WHEAT CROP IDENTIFICATION AND DISCRIMINATION USING RESOURCESAT P-6 LISS III AND AWiFS SENSOR SATELLITE DATA OF INDORE DISTRICT

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Abstract

Crop recognition (identification and discrimination) from other crops is a primary step for further research, analysis and studies about crop condition, acreage, production estimation, crop growth monitoring, crop disease analysis etc. Crop identification and discrimination is based on differential spectral response of various crops in a multi-dimensional feature space produced by different spectral bands, or time domain or both and is influenced by sensor characteristics and pattern recognition techniques. Each crop has its unique architecture and growing period, thus enabling discrimination through remote sensing data. If there are two crops with similar spectral signatures on a given date (confusion crops), multi-temporal remotely sensed data may be used to discriminate them. This paper highlights wheat crop identification and discrimination from pulses and other crops with the help of single date LISS-III and multidate AWiFS for Indore district of Madhya Pradesh during the period between 2010-11. For this study we have collected various ground control points (GCPs) from wheat dominant area and further plotted against the classified images for the same region. AWiFS and LISS-III data has proven its efficacy to reveal the information of natural resources especially wheat crop identification at district and village level respectively.

Keywords: Wheat crop, Remote sensing, LISS-III, GPS, Indore.

Introduction

Agriculture is the backbone of the Indian economy, contributing about 40% towards the Gross National Product (GDP) and providing livelihood to about 70% of the population. The total geographical area of India is 328.7 million hectares with 140.3 million hectares is net-sown area, while 193.7 million hectares is the gross cropped area (annual report, Ministry of Agriculture, Govt. of India 2009-10). India has a very well developed system for collection of crop statistics covering more than 50 crops at village level and aggregating it at different administrative levels. However, need for early and in-season crop production forecasting has been strongly felt. Remote sensing for crop assessment has been explored since very beginning of Space Applications in India. A nation-wide project called Crop Acreage and Production Estimation (CAPE) was launched by the Ministry of Agriculture and co-operation, Government of India in 1988. Crop identification with remote sensing technique requires the data when crop has sufficiently grown. However, forecasting of crop at sowing stage would require use of weather data and information on economic factors controlling the farmer's response. Considering these things forecasting agricultural output using space, agro-meteorological and land based observations (FASAL) concept was devised. Remote sensing can obtain surface information macroscopically, periodicity and economically. It has many advantages in agricultural monitoring and survey. Governments has long been paid much attention to survey crop acreage and yield using remote sensing, and great success has been achieved (**Narasimhan R L and Chandra 2000; Dadhwal and Ray 2000; Bastiaanssen and Ali 2003; Prasad et al., 2006**). **Campbell *et al*.** (1987) has evaluated direct use of temporal spectral data for wheat acreage estimation in Australia. Crop yield estimation has an important role on economy development (**Hayest and Decker, 1996**).These predictions suggest to the decision makers about potential reduction in crop yields and allow timely import and export decision. This is possible only with the crop identification and discrimination. In the present study various GCPs points for the wheat crop were collected through GPS, interviewing with formers for collect information about management practice, date of sowing of wheat crop for Rabi season, November2010-March 2011 for Indore district.

Study Area

The study was conducted for Indore district of Madhya Pradesh, India during Rabi season of 2010-2011. Indore district lies in the heart of Malwa plateau and covers an area of 3904 sq km. It is bounded by N latitudes 22° 31' and 23° 05' and E longitudes 75° 25' and 76° 15'. The area is characterized by two growing seasons viz-*kharif* and *rabi*. Wheat is grown in *rabi* season from middle of Oct to middle March.

Climate

The climate of Indore district is characterized by hot summer. The year may be divided into four seasons. The cold season, December to February is followed by the hot season from March to middle of June.

