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Change Detection of Salt Affected Land Area of Unnao District in Uttar Pradesh using Remote Sensing and GIS

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Abstract: ***Reasons for excess salt in soil are due to both natural and anthropogenic activities. About 955Mha Sodic soil is present in worldwide out of which about 60% is cultivable area. This has huge impact on economic and agricultural production. Salt affected soil is locally called as reh, thur, chopan and kallar. Traditional methods are time consuming and expensive. This can be only fulfilled by using emerging technologies like remote sensing and GIS which are economical and easy in less time. Remote sensing is a technique using to conquer information without in being touch with that object. Remote sensing is very helpful for in temporal changes and spatial changes. So with the help of remote sensing mapping of salt affected area of Unnao district using satellite data of LISS-III of year 2012 and 2018 to calculate spatial changes in between this year and suggest some methods and techniques for reclamation. Analysis shows that Sodic area in Unnao is decreasing and awareness about reclamation of Sodic soil with new techniques is spreading among farmers. In this study, Unnao district has been taken as the study area for mapping and monitoring the change detection with respect to salt affected lands. Salt affected land covers mapped is 14495.63 ha area in 2012 in the district. But in 2018, the total area of salt affected lands has been decreased by 11054.62 ha. The major areas that have been reported having large salt affected land are Auras, Bichhiya & Mianganj Blocks.***
Keywords: saline soil, Sodic soil, remote sensing, GIS.

I. INTRODUCTION

Salt affected soil is the soil having high concentration salt in it due to both man-made and natural causes. Salt affected soil is mainly classified in two categories which are Sodic soil and saline soil. Sodic soil is the soil having excess concentration of any type salt while Sodic soil is the type of soil having high concentration of sodium ions in compare to other cations. Sodic soil is dispersive in irrigation water causing blockage of pores which results in crust formation 7reduced city in compare to Sodic soil. But Sodicity reduces productivity of soil. A large cultivable land gets converted into barren land due to excess of salt present in it. To prevent this we reclaim the soil which is salt affected. Reclaimed area can be used for forest, fruit production, garden and rest in construction. With the evaluation of remote sensing and modern technologies, analysis and change detection salt affected soil is became very easy on a large scale. This forecasting helps in minimizing and reduction of salt affected area (Zhang, Wang, & Wang, 2002). The new remote sensing technologies become a powerful method to provide global and rich information on the spatial-temporal evolution of surface soil without any direct contact. Traditional methods are insufficient for current soil salinity issue as it extends in large area. The digital analysis of remote sensing data revealed mixed surface properties for salts, soil particles during dry (June) season and complex spectral signatures of moist soil surface and moderate crop cover in salt-affected soils (Khan et al., 2005 The aim of this research article is to identify the salt affected areas. The reclaimed area can be used for agriculture practices and forest area in later. In this study, Unnao district of Uttar Pradesh is taken as the study area for mapping and monitoring the change detection in salt affected area with respect to time. As a World Bank aided project is running in the district since last 15 years to reclaim the Sodic area and make the area for cultivation of normal crops. Salt affected land is broadly classified in two categories in Sodic Land and Saline Land. Sodic Soil is the soil having high concentration of sodium ion in it in compare to other cations. Remote Sensing helps in recognize salts are really reflective and helps in mapping of saline soil surface. The study concluded that integration of GIS with Digital Image Processing of LISS III data was very effective for classifying and monitoring of salt affected soils in Unnao district. New satellite sensors like RESOURCESAT-1, CARTOSAT-2, IKONOS-II, and RISAT-2 are having advance image processing are very effective in spatial and temporal analysis using GIS. In this report we are using RESOURCESAT-1 sensor .The surface can reveal presence of salts in two different ways: directly on bare soils with efflorescence and salt crusts and indirectly by affecting type of vegetation or moisture condition.

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II. STUDY AREA

Unnao is a district of Uttar Pradesh situated between Lucknow and Kanpur. The shape of Unnao district is like a parallelogram roughly. Latitude of the district is from $26^0$8 N to $27^0$2N and longitude lies from $80^0$3E to $81^0$3 E. Hardoi district is situated in north of Unnao while Raebareli is in south of it. Ganga River forms its boundary from Kanpur and fatehpur districts in west. Lucknow is situated in east of Unnao. Unnao is a part of Central Ganges plain having alluvial soil. Ganga, Kalyani and Sai are the main rivers of district. The total geographical area of Unnnao district is 4558km^2. There are 6 tehsils and 16 blocks in the district.

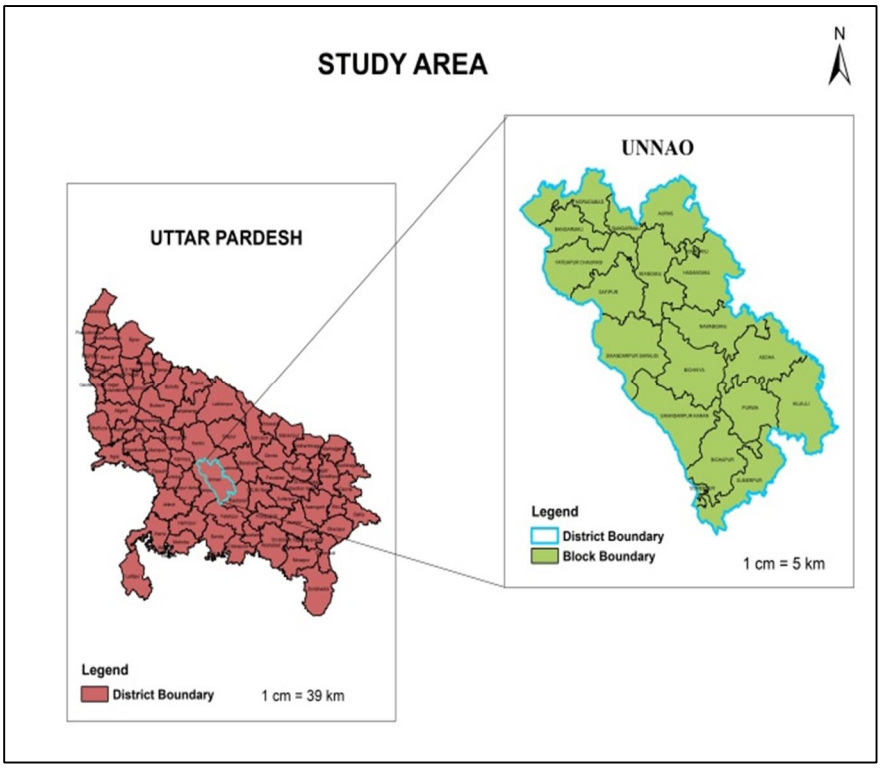

Fig.1 Location Map

III. DATA USED AND SOFTWARE USED

1) Satellite data of Resourcesat-1 LISS III of march 2012 and Feb 2018.
2) Software used for this study are- ARC GIS 10.2.2, ERDAS IMAGINE and MS OFFICE.

Table 1- Specification of satellite data

S. No.	Satellite	Sensor	Path	Row	Season	Year
1	IRS-P6	LISS III	100	53	Rabi	2012 & 2018

IV. METHODOLOGY

The methodology in this study is basically based on the use of digital image analysis technique and mapping of Sodic land on satellite data of resourcesat-1 of Unnao region using ARC GIS and ERDAS IMAGINE authenticated by ground truth.

A. Satellite data acquired from BHUVAN of IRC 1C LISS-III of 2012 & 2018.
B. Preparation of false color composition using different bands in ERDAS IMAGