ACREAGE ESTIMATING OF MUSTARD CROP IN HARYANA USING REMOTE SENSING

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Abstract:

The present study was conducted to analyses the spatial extent of mustard crop for Haryana State (India) by remote sensing data. Multi date Landsat 8 digital data of Rabi seasons of 2015-16 and 2016-17 where used for this study. The cloud free images of Rabi season were classified separately using unsupervised (ISO-DATA) Iterative Self-organizing Data Analysis Technique clustering approach defining conditions such as number of clusters. In season collected ground truth data using hand held GPS along with field photographs were used to identify mustard crop areas and other land features. The area was estimated by computing pixels under the classified image.The crop area under mustard crop was found 496200.06 hectares in 2015-16 and 499398.03 hectares in 2016-17 on satellite image which varies 2.9% (2015-16) to -6.9% (2016-17) from area as per Haryana statistical abstract. The density of mustard sown area was found in southern and south-western districts of Haryana State.

Introduction

Agriculture has a significant role in the socio-economic fabric of India. Agriculture and allied sectors accounted for 13.7of GDP and about 50% of the work force. Haryana is primarily an agriculture state. About 70% of residents are engaged in agriculture Haryana is self-sufficient in food production and the second largest contributor to India’s central pool of food grains and major portion of wheat, rice, bajra, mustard, sugarcane and cotton crops. In the recent years, state agriculture is more oriented towards commercial aspects of mustard, vegetables and fruits. Haryana is the third major mustard producing state in the country after Rajasthan and Uttar Pradesh. Along with the other mustard producing states in India, Haryana also benefited from the introduction of National Mission on Oilseeds and Oil Palm (NMOOP) which aims to increase production of vegetable oils sourced from oilseeds. It is Mainly grown in Rewari, Mahendergarh, Bhiwani, Jhajjar, Hisar, Gurgaon and Faridabad Districts. In recent years, mustard consumption has been increasing, leading to increased demand in global as well as domestic markets. Basically, mustard seed crop enjoys proper germination when soil starts containing moisture and the average temperature is 28 degree Celsius. A remarkable feature of changes in cropping pattern in Haryana is the enhanced share of the cereals, occupying two third of total cropped area at the expense of other food grain or pulses. Sangwan (1985) observed that changes in the cropping pattern of state resulted from increase in irrigation facilities to a large extent. Owing to the diversity of soil, agro-climatic conditions, availability of canal irrigation and infrastructure services like road and markets across the region, there exists lot of potentiality to cultivate varied types of crops.

Pre-harvest estimates of crop production, guides the decision makers in formulating optimal strategies for planning, distribution, price fixation, procurement, transportation and storage of essential agricultural products. ICT based monitoring of crops during the season and generating customized information on the prospects of crops would help minimize the impacts of various kinds of risks in farming. Thus, the near realtime crop information products from sowing-harvesting, has great influence on crop management and policy-making on the price, circulation and storage.

Conventional methods for mustard monitoring are based on ground-collected statistics, which is time consuming, inaccurate and expensive. Since the 1980s, satellite remote sensing has been considered as an important component in most crop monitoring programs. Ground surveys estimate the crop acreage and production at the provincial and national level but the limitation is getting timely and accuracy. Some of the limitations of conventional crop monitoring systems include qualitative measurements, human intensive, subjective judgments, time consuming, expensive etc. Unlike point observations of ground data, satellite sensors provide direct spatial information. Because of its ability to provide fast, up-to-date information and wide spatial coverage, space borne imagery is being used extensively for monitoring agriculture. Remote sensing (RS) is very promising in monitoring agriculture activities as both the spatial and temporal characteristics of a region can be easily accounted for by satellite imageries. Remote sensing, with varying degree of accuracy, has been able to provide information on land use, irrigated area, crop type, biomass development, crop yield, crop water requirements, crop evapotranspiration, salinity, water logging. It is possible to extract crop phenological stages from satellite image. Geographic Information System (GIS) have emerged as a powerful tool in the management and analysis of the large amount of basic data and information, statistical, spatial and temporal, needed to generate information products in the form of maps as well as tabular and textual reports for land use decisions. In recent years FAO has been developing GIS in linkage with its agro-ecological zoning and similar models, applying these to tackle issues of land at regional levels. There has been remarkable progress in developing GIS-based tools for land resources planning at regional scale.

