IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

Evaluation of Cropping Pattern and Crop Rotation of Rohtak District of Haryana using Sentinel Satellite data

Jyoti Devi
Ph.D. Scholar, O.S.G.U., Hisar

Sandeep Kumar
Assistant Professor, F.G.M. Govt. College, Adampur

Sunil Kumar
Associate Professor of Geography, O.S.G.U., Hisar

Abstract

Cropping patterns are essential in determining the level of agricultural development in any particular area. Cropping patterns also demonstrate agricultural temporal variations. The cropping pattern depicts the area's primary crops. Rice and wheat are the main food crops in the study area. Farmers of the study area conduct intensive agriculture because their income comes from their fields. The demands, but not the fields, are expanding as the population grows. To enhance agricultural productivity, farmers are using a wide range of seeds, fertilizers, and improving and expanding irrigation facilities.

The present study examined cropping patterns of the Rohtak district with the help of Sentinel 2B high resolution satellite data. Supervised classification techniques were used to carry out the cropping pattern for Rabi and Kharif seasons for the year 2020-2021. The study evaluates that Wheat is the dominant crop in the Rabi season that is sown in 866 square kilometer area and Rice is the dominant crop in Kharif season that is sown in 171 square kilometer area.

Future scope

The Rohtak district's crop rotations and cropping patterns are all covered in detail in this research paper. For any type of agricultural planning, it is very beneficial. This paper identifies the crops that are growing in each district area. Currently, farmers are able to meet all of their needs on their farms, but as the population and the farmers' needs grow, it's possible that these crops won't be enough to meet everyone's needs. Therefore, based on the information provided, policymakers will suggest alternative cropping patterns and various high-yielding seed varieties in the future to ensure that farmers are able to harvest an adequate amount of produce from their fields. Second, the study shows that the predominant crop during the Kharif season is rice, which is planted over an area of 171 square kilometers and, as we all know, requires a lot of water. The Rohtak district is located in Haryana's central lowland basin. The Rohtak district deals with issues like waterlogging and salinity in the post-monsoon season. The current Rice-wheat cropping pattern and physiography of Rohtak district are to blame for the waterlogging and soil salinity issues. In Rohtak district, the water-logged area increased from 663.1 km^2 in 1975 to 907.4 km^2 in 2015, while the

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

salinity level increased from 314.1 km^2 in 1975 to 820.15 km^2 in 2015 (Gulab, Singh, M. and Kumar, S. 2019). Concerning the twin issues of soil salinity and waterlogging, this research paper aids policymakers in understanding the current crop rotations and crop patterns to recommend one that is both environmentally and economically advantageous for this area.

Key Words
Cropping Pattern, Sentinel, ERDAS Imagine & Supervised classification.

Introduction

One of the key economic sectors in India is agriculture, which meets the basic necessities of the populace by giving them food and work. Since many people rely on it for their living, this is well known. The single industry in the Indian economy that accounts for the largest share of GNP is agriculture. The primary source of both food supplies and foreign exchange is agriculture. It gives emerging nations like India the sources of their foreign exchange revenues (Agnihotri N. & Priyanka 2017).

Cropping Pattern refers to the variety of crops cultivated and the amount of land under various crops at any given moment (Kumar J. 2013). The concept of cropping pattern is dynamic since it evolves throughout time and space. Any specific location is susceptible to change from time to time due to the influencing circumstances (Khan, M. & Ahmad, A. 2019). Cropping pattern of a particular area is affected by the climate of that particular area and availability of agricultural land and demand of particular crops. A cropping pattern is the percentage of an area that is currently covered by different crops. A combination of physio-cultural factors has led to the changing cropping pattern (Parihar S. 2017). Cropping pattern refers to the share of land planted in different crops at a given time period, as well as the distribution and the factors that influence cropping pattern over time (Misra & Puri 2011). Cropping patterns are adopted in any place as a result of a variety of variables, including physical, social, and economic factors. Some of these, like prices, government regulations, technology, etc., are subject to change and have behaved significantly differently over time (Singh Gomatee 2012). Due to the Green Revolution in Haryana and Punjab, cropping patterns have shifted from being diversified to being specialized (Singh, G.B. (2000).
Crop rotation is defined as cultivating successive crops on the same plot of land at various times of the year (seasons) without compromising the fertility of the soil (Yadav, K et al., 2015). Crop rotation, which involves planting one crop after another on the same plot of land during various times of the year (seasons), should be used. To maximize resource usage, crops are rotated so that the next crops are of a different genus, species, subspecies, or variety from the previous crop. Crop rotations and choices are crucial for increasing cropping intensities and yields, maximizing the productivity of both land and labor, and reducing waste (Singha, Chiranjit et al., 2020). The sustainability of agricultural practice is significantly influenced by crop rotation (R, Manjunath & Kundu, Nitai & Panigrahy, S. 2006). A cropping system is described as the crop pattern and its management to obtain benefits from a specific resource base under a particular environmental situation (Satyawan, Yadav, M.,

