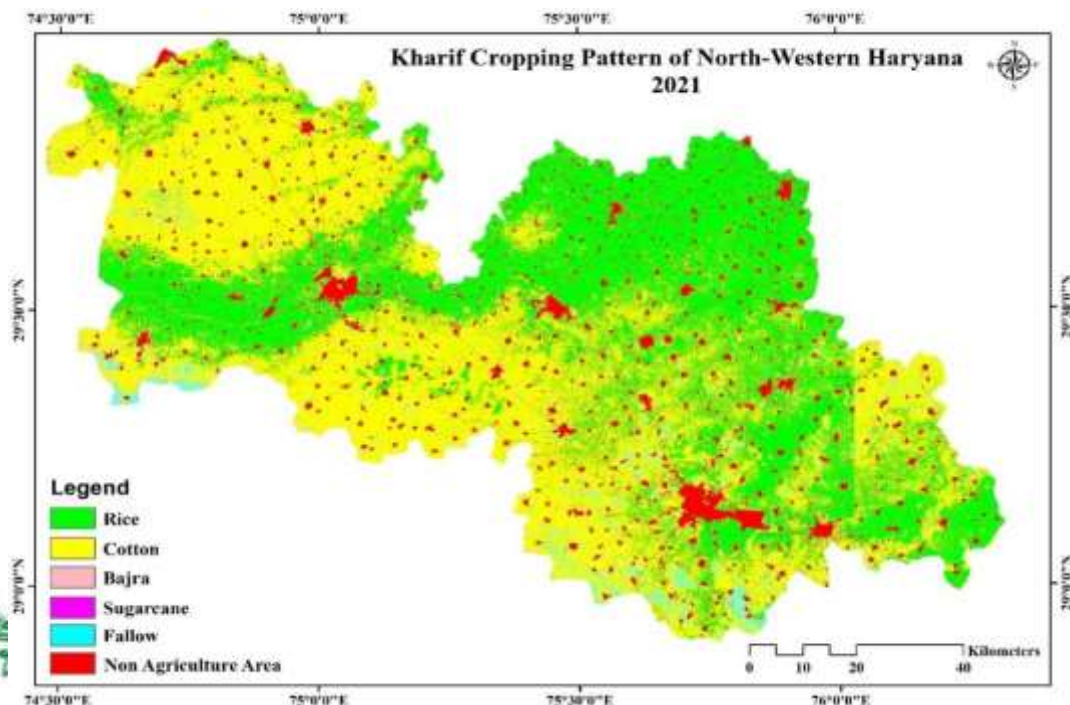


Figure:4 Kharif crops and others classes in north-western Haryana (2021).

The area under bajra crops cover 8.77 percent during 1990 and 0.43 percent during 2021 (as shown in table 1 & figure 3 & 4) of the entire geographical area. Non-agricultural land as shown in table1 and figure 3 & 4 made up 8.26 % during 1990 while it reduced upto 7.45 % during 2021 to the total geographical area.

**Table:1**

**Kharif Cropping Pattern in North-Western Haryana from 1990-2021**

| Crops              | 1990             | 2021             |
|--------------------|------------------|------------------|
|                    | Percentage (TGA) | Percentage (TGA) |
| Rice               | 15.99            | 37.31            |
| Cotton             | 45.31            | 51.34            |
| Fallow Land        | 21.66            | 3.47             |
| Bajra              | 8.77             | 0.43             |
| Sugarcane          | 0.01             | 0.01             |
| <b>Total</b>       | <b>91.74</b>     | <b>92.55</b>     |
| Non Agri           | 8.26             | 7.45             |
| <b>Grand Total</b> | <b>100</b>       | <b>100</b>       |

\*TGA – Total Geographical Area \*\* Source: Landsat 5 & Sentinel-2

**6. Conclusion:**

Cotton was the most important kharif crop in North-western Haryana. However, rice was the dominating crop in the rest of Haryana. Cotton and rice lands have grown, whereas bajra and sugarcane acreage have decreased, according to satellite data analysis from 1990 to 2021. The sandy soil in the south-eastern and south-central parts of the research sites makes large water-consuming crops like paddy/cotton unsuitable to flourish.

Geospatial technologies are facilitator for changing kharif cropping pattern mapping time to time with time and cost effectiveness. The cropping pattern in the north-western Haryana is unsustainable as compared other part of state and for agricultural production to be sustainable, the area need the most effective land and water management strategies.

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