The ability to gain practical experience using a remote sensing software and learning the digital image processing techniques or working with satellite imagery is a valuable understanding. The purpose of the following assignment serves as a means to analyse cropped area under mustard crop with the help of satellite imageries using ERDAS Imagine software. It gives an opportunity to learn digital image processing (DIP) by performing the methods of both unsupervised classification as well as supervised classification. Through both classification methods, it was learned how to adjust parameters and algorithms in order to produce an accurate & detailed final output map. Furthermore, upon completion of classification methods, the assignment taught how to read and analyze the statics relating to the images and how they are able to tell thorough information about the area through the digital image. GIS technology is very useful for automated logical integration of bio-climate, terrain and soil resource information, which are required for landuse planning in a region. Generation of spatial database from point database using geo-statistical techniques is an important part of GIS application which aids in the integrated analysis. The system is capable of containing all data required to solve resource management problems. Topographic maps, land resource map and contour maps having physiographic, geographic and bio-climate information forms primary input of GIS for landuse planning. GIS is a vital tool to analyse a multi-layered database. Its capabilities to process various data in spatial domain make the planning process easier. A GIS-based decision support system creates opportunities as an invaluable tool for all aspects of the land use planning process. (Aditi Sarkar, 2008)

II. STUDY AREA

As per Planning Commission of India, the state comes under the 'VI' agro-climatic region (Trans-Gangetic plain region). It lies within the geographical coordinates from 27º39' N to 30º55' N latitudes and 74º27' E to 77º36' E longitudes (Fig.1). Total geographical area is 44212 Sq.km (1.37% of country's geographical area) and 85% of it is available for agricultural use. Rest of 15% is covered for non agricultural purposes say built up, barren land or forests etc. The state has population of 25 million (2% of India's Population) as per census 2011. More than 70% of the population of Haryana is dependent on agricultural sector for their livelihood. Average annual rainfall of the state as a whole is 573 mm and below for arid/semi arid regions. The net cropped area is 3.64 million hectares. About 86% of the area is arable, and of that 96% is cultivated. About 75% of the area is irrigated through tubewells and an extensive system of canals. Mustard is the major crop after Wheat in the state during rabi season (October to March) and grown in arid/semi arid region of the State. For Mustard crops, the ground is prepared by 25th September to 10th October the and the crops are harvested by last of February or in beginning of March.

The climate is arid, semi-arid and sub-humid in different districts. In summer months temperature rise up to 43°C radiating heat waves with occasional dust storms. Rainfall varies from 190 mm to 1,150 mm. Mustard crop cultivated in arid and semi arid agriclimate zone. In addition to it, undulating topography of sand dunes also poses a challenge for canal irrigation. Areas supplied with canal irrigation or by other means, are predominantly under wheat crop otherwise mustard or pulses crops are cultivated. Therefore, to find out exact location and area under Mustard crop in Haryana of varied topography, remote sensing technology is best way and used in the present research.