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

Hooda,R.S. 2014). Analysis of a region's cropping patterns is crucial because it aids in choosing the crop that is most appropriate for that particular region (Wali V.S., Poddar R., Mundinamani S.M., Yenagi B.S. 2019).

Although it is commonly recognized that one of the key benefits of deploying remote sensing satellites is the systematic and repetitive data collection that allows for the tracking of crop rotations and multi-year cropping patterns. In the studied area, a fixed cropping pattern can be seen after the green revolution. The primary goal of this research is to discover and thoroughly investigate the current cropping pattern of the Rohtak district using geospatial technology. Cropping pattern shows spatio- temporal changes of the crops of the study area. Guar, Cotton and Bajra crops are sown in Kharif season while Wheat, Mustard, Barley and Gram are grown in Rabi season. The key objectives of this study are to determine the cropping pattern and crop rotation in the Rohtak district using high-resolution satellite data.

Study area

The present study area is Rohtak district of Haryana. Rohtak does not share its boundaries with any state of India because it is situated in the middle part of the Haryana state. Neighboring districts are Jind in the north, Sonipat in the south, Jhajjar in the east and Hisar and Bhiwani in the west. The geographical coordinates of the district are 28°40'30" N to 29°05'35" N latitude and 76°13'22" E to 76°51'20" E longitudes. The geographical area of Rohtak district is 1669 km^2. Topographically Rohtak district lies in a low lying area of Gangetic plain. The study area has continental climate that is too cold in winters and too hot in summers. Study area gets rainfall from the south west monsoon. The south west monsoon arrives in the last week of June and leaves around the end of September, providing for approximately 84 percent of annual rainfall. Western disturbances bring rain in during the winter months. Average rainfall is 592 mm in the study area. Location map of the study area is presented in Figure-1.

