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PADDY CROP CLASSIFICATION USING MICROWAVE SATELLITE DATA IN 23 DOWN HAIDERGARH CANAL COMMAND SYSTEM, UTTAR PRADESH, INDIA

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ABSTRACT- *Paddy (Rice) is one of the major food crops of 23 Down Haidergarh Canal Command Area of Uttar Pradesh. It is necessary to determine the paddy (rice) field as accurately as possible using fast and economical methods for generating minimum support price for rice to provide maximum benefit to the farmers as well as for crop insurance and due to excess production problem of storage has been increased and if the area and productions are less then there is a problem of over pricing as well as starvation, to mitigate both the situation there proper planning is required. So the remote sensing and GIS technique provide quick and reliable information to the planning organizations for proper management. Rice is cultivated during two main seasons namely Kharif and Rabi. In the study area rice is transplanted during July and August and harvesting during October to mid. November. Cloud cover is the major problem during this season and optical data could not penetrate through the cloud. Microwave Remote Sensing uses electromagnetic radiation with a wavelength ranges between 1 cm and 1 meter. It enables observation in all weathers condition, day-night and penetrate through cloud cover, haze, dust except the heaviest rainfall. This is one of the most important advantages which are not possible with optical remote sensing. So we used Sentinel-1 C- band microwave satellite data for the year 2018 for Paddy acreage estimation in the study area. The classified paddy cropped area was* ***66287.25 hectares*** *for the year 2018.*

Key Words: Microwave; Paddy; Remote Sensing & GIS; Sentinel-1

1. INTRODUCTION

Paddy (rice) is one of the most important crop not only in India but also in world. Paddy (rice) fields account for approximately 15% of the world's arable land. Rice is cultivated during kharif and rabi season. The kharif season starts from mid-June and ends in November whereas rabi season starts in December and ends in May. In the study area paddy is transplanted in kharif season. Paddy (rice) is the major crop in this area and it is transplanted on a flooded soil. In kharif season, rice is transplanted in the period from mid June to last of the July. During this time weather conditions are usually cloudy. Due to cloud cover, potential of optical sensors becomes bounded. But cloud cover is glassy at microwave frequencies so microwave sensors are essential part in collection of data in monsoon season. The multi-date Sentinel-1 C-band satellite data of 2018 was used to identify the paddy fields. After identification of paddy field and crop area in hectares were estimated.

2. STUDY AREA

Haidergarh is a town and a nagar panchayat of the Barabanki district in the Indian state of Uttar Pradesh. Haidergarh (23 Down) Canal Command system lies in central physiographic region of Gangetic plains. The normal average rainfall of the area is 800 mm. It lies between Latitude 26⁰23'32.555''N to 26⁰41'27.447''N and Longitude between 81⁰16'25.31''E to 81⁰42'3.955''E. It is situated about 55 km from Lucknow. The total area of the Haidergarh Branch Canal Command Area is 102179.49ha.

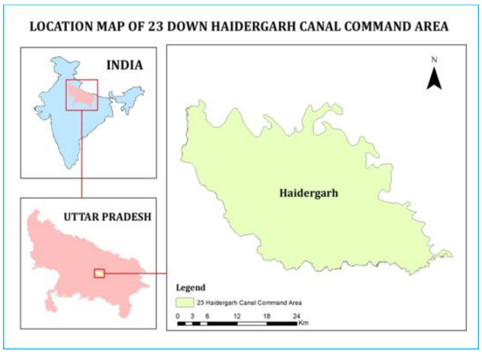

Figure-1: Study Area Map

3. DATA USED

SENTINEL-1A satellite operates at C-band. Eight date Sentinel-1A GRD datasets of 12 days temporal resolution was downloaded from freely available Copernicus data hub provided by European Space Agency (Table-1).