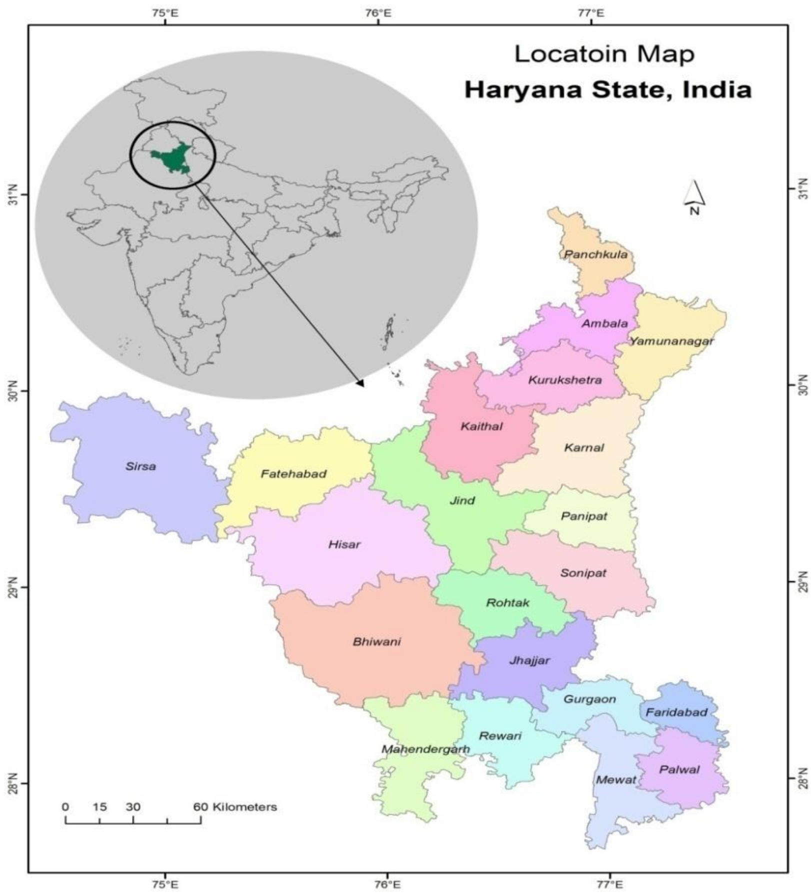

Fig. 1 District map of Haryana

Haryana state falls under 147 - 148 paths and 39 - 40 rows. Reference map shown in Fig. 2. Time period of scene acquired for Mustard analysis was Dec 2015 to March 2016, Dec 2016 to March 2017

A satellite image is geographical reference data that also composed of multiple bands (raster layers) having various type of spatial and radiometric resolutions. Therefore, a particular kind of software are required to handle and analysis of satellite images or remote sensing data. Some famous remote sensing software (also called Digital Image Processing software) are ERDAS Imagine, ENVI, Geomatica. In the present research, satellite data was analyzed in ERDAS Imagine software available in Lab of Deptt. of Agricultural Meteorology, CCS HAU Hisar.

III. Methodology

Step by step methodology starting from importing of data to classification is presented in following flow chart (Fig. 3).