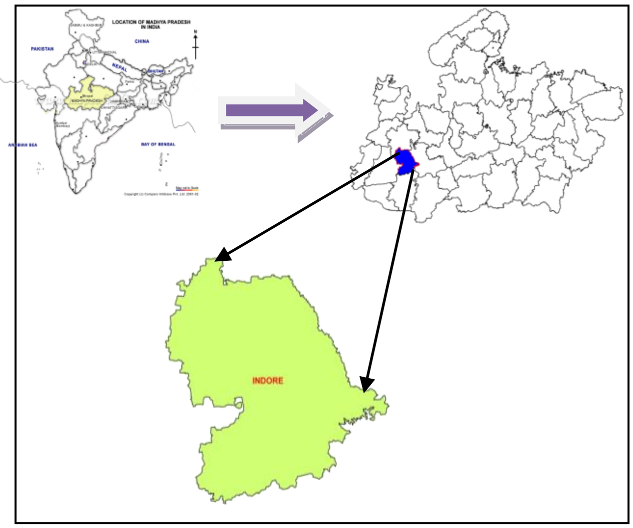


Figure 1 Study area location showing Indore district

Rainfall

The rainfall of Indore district is well-distributed rainfall during the southwest monsoon season. Monsoon arrives generally in the middle of June and the weather becomes pleasant. January is generally the coolest month. The district receives maximum rainfall during the south west monsoon period. Thus about 91.2 % of the total annual rainfall takes place during the south west monsoon period (June to September) alone. The maximum monthly rainfall takes place during the month of July.

Soil

The district is generally covered with black cotton soils converging almost three fourths of the area .this part is occupied by Deccan Basalts.

Materials and method

Present study has been carried out with the help of Multi-date AWiFS sensor satellite data from sowing to maturity period and single date LISS-III sensor satellite data of max [m] vegetation growth crops are used for crop identification and discrimination in the study area. The spatial resolution of LISS-III (23.5 m) is higher than spatial resolution of AWiFS (56 m) but the temporal and radiometric resolution of AWiFS is much better than that of LISS-III. Both the sensors have same spectral resolution (four bands from green to middle infrared).

Various GCPs were collected for wheat crop through GPS and interviews with former were conducted on farmer field. All the information collected during the field visit was imported on the IRS images.

Table 1 Details of LISS-III and AWiFS sensors of Resourcesat 1 IRS P-6 satellite data used:

Instrument	LISS - III	AWiFS
Spatial Resolution	23.5 meter	56 m (nadir) (70 meter at swath edge)
Spectral Bands (µm)	B2:0.52–0.59(green) B3 : 0.62 – 0.68 (red) B4 : 0.77 -0.86 (NIR) B5 :1.55 -1.70 (SWIR)	B2:0.52—0.59, (green) B3: 0.62—0.68, (red) B4: 0.77—0.86, (NIR) B5:1.55—1.70 (SWIR)
Swath Width	141 km	740 km
Revisit time	24 days	5 days
Power (W)	70	114
Weight (Kg)	106.1	103.6
Data Rate (MBPS)	52.5	52.5
Quantization (bit)	7	10

Ground Truth (GT)

Ground Truth (GT) data was collected during November to March, which coincides with the sowing stage to maximum growth stage of wheat crop. Wheat dominant grown areas under different physiographic conditions were identified using previous season FCC. These sites were visited and interviewing with former's conducted on field about management practices and agronomic observations like growth stage of crop, crop density, variety etc were recorded for each site. The geographic locations of important sites in the wheat-growing areas were recorded by using global positioning systems (GPS).

Table 2 GCPs for wheat crop in the study area.