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

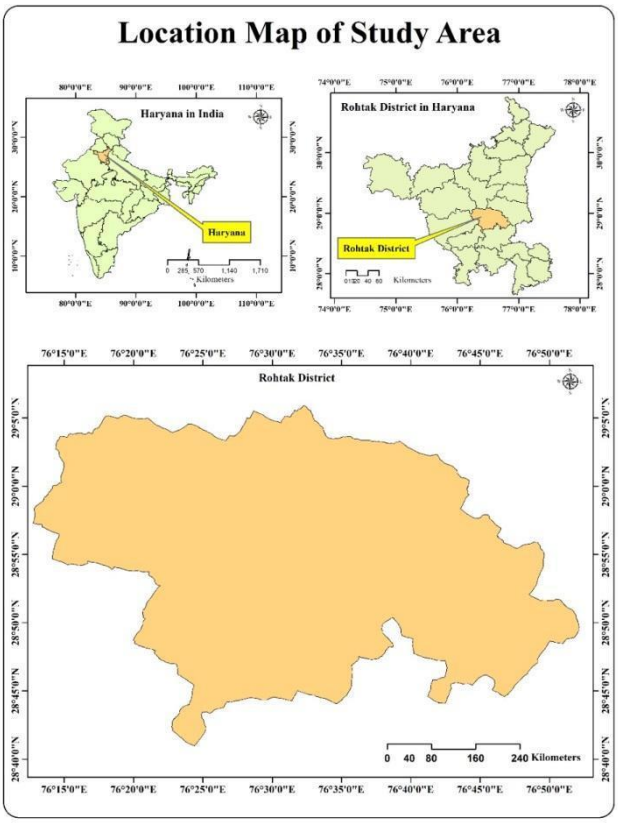


Figure-1

Database & Methodology

Data source

In present study Sentinel 2B Satellite images are used to get the exact information regarding cropping pattern for the year 2020-21 and satellite images of both seasons Rabi and Kharif were downloaded from the website of USGS. The sentinel satellite image was used as the primary source for all information, and Shodganga and Google Scholar were used as secondary sources. In secondary sources, literature reviews can be found that present the opinions of academics on crop rotation and pattern. Literature reviews aid in a deeper understanding of the related topic. In the map-making process, Arc GIS 10.8 and ERDAS software 9.3 are used, and all written work is completed in Microsoft Office software. Detailed specification of satellite data is discussed in Table-1.

Table -1
Specification of Satellite data

Satellite	Sensor	Season	Date of Acquisition	Spatial Resolution	Swath	Source
Sentinel 2B	MSI (Multi scanner	Rabi season	29 Jan., 2021	10 to 60 meter	290 km	https://www.usgs.gov
		Kharif	11 Sept.,			

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

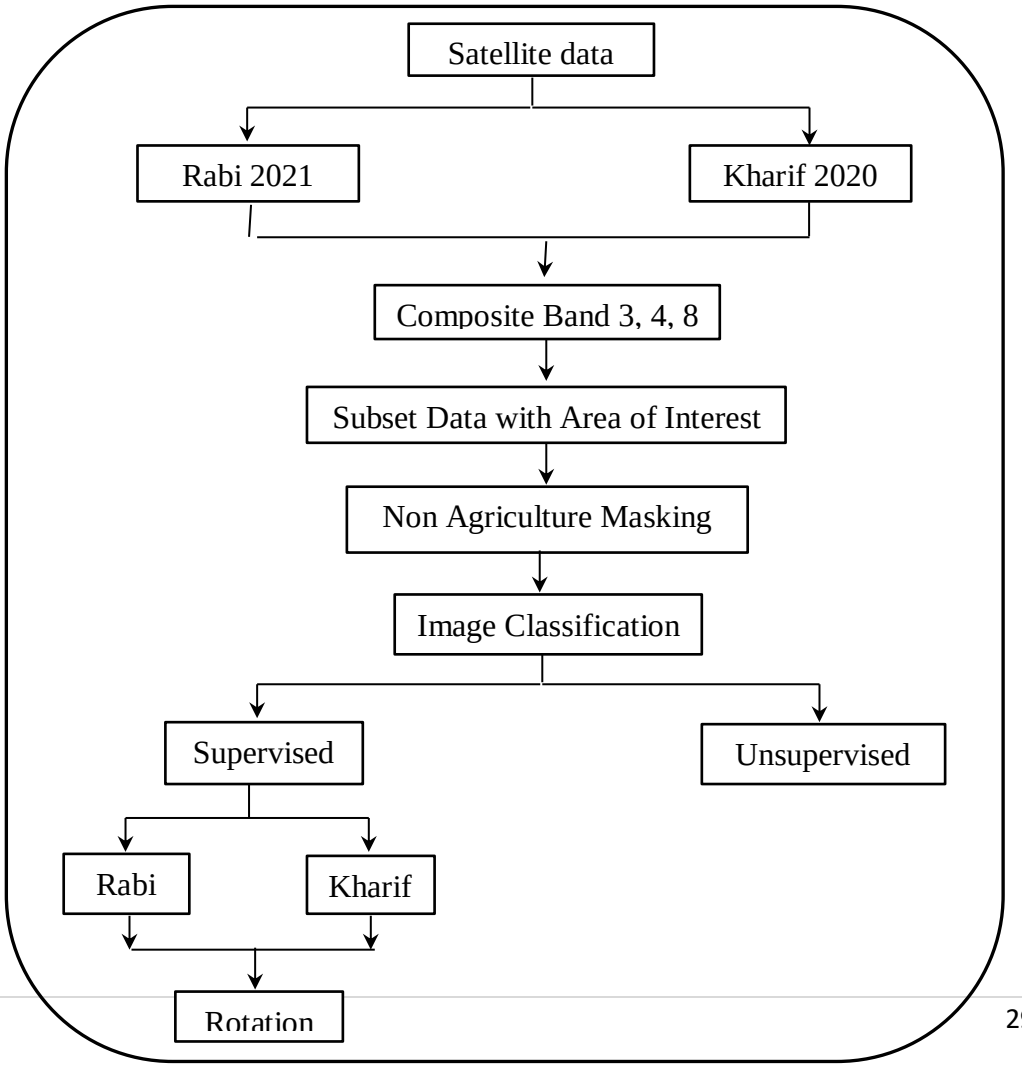
	imager)	season	2020			

Software Used:

- ArcGIS 10.8 Desktop
- ERDAS Imagine 9.3
- Microsoft Office

Methodology:

The reclassification process is carried out using the ERDAS Imagine software. Supervised categorization schemes of digital image classification techniques for mapping of cropping patterns were used. Supervised categorization is a less time-consuming technique. The final maps that represent the cropping pattern of Rabi 2021 and Kharif 2020 and crop rotation are created using supervised classification. The following steps were used to complete the supervised categorization scheme- Gathering of training samples - Training sample evaluation- Editing in training samples- Creating a signatures file- Examining the signatures file- Using Interactive Supervised Classification. Final maps were prepared and calculation of statistics completed with the help of Arc Map 10.8 software. Detailed Methodology is discussed in methodology flow chart (Figure- 2).



Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

Figure-2 Methodology Flow Chart

Results & Discussion

Evaluation of Kharif cropping pattern

Kharif crops are typically cultivated at the start of the first rains of the south-west monsoon season and reaped at the end of the monsoon season. Kharif crops are also referred to as monsoon crops because the rain during the monsoon season promotes their growth. Sentinel satellite data for the year 2020 is being used to determine the cropping pattern in the Rohtak district. To obtain precise information, Rabi and Kharif cropping pattern-based maps were created in ArcGIS 10.8 and ERDAS Imagine 9.3 software. Rice, Cotton, Sugarcane, Bajra, Jowar, and Guar are the major crops that were grown in the study area in the Kharif season. Rice and cotton are the major crops that were sown in 171 and 152 square kilometers respectively of the total geographical area of Rohtak district. Rice and cotton crops have been observed in the blocks of Meham, Lakhan Majra and Rohtak. Sugarcane is an annual crop and cultivated in 127 square kilometers of the district. The area covered by Bajra/Jowar/Guar crops is 475 square kilometers that is 28.4 percent of the total geographical area of the district. Minor crops are sown in 211 square kilometers area which is 12.6 percent of the total area of the district. The 288 square kilometers area is remaining fallow during Kharif season that is primarily observed in the southwestern Kalanaur, north-western Meham, eastern-central Sampla and central and northern Rohtak blocks of Rohtak district. Spatial distribution of Kharif cropping pattern is discussed in Table 2 and Figure 3.

Table- 2
Spatial Distribution of Kharif crops

Crops	**Area in square kilometer**	**Percentage to total geographical area of the district**
Rice	171	10.2
Cotton	152	9
Sugarcane	127	8
Bajra/Jowar/Guar	475	28.4
Other crops	211	12.6
Fallow land	288	17.2
Non agriculture	245	14.6
Total	**1669**	**100**

Evaluation of Rabi cropping pattern

Rabi crops are planted in the winter months of October to December and harvested in the summer months of April to June. The presence of precipitation throughout the winter months due to western temperate cyclones aids in the growth of these crops. Wheat, Mustard and Sugarcane are the main crops of Rabi season in the study area that is sown in 866 and 292 square kilometers of the study area respectively. Wheat crops can be seen all across the study

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

area and covered 52 percent area of the district and Mustard is sown sporadically in the research area having 17.5 percent area of the district. Other minor crops of the Rabi season in the study area cover 56.2 square kilometers area. Like that, fallow lands encompass an area of 82.3 square kilometers. Areal and geographically distribution of Rabi crops in the district is presented in Table 3 and Figure-4 respectively.