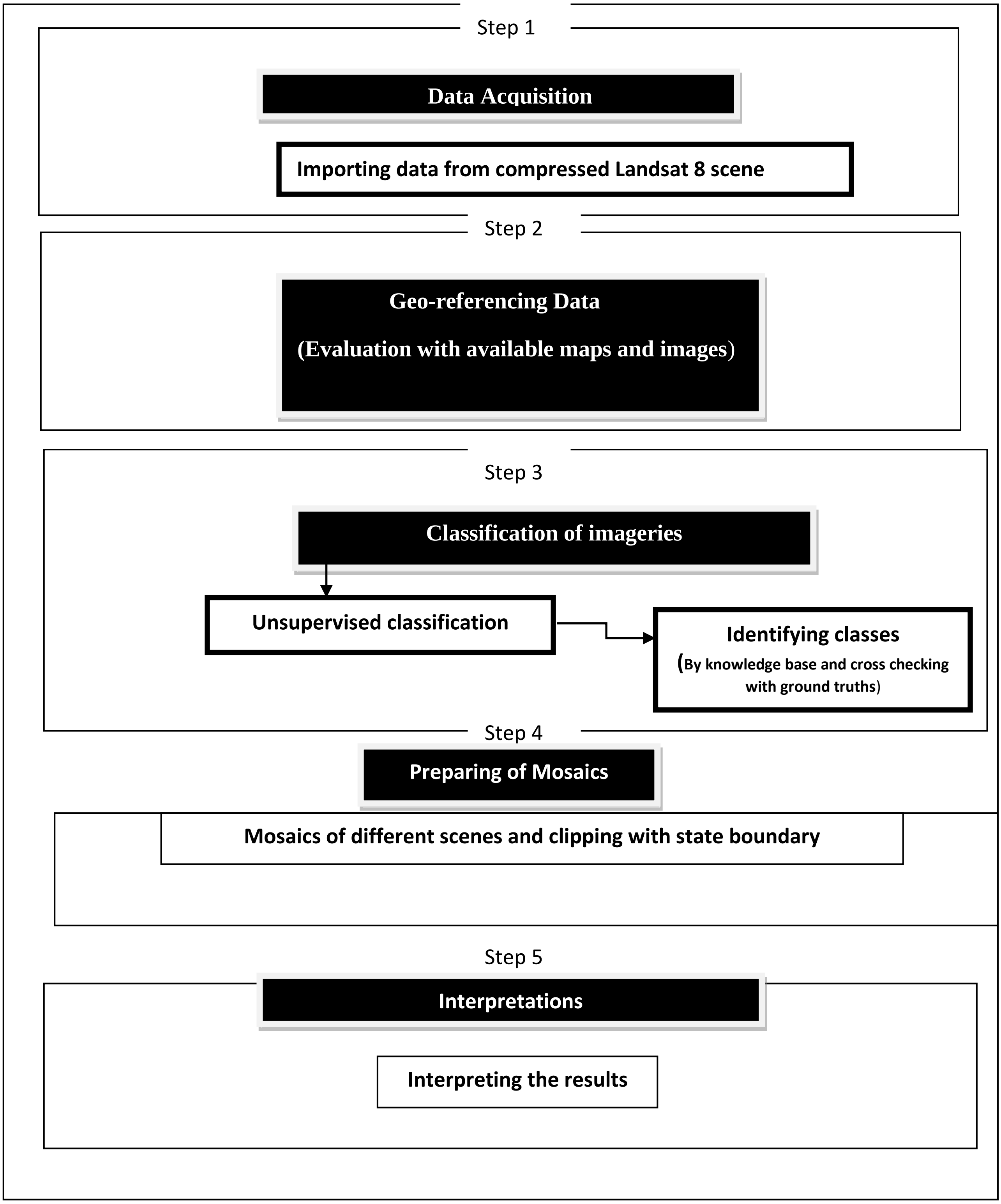

Fig. 2 Flow chart for methodology

Analysis and Results

Unsupervised Classification

In a multispectral image, each pixel has a spectral signature determined by thereflectance of those pixels in each of the spectral bands. Multispectral classification is an information extraction process that analyzes the spectral signatures and then assigns pixels to classes based on similar signatures (Sabins, 2007). For example, all of the pixels which represent an area of forested land on a TM image should have roughly the same spectral signature. Classification procedures attempt to group together such similar pixels.

This way, a layer can be generated with each land cover type represented by a different class. The detail of the classes depends on the spectral and spatial resolution characteristics of the imaging system. Landsat imagery is usually good for creating a general land cover classification map. Unsupervised classification is a method in which the computer searches for natural groupings of similar pixels called clusters (Jensen, 2009).

In ERDAS unsupervised classification is performed using an algorithm called the Iterative Self-Organizing Data Analysis Technique (ISODATA). Using this algorithm, the analyst input the number of clusters desired and a confidence threshold. The computer or software, then build clusters iteratively, meaning that with each new iteration, the clusters become more and more refined. The iterations stop when the confidence level (or a maximum number of iterations specified by the user) is reached (Jensen, 2009). For example, if the user wants 30 clusters at 95% confidence, the computer will iteratively build the clusters until it is 95% confident has attained the best distribution of pixels into 30 clusters.

For identifying the classes, each class was highlighted at a time and then determine which of the landuse it belonged to by interpreting the original multispectral image. Fig. 4, 5 and Fig. 6 present the Landsat scene 147-40 of Haryana before and after classification respectively. In addition to MSS, NDVI of the image was also prepared and compared with each class to identify vegetation. Then each class was given a color such as water as blue. Finally, the image was exported to map as shown below.