Table -1: Details of Satellite data used for the study

Sensor	Polarization	Frequency And Acquisition Mode	Acquisition Date (2018)
Sentinel-1A	VV+VH	C-Band (5.4GHz) and Interferometric Wide Mode(IW) with 250 km swath & 10 m Spatial resolution	17thJune 29th June 11th July 23thJuly 4thAugust 16thAugust 28th August 9th September 21st September 3rd October

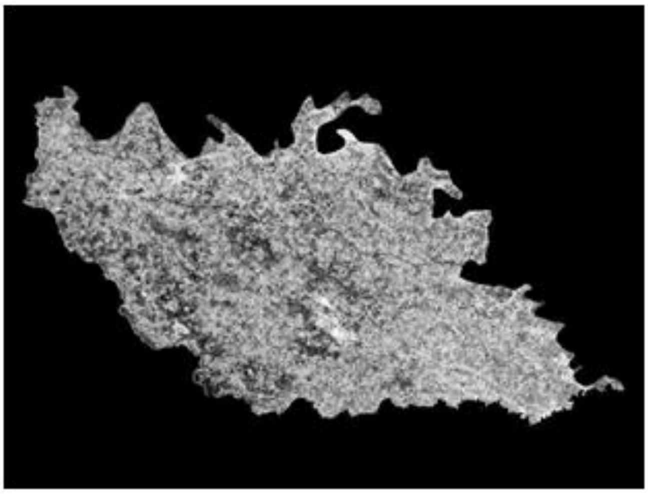

Figure -2: Single Date Image of Microwave Data

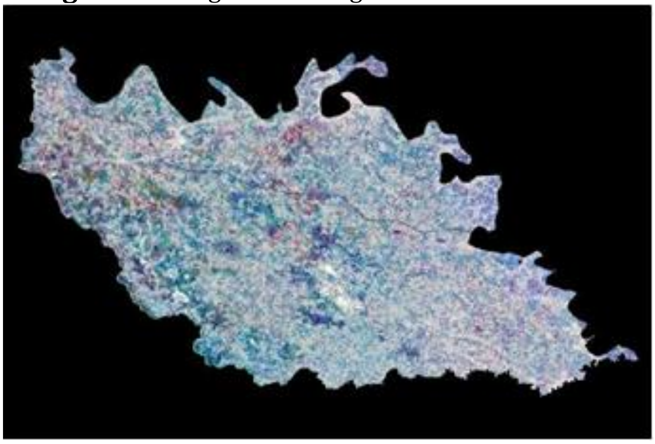

Figure -3: Multispectral Image of Microwave Data

4. METHODOLOGY

4.1 DATA PRE-PROCESSING

The datasets of Sentinel-1A were pre-processed by SNAP software. The orbit file correction was carried out to modify the metadata with specific orbit vectors. The study region includes mostly agricultural regions with varied crops leading to random scattering process.

For this specific scene, adaptive filter Lee Sigma filter of window size 5X5 was seen as compelling as it is based on neighborhood statistics (standard deviation) determined within the each filtering window of the image. It eliminate the speckles without flexible the edge sharpness, scattering mechanisms and preserves finer image details(Saxena & Rathore, 2013).For comparing values of multi-temporal datasets and for various parameter characterization, radiometric calibration of SAR data is done and converted to dB scale(Freeman, 1992). Finally the temporal images are registered with first date master image and made as eight date stack (Fig: 3).with principles created. After the stratification of image crop extent and acreage estimation of paddy crop in hectares is assessed.

4.2 CLASSIFICATION OF PADDY AREA

For classification any three date out of ten datasets SENTINEL-1A satellite image is used. Using ERDAS imagine software study area boundary was rasterized and then appropriate models were run (Fig.4). Due to backscatter value the three dates paddy (rice) is fundamentally separated into three classes early planted, mid planted and late planted paddy. For early planted paddy (rice) backscatter increments in 2nd date yet there is reduce in backscatter in the 3rd date. The reduction in 3rd date might be because of water content in the crop. In mid planted paddy crop backscatter increments in 2ndand 3rd date. This expansion in backscatter might be because of volume dispersing from the vegetation. In late planted paddy, paddy (rice) planted in the end of July there is high backscatter in 1stdate because backscatter is predominantly from the soil surface, so soil roughness and soil moisture impact the backscatter values. The high rough and high wet field give high backscatter in 1sr date and 2nd date low backscatter is observed. This might be because of inundated soil. The backscatter again increases in third date. The expansion in backscatter in third date is because of volume dispersing from vegetation. In view of backscatter esteems in three dates separate choice principles are worked for early, mid and late planted paddy (rice). The image is then classified.