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

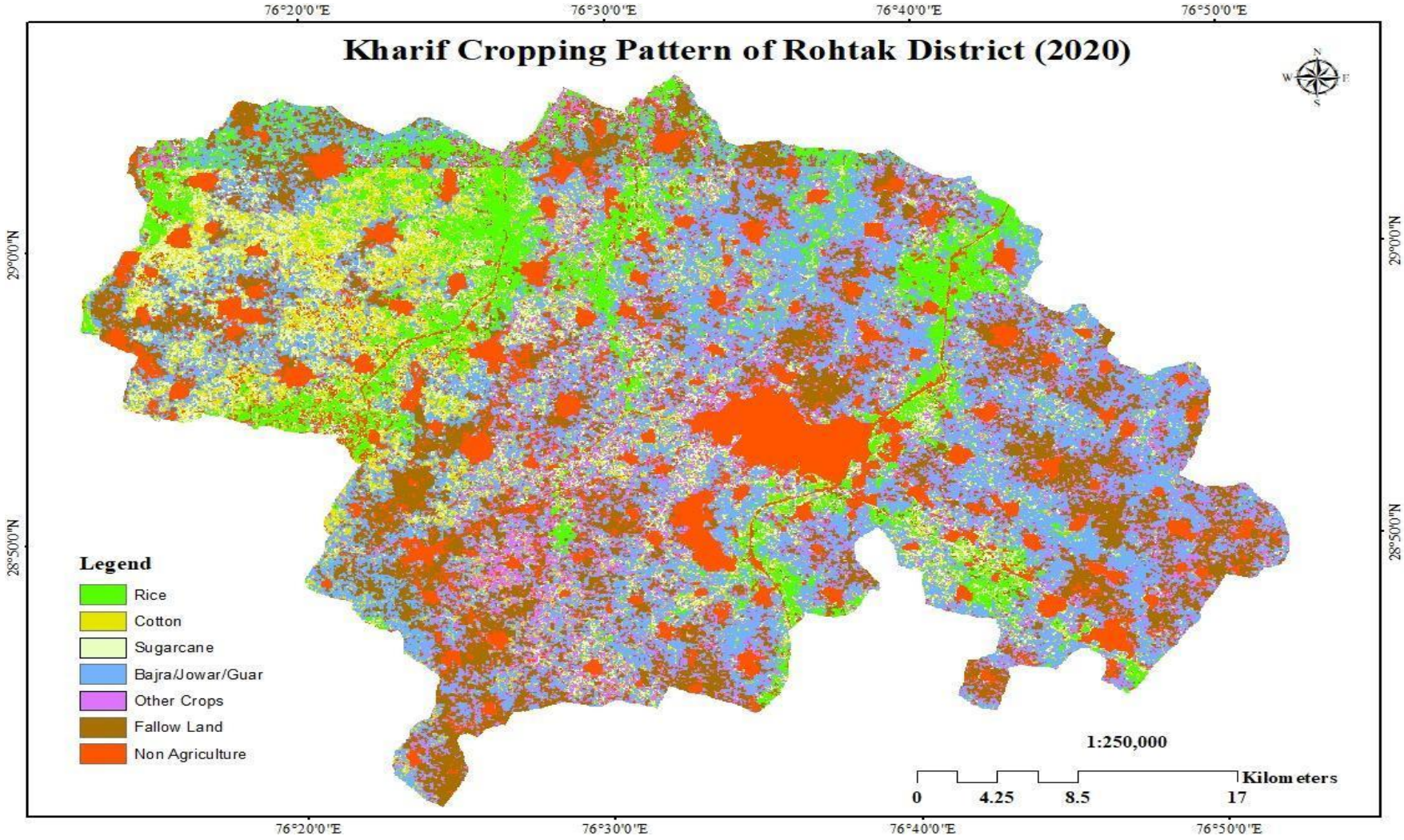


Figure 3

IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

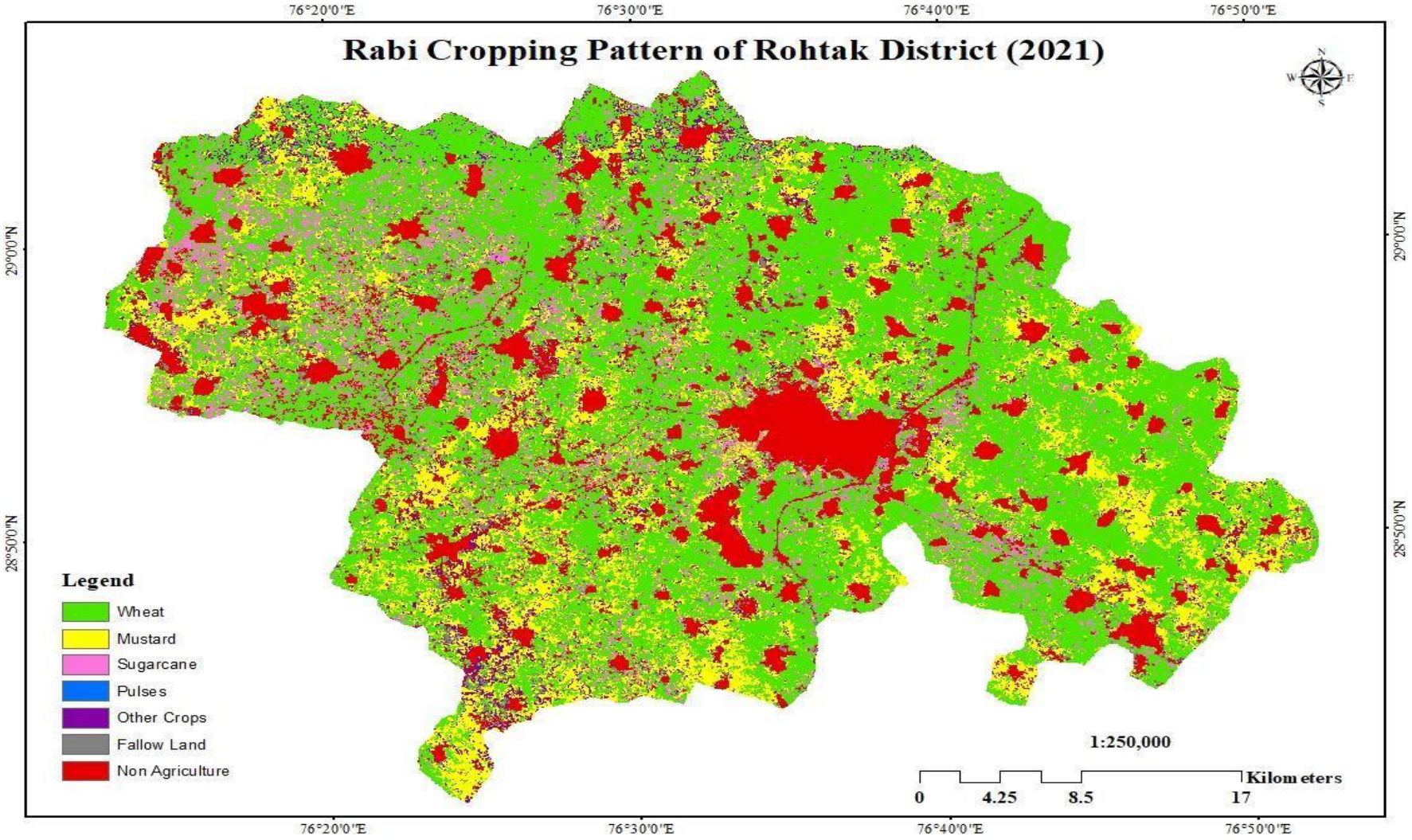


Figure 4

Table- 3
Spatial Distribution of Rabi crops

Crops	Area in square kilometer	Percentage to total geographical area of the district
Wheat	866	52
Sugarcane	127	7.6
Mustard	292	17.5
Pulses	0.5	0.02
Other crops	56.2	3.4
Fallow land	82.3	4.9
Non agriculture	245	14.6
Total	**1669**	**100**

Evaluation of Crop Rotation

The crop rotation map analysis reveals that the Bajra/Jowar/Guar crop and Wheat crop rotation is the dominant rotation having 368.7 square kilometers of area of the district. Crop rotations based on Rice-Wheat, Cotton-Wheat and Sugarcane based rotation cover 153, 116, and 128 square kilometers of the study area respectively. Crop rotation map shows that Rice-Wheat is to be uniformly distributed in the study area. Minor rotations are the second largest category spanning 369 square kilometers. Rotation of Rice with other crops, wheat with other crops and cotton with other crops occupies 4, 119.3 and 2 square kilometers of area of the district respectively. Group wise detail of all crop rotation classes with their respective area is explained in Table-4 while spatial distribution is presented in Figure 5.