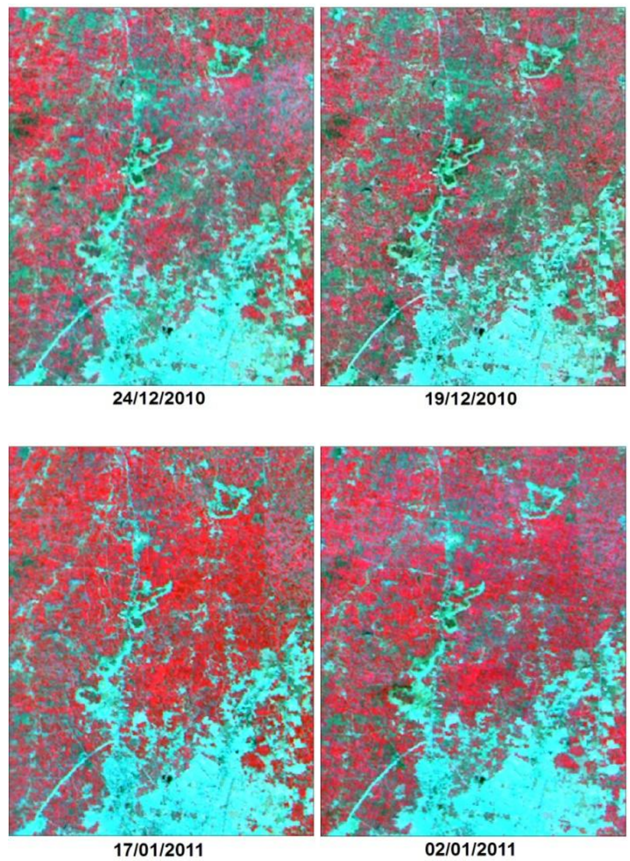
S. N.	Latitude	Longitude	Village Name	Sowing Month

1	22° 51'55.2"	75° 40' 6.48"	Sumtha	November
2	22°50'27.5"	75° 38' 18.6"	Sumtha	November
3	22°50'21.3"	75° 34' 48"	Badoli	November
4	22°52'9.91"	75° 51' 3.87"	Solsinda	Mid-October
5	22°51'44.5"	75° 51' 44.5"	Dharampuri	End-October
6	22°52'16.1"	75° 51' 38.8"	Solsinda	November
7	22°55'8.7"	75° 50' 8.77"	Tarana	November
8	22°58'7.52"	75° 50' 45.9"	Ranver	November
9	23°2'7.35"	75° 50' 11.3"	Badodia Khan	November
10	23°51'5.18"	75° 28' 50.4"	Limdoda Par	November
11	22°51'56.4"	75° 28' 48.9"	Khatwadi	November
12	22°50'42.7"	75° 35' 53"	Badoli	November
13	22°51'30"	75° 30' 44.3"	Depalpur	November
14	22°43'9.83"	75° 42' 8.33"	Borsi	November
15	22°33'3.34"	75° 39' 11"	Avlay	November
16	22°29'21.9"	75° 39' 14.9"	Bhicholi	November
17	22°31'10.3"	75° 36' 27.5"	Kamadpur	November
18	22°29'43.6"	75° 34' 53"	Khedishihod	November
19	22°51'53.2"	75° 40' 42.2"	Aarnia	October
20	22°52'6.47"	75° 42' 9.86"	Ratankhedi	October
21	22°50'11.9"	75° 44' 42"	Basandra	October
22	22°45'34.1"	75° 43' 36.3"	Rozdi	October
23	22°44'58.8"	75° 43' 6.18"	Kalmer	November
24	22°52'52.9"	75° 43' 7.51"	Jindalheda	November
25	22°43'7.06"	75° 42' 35.2"	Borsi	October

Crop Identification and discrimination using Satellite Data

The crop Identification and discrimination using satellite data is possible either by visual or digital interpretation techniques. Visual techniques generally are based on standard FCC (False Colour Composite) generated using 3 band namely green, red and near-IR bands assigned blue, green and red colors. The digital techniques are applied to each pixel and use full dynamic range of observations and are preferred for crop discrimination.

Multi date data (AWiFS) are used when single date (LISS-III) data does not permit accurate crop discrimination. For the confusion crops, we consider following three stages: (a) preprocessing, (b) data compression, and (c) *image* classification. The pre-processing includes multi-date registration and removal/ minimization of atmospheric effects through radiometric normalization or atmospheric correction.Although all the bands from multiple acquisition data set have been used in multi-date classification procedures (**Bizzell *et al*. 1975; Bauer *et al.* 1979; Hixson *et al.* 1980).**