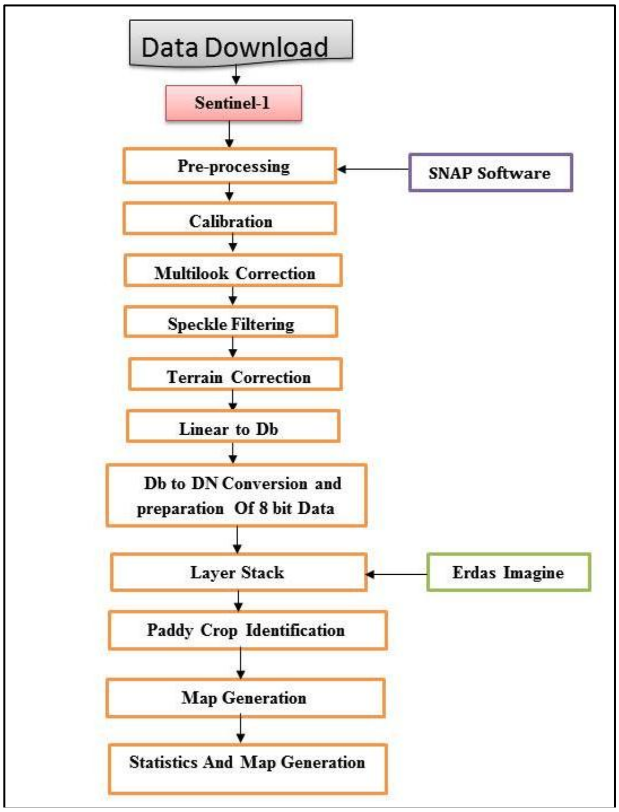

Figure -4: Methodology Flow Chart

5. RESULT AND DISCUSSION

Various Crops planted at various time have unique cropping vegetation profiles. This makes simple for the segregation and classification of crop utilizing multi date SAR information. The paddy crop is transplanted on overflowed soil. So initially we get low backscatter. As the crop grows the backscattered energy increases because of the volume scattering from the crop. At the point when rice comes to approach gathering stage at that point backscatter diminishes because of reduction in dampness content in the yield. For urban regions, towns and villages so forth high backscatter is seen in all the three dates. This region seems very shiny in the entire dates. For woodland zone almost no change in backscatter is seen in all the three dates. Low backscatter is seen for water bodies like Ponds, drainage and so on. These seem dim in radar picture. So based on backscatter values the pixels might be delegated paddy (rice) and non-rice crop. The total area of paddy (rice) crop for 23 down Haidergarh canal command system was estimated **66287.25 hectares** for the year 2018 (Fig.3).

Ground truth (GT) data was collected using ODK Collect Application in the 23 Down Haidergarh Canal Command System Uttar Pradesh. The coordinates of GT sites were recorded using ODK Collect App. shows in table 2. The Ground truth point shows in the fig.4. The GT data was also used to check the accuracy of classification.