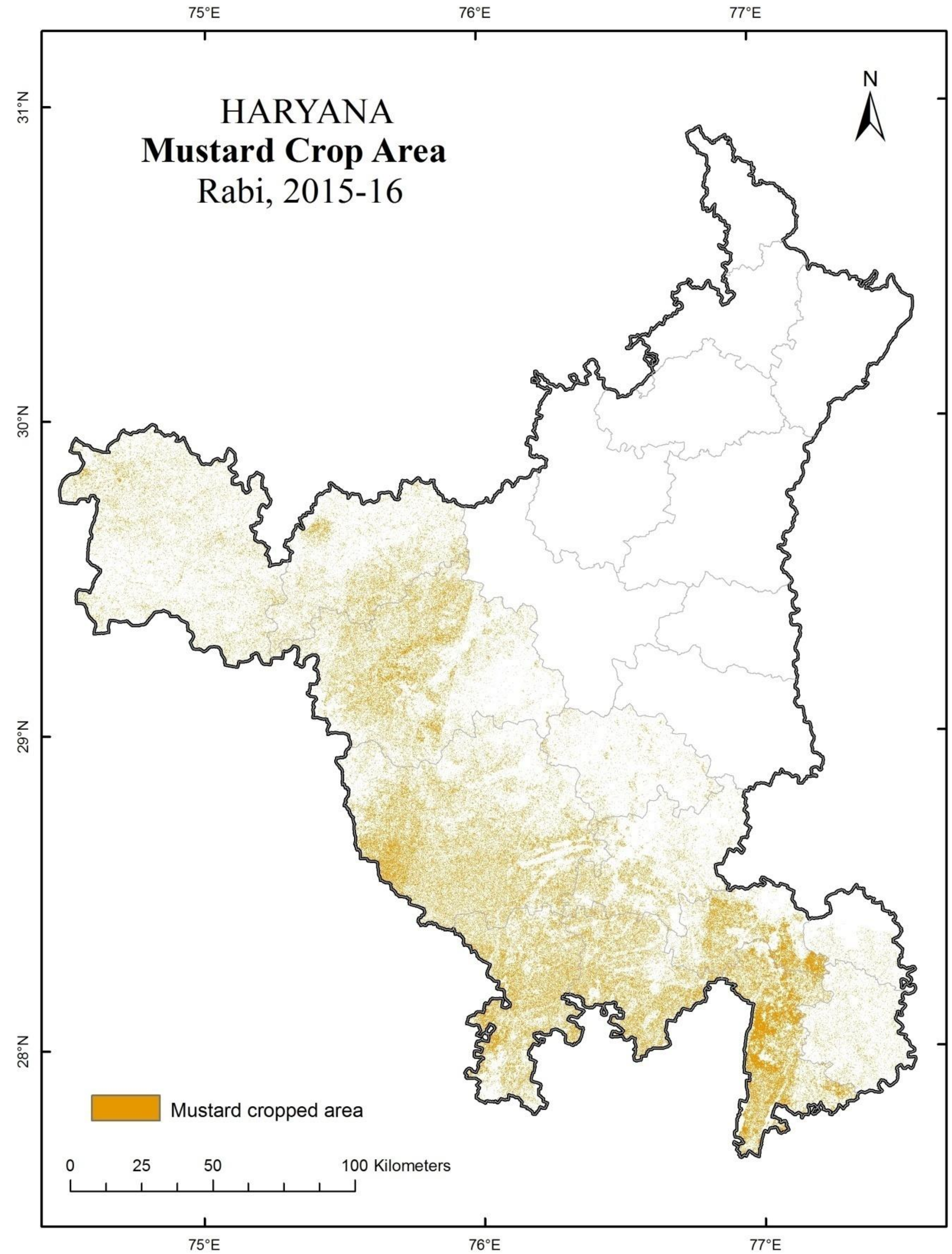

Fig. 5 Mustard Crop Area in scene 147-148; 39-40. 2015-16

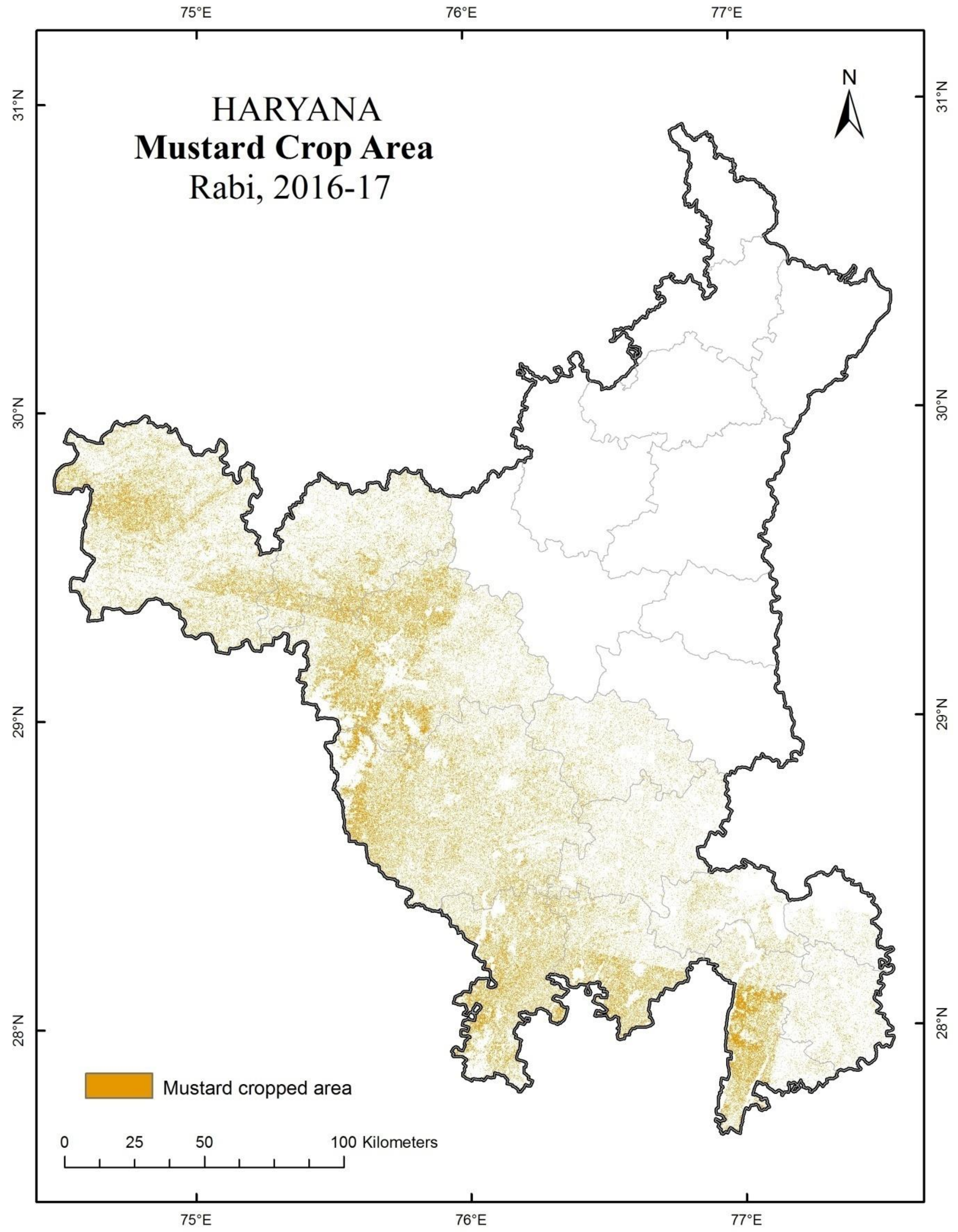

Fig. 6 Mustard area in scene 147-148, 39-40.

Total of 30 classes were classified and presented (Table 2) here along with count of pixels in each class.

As per classified area for 2015-16 rabi season,

Count of mustard pixel was: 5513334 pixels

Hence area under wheat was: 5513334 x 0.09

= 496200.06 hectares

The area of 496200.06 hectares is +2.9 of total area under mustard crop as reported by Department of Agriculture of Haryana in 2015-16 (481000.10 hact)

As per classified area for 2016-17 rabi season,

Count of mustard pixel was: 5548867 pixels

Hence area under wheat was: 5548867 x 0.09

= 499398.03 hectare

The area of 499398.03 hectare is 93.1 % of total area under mustard crop as targeted by Department of Agriculture of Haryana in 2016-17 (537000.0 hact)

VI. CONCLUSION

In map of 2015-16 it is observed that area of mustard crop found maximum in Bhiwani followed by Mahendragarh, Hisar, Rewari, Sirsa. This area is mainly located around Haryana Rajasthan border which is arid and semi-arid Region.

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