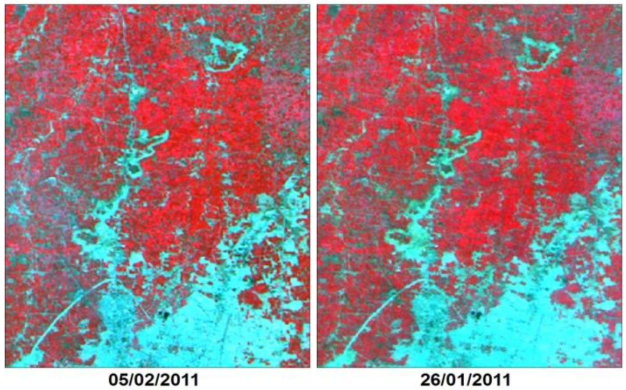
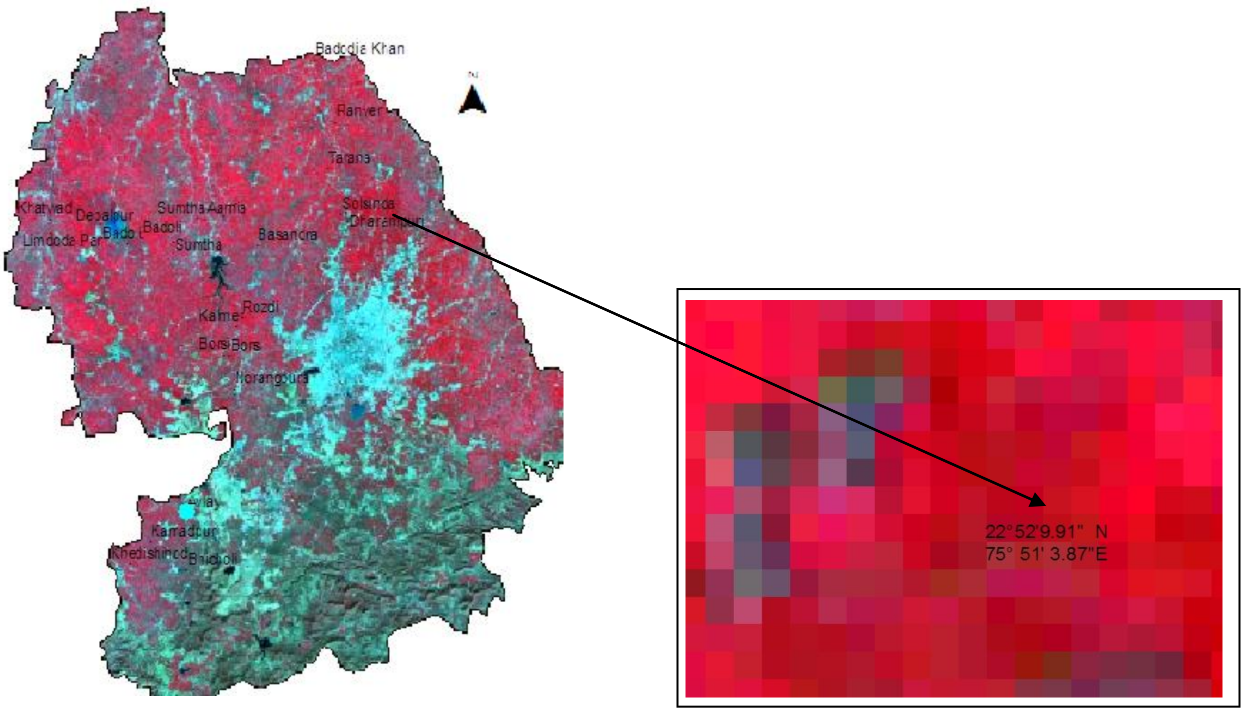


Figure 2 Multi date IRS P6 (ResourceSat 1) AWiFS satellite data (rabi season 2010-2011)



(a)