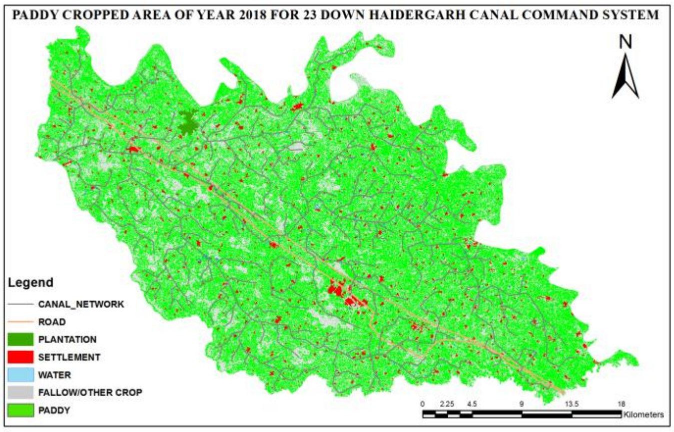

Figure -5: Map of Paddy Crop (2018) of 23 Down Haidergarh Canal Command System

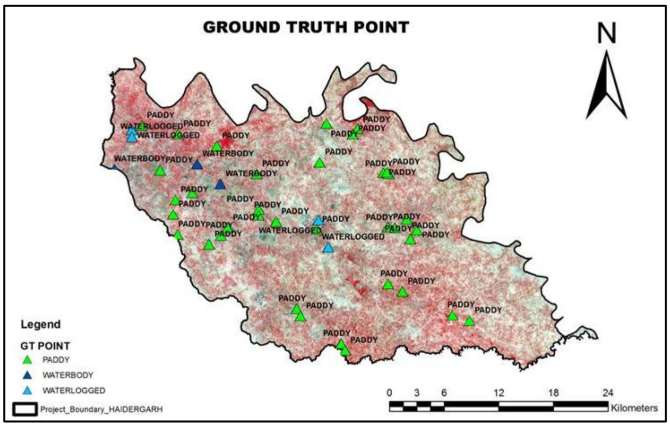

Figure -6: Map of Ground Truth Point

Table -2: Coordinates of Ground truth Point

S.No	GT Point Categories	Latitude	Longitude
1	Paddy	26.63761	81.32066
2	Water Logged	26.63358	81.30971
3	Water Logged	26.62660	81.30970
4	Water Body	26.59476	81.29067
5	Paddy	26.62931	81.36067
6	Paddy	26.61737	81.40327
7	Paddy	26.57108	81.37629
8	Paddy	26.59351	81.34093
9	Paddy	26.58954	81.44743
10	Paddy	26.55427	81.44947
11	Paddy	26.54873	81.44905
12	Paddy	26.54210	81.46853
13	Paddy	26.53442	81.51335
14	Paddy	26.60082	81.51671
15	Paddy	26.52995	81.36001

16	Paddy	26.54982	81.35501
17	Paddy	26.56411	81.35773
18	Paddy	26.52006	81.39467
19	Paddy	26.52888	81.40785
20	Paddy	26.53640	81.41496
21	Water Body	26.59940	81.38165
22	Water body	26.57978	81.40726
23	Water logged	26.54371	81.51517
24	Waterlogged	26.51676	81.52588
25	Paddy	26.52435	81.61649
26	Paddy	26.53327	81.62354
27	Paddy	26.53567	81.59954
28	Paddy	26.54397	81.61256
29	Paddy	26.48008	81.59175
30	Paddy	26.53642	81.59165
31	Paddy	26.47256	81.60751
32	Paddy	26.44920	81.66261
33	Paddy	26.44356	81.68101
34	Paddy	26.42126	81.53969
35	Paddy	26.45588	81.49091
36	Paddy	26.44887	81.49513
37	Paddy	26.62935	81.52450
38	Paddy	26.41465	81.54404
39	Paddy	26.62855	81.55353
40	Paddy	26.59024	81.58715
41	Paddy	26.63397	81.55870
42	Paddy	26.58907	81.59293
43	Paddy	26.59082	81.59103

6. CONCLUSION

Paddy (Rice) is becoming the major kharif season crop of 23 down Haidergarh canal command system of Uttar Pradesh after the restructuring of canal in this region. The study demonstrated that temporal backscatter got from multidate SAR information utilizing C-band is helpful for separation of paddy (rice) and other related kharif season crops. Rice transplanting designs (early, mid and late planted) can be recognized utilizing multidate SAR information. As the microwaves has more infiltration so overcast spread in kharif season makes no issue for gaining the SAR information.

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