Table- 4
Details of crops rotation classes

Crop Rotation class	Area in square kilometer	Percentage to total area of the district
Rice-Wheat	153	9.1
Cotton-Wheat	116	7
Sugarcane based	128	8
Rice-other crops	4	0.2
Wheat-other crops	119.3	7.2
Cotton-other crops	2	0.1
Bajra/Jowar/Guar-Wheat	368.7	22
Rice-Fallow	7	0.4
Bajra/Jowar/Guar-Fallow	34	2
Cotton-Fallow	15	0.9
Wheat-Fallow	108	6.5
Minor Rotations	369	22
Non Agriculture	245	14.6
Total	**1669**	**100**

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

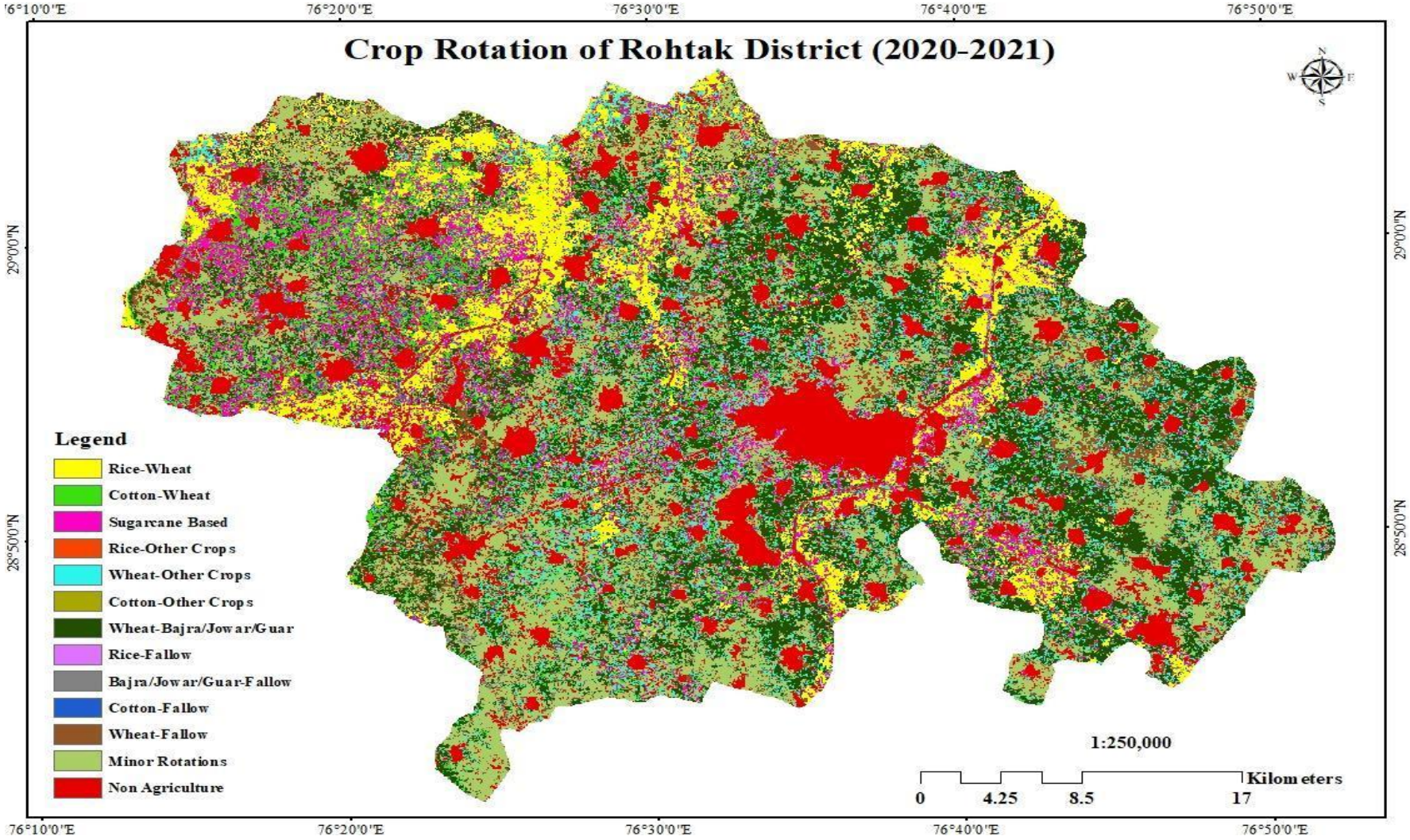


Figure 5

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, Sep 2022

Conclusion

The current study's goal is to examine cropping patterns in the Rohtak district utilizing digital image processing techniques and high resolution satellite data. As per analysis of the present study it is observed that the cropping pattern of Rohtak District is highly affected by the green revolution. Wheat, Mustard, and Pulses are the major crops in Rabi season while Rice, Cotton, Bajra, Jowar and Guar are main crops of Kharif season in the study area. Rice-Wheat, Cotton-Wheat, Rice-Other crops, Wheat-Other Crops, Bajra/Jowar/Guar-Wheat, and Wheat-Fallow are the major crop rotations observed in the study area.

References

- Agnihotri N. & Priyanka (2017). Trends and Patterns of Punjab Agriculture- An Analysis. *International Journal of Research in Management, Economics and Commerce*. Vol. 7 (6), pp- 17-23, ISSN- 2250-057X,
- Gulab, Singh, M. and Kumar, S. (2019). Causes and Temporal Inventory of Waterlogging and Salinity: A Case Study of Rohtak District, Haryana. 6 (2) (E-ISSN 2348-1269, P- ISSN 2349-5138).

  https://doi.org/10.3390/agriculture10060213.
- Khan, M. and Ahmad, A. (2019). Changing cropping pattern in Kheri district, Uttar Pradesh, India. *Economic Affairs*, Vol. 64(4), pp. 803-812. DOI: 10.30954/0424-2513.4.2019.16