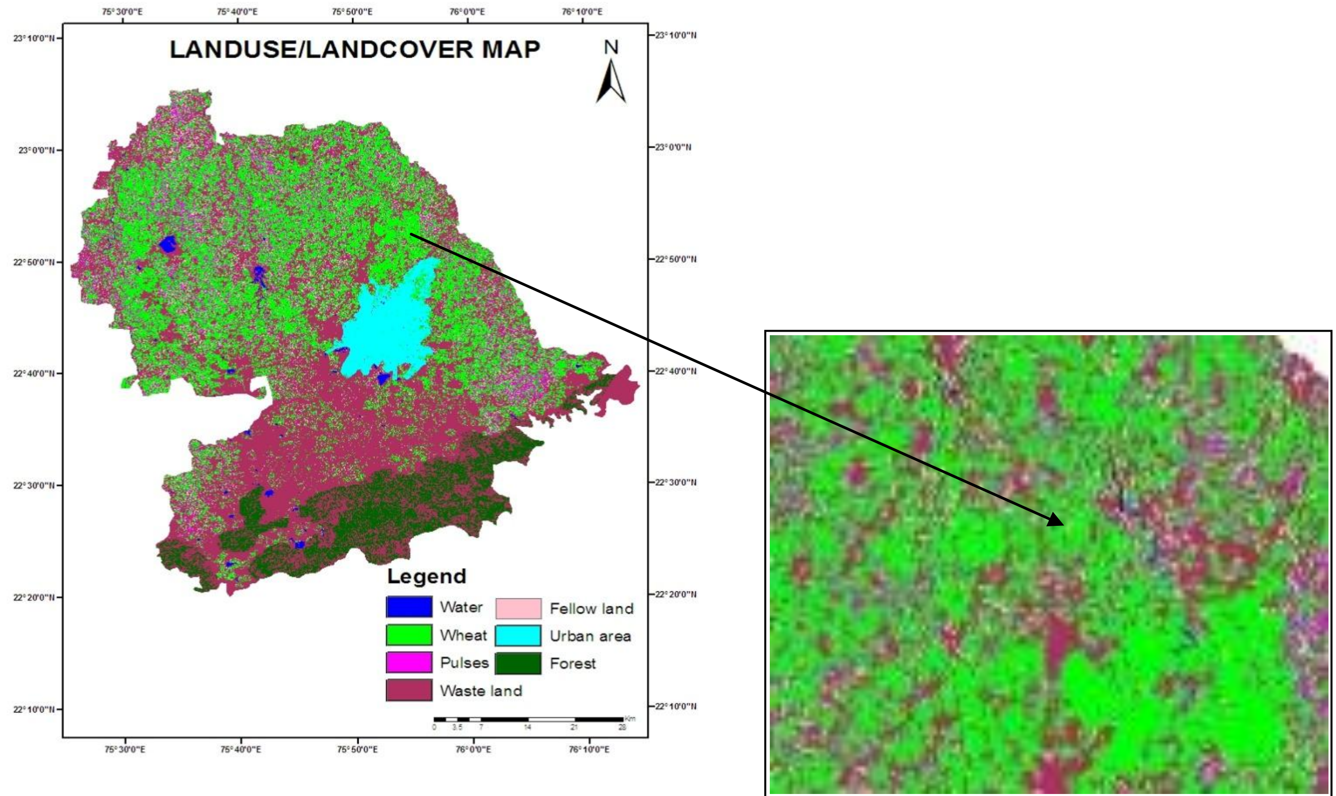


Figure 3 (a) Showing LISS III image and (b) corresponding classified image.

Result and discussion

This is now very much evident that wheat crop can easily be distinguished with other crops with the capability of coarse resolution remote sensing data, which gives a unique signature form standing crop. Health of crop can also be identify with the fact that healthy crops gives relatively more reflectance than un-healthy one (Fig. 3). A healthy wheat crop reflect maximum amount of incoming radiation and hence appears deep red in standard FCC which can be easily distinguished with other same season crops. Here in the Figure 2 it is observed that pulse has relatively light (pink on image) color tone. The GPS point collected during field validation has laid over the classified image to validate the accuracy, which was observed more than 92 with 8% commission and 12% omission error due to may be small plot size with respect to pixel size (23.5 m in case of LISS III). Visual image interpretation technique was also considered for mapping with element of image interpretation like, texture, tone shape and associations.

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