Acreage estimation of Rice Crop Using Multi-Temporal RADARSAT Satellite Data for Jind district, Haryana

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Abstract— This paper explains area estimation of rice crop using multidate RADARSAT satellite data for Jind district of Haryana. The paper shows backscatter behaviour of rice crop as a function of time using multidate RADARSAT satellite data. The all weather capabilities of microwaves is one of the major factors for its application in crop forecasting. Microwave remote sensing has advantages over optical remote sensing. Firstly, the radar energy has the ability to penetrate the clouds and even the light rain and thus we can get the data even in kharif season. Secondly, the radar backscatter depends on dielectric constant of the surface. As the rice in Haryana is mostly transplanted on flooded soil, so the backscatter obtained from multidate SAR data helps us in discriminating rice from other major kharif season crop like cotton etc.

Keywords — Remote sensing, Radarsat multidate data, area estimation

I. INTRODUCTION

Multi-Date SAR data has been successfully used to discriminate different crops, especially rice, from other crop covers (Brown et al.,1984; Parihar et al., 1998). These data were used to study the temporal backscatter coefficient of the several crops in relation to their growth stage. Macelloni et al (2001) also found results in modelling the backscatter for the wheat crop during its various growth stages and estimated the cover under wheat. Rice is the major kharif season crop of Haryana state .The main characteristics of rice crop is that it is transplanted on flooded soil. In Jind district rice and cotton are grown as the major kharif season crops. Being a kharif season crop rice is transplanted in the period from 15th June to 31st July. During this period wheather is mostly cloudy and rainy. So under cloud cover conditions capabilities of optical sensors becomes limited. But cloud cover is more transparent at microwave frequencies, so microwave sensors play important role in data collection in monsoon season. Crop classification includes crop identification, discrimination from associated crops and acreage estimation. The multi-temporal RADARSAT satellite data was used to classify rice crop. After the classification crop proportion and finally crop area in hactares is estimated.

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II. STUDY AREA

The district lies in the North of Haryana between 29.03' and 29.51' North ltitude & 75.53' and 76.47' East longitude. On its East and North-East lie the districts of Panipat, Karnal and Kaithal respectively. Its boundary line on the North forms the inter-state Haryana- Punjab border with Patiala and Sangrur districts of Punjab. In the West and South-West it has a common boundary with districts Hisar & Fatehabad and in its South and South-East lies the district of Rohtak and Sonipat respectively. Total geographical area of the district is 2702 sq.km. The district has tropical steppe, semi-arid and hot monsoon type of climate. The normal annual rainfall of the district is 515 mm, which is unevenly distributed over the area in 26 days. The Jind district is sub-divided into seven communities development blocks viz., the Narwana, Uchana , Alewa, Jind, Julana, Pillukhera and Safidon.

III. DATA USED

The RADARSAT satellite operates at C-band. Details of SAR data used in the study is given below in the table.

Date	Major crop during acquisition of data
06-July-2011	Rice, Cotton
30-July-2011	Rice, Cotton
24-August-2011	Rice, Cotton

The first date assigned red colour (R), second date to green colour (G) and third date to blue colour (B) to have multidate false colour composite (fcc). The multi-temporal co-registered SAR data was used to classify rice crop using ground truth information. The pixel size of co-registered data is of 25m.

IV. METHODOLOGY

Digital image analysis of multidate radarsat image was carried out using Geomatica software. Ground truth (GT) data was collected using hand held Global Positioning

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System (GPS) in the Jind district. The coordinates of GT sites were recorded using hand held (GPS). The ground truth data was overlayered on georefrenced multidate RADARSAT image.The ground truth data was used to extract rice signature and to built decision rules for rice classification. The ground truth data is also used to built models for classification. The SAR image is then classified using hirarical decision rules. Complete enumeration approach has been used to estimate rice area in hactares. The GT data was also used to check the accuracy of classification