- Kumar J. (2013). Land Use and Cropping Pattern in Village Surah, Teh. Jhajjar, Distt. Jhajjar. Haryana. *Indian Journal of Research*. *2* (12), 91-93.
- Misra,S.K. and Puri, V.K.(2011). Indian Economy- Its Development and Experience, Himalaya Publishing House Pvt. Ltd.
- Parihar S. (2017). An Analysis of Cropping Pattern in North-Western India. *International Journal of Recent Scientific Research*. *8*(11), pp. 22013-22022. DOI: http://dx.doi.org/10.24327/ijrsr.2017.0811.1182
- R, Manjunath & Kundu, Nitai & Panigrahy, S. (2006). Analysis of Cropping Pattern and Crop Rotation Using Multi-Date, Multi sensor And Multi-Scale Remote Sensing Data: Case Study for the State of West Bengal, India - Art. No. 64110O. *Proceedings of SPIE - The International Society for Optical Engineering*. DOI:10.1117/12.693921.
- Satyawan, Yadav, M., Hooda,R.S.(2014). Cropping System Analysis Using Geospatial Approach: A Case Study of Sirsa District in Haryana, India. *International Journal of Science and Research (IJSR)*. ISSN No. 2319-7064. Vol.3 (9).

- Singh Gomatee (2012). Factors Influencing Cropping Pattern of Bulandasahar District with Special Reference to the Size of Land Holding. *International Journal of Scientific and Research Publication*. *11*(5), ISSN 2250-3153.
- Singh, G.B. (2000). Green Revolution in India: Gains and Pains. Presidential address, *National association of geographers India*, pp. 15-19.
- Singha, Chiranjit, et al. (2020). Best Crop Rotation Selection with GIS-AHP Technique Using Soil Nutrient Variability. *Agriculture*. 10(6), pp. 213. Retrieved from
- Wali V.S., Poddar R., Mundinamani S.M., Yenagi B.S. (2019). An Analysis of Cropping Pattern in Malaprabha Project Command Area. *International Journal of Agriculture Sciences.* Vol. 11(2), pp.-7739-7742, ISSN: 0975-3710 & E-ISSN: 0975-9107.
- Yadav, K et al (2015). Cropping System Analysis of Kurukshetra District using Remote Sensing and GIS. *International Journal of Engineering Studies and Technical Approach*. *1*(5), ISSN No. 2395-0900.