V. CLASSIFICATION OF RICE AREA

For classification three date geo-refrenced RADARSAT satellite image is used. Using Geomatica software district boundary is rasterized and then appropriate models are run. Based on backscatter values in three dates rice is mainly divided in three categories early sown, mid sown and late sown rice. For early sown rice backscatter increases in 2nd date but there is decrease in backscatter in the 3rd date. The decrease in 3rd date may be due to decrease in moisture content in the crop. In mid sown rice crop backscatter increases in 2nd and 3rd date. This increase in backscatter may be due to volume scattering from the vegetation. In late sown rice i.e. rice sown in last week of july threre is high backscatter in 1st date. In this case backscatter is mainly from soil surface, so soil roughness and soil moisture effect backscatter values. The high rough and high moist field give high backscatter in 1st date. In 2nd date (30th july) low backscatter is obeserved. This may be due to flooded soil. The backscatter again increases in third date. The increase in backscatter in third date is due to volume scattering from vegetation. Based on backscatter values in three dates separate decision rules are built for early, mid and late sown rice. The image is then classified with decision rules developed. After the classification of image crop proportion and finally acreage estimation of rice crop in hactares is estimated.

VI. RESULT AND DISCUSSION

Different crops sown at different time have different cropping growth profiles. This makes easy for the discrimination and classification of crop using multidate SAR data. The rice crop is transplanted on flooded soil. So intially we get low backscatter. As the crop progresses the backscatter increases due to volume scattering from the crop. When rice reaches near harvesting stage then backscatter decreases due to decrease in moisture content in the crop.

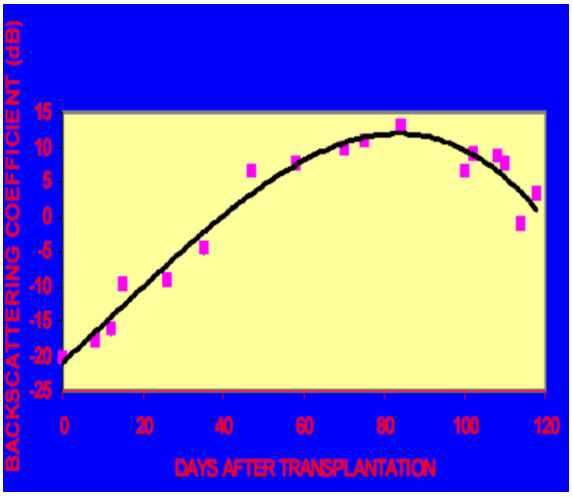

Fig .1 shows temporal variation of backscatter for paddy crop.

For other main kharif season crop such as cotton in the 1st date backscatter is mainly from soil surface. So soil roughness and soil moisture plays main role in radar backscatter. High rough and high moist fields give high backscatter values. In the 1st date we generally get high backscatter from cotton field. As the plant developes then radar backscatter further increases due to volume scattering from the vegetation. For urban areas, villages etc high backscatter is observed in all the three dates. These areas appeared very bright in all the three dates. For forest area very little change in backscatter is observed in all the three dates. Low backscatter is observed for water bodies like ponds, river etc. These appear dark in radar image. So based on backscatter values the pixels may be classified as rice and non rice crop. Fig.2. shows multidate RADARSAT image of Jind district.

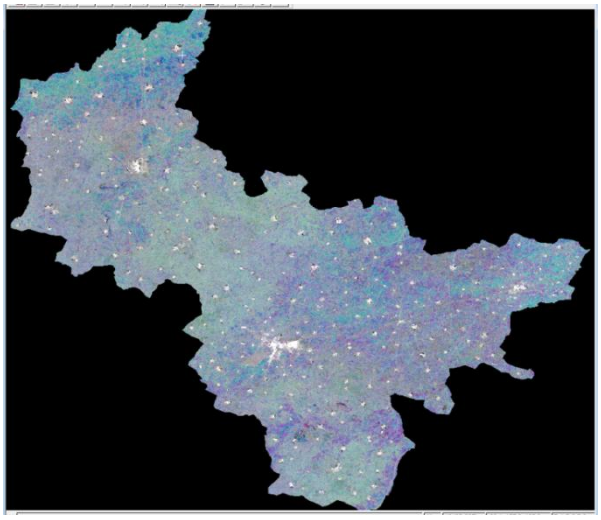

Fig.2. RADARSAT image (FCC) of Jind district

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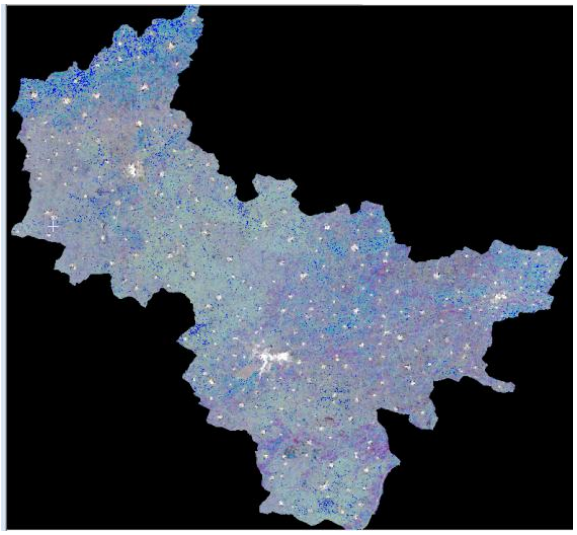

Fig.3. classified image of early sown rice (blue colour)

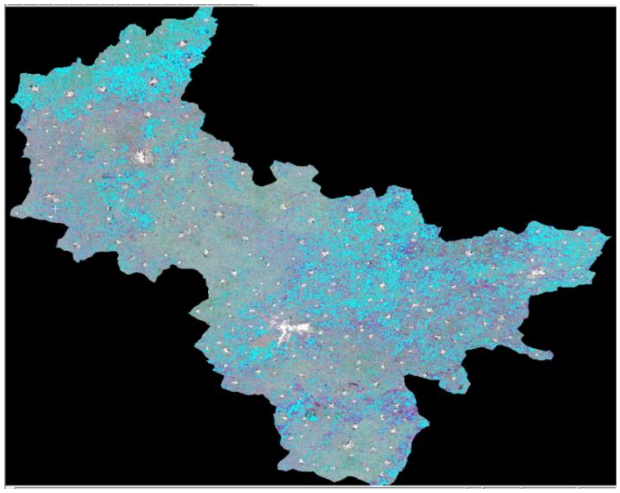

Fig.4. classified image of mid sown rice (cyan colour)

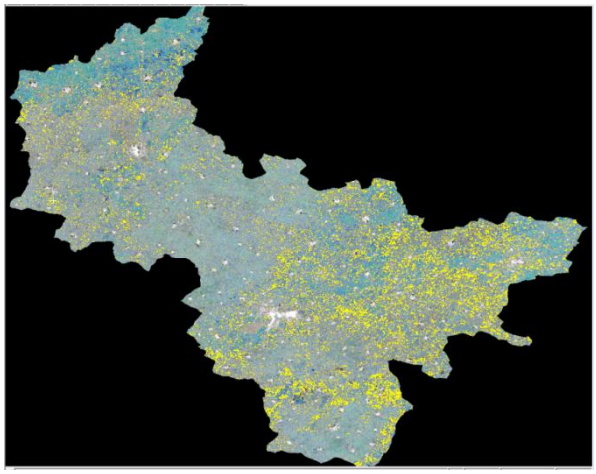

Fig.5. classified image of late sown rice crop(yellow colour)

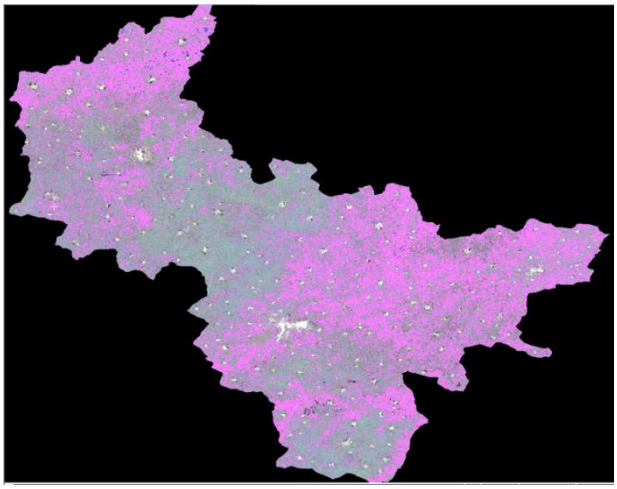

Fig.6. Classified image of rice crop of Jind district (pink colour).

The total area of rice crop for Jind district was estimated 106449 hactares for the year 2011.

VII. CONCLUSION

Rice is one of the major kharif season crop of Jind district.The study showed that temporal backscatter obtained from multidate SAR data using C-band is useful for discrimination of rice and other associated kharif season crops. Rice transplanting patterns (early, mid and late sown) can be identified using multidate SAR data. As the microwaves has more penetration so cloud cover in kharif season creates no problem for acquiring the SAR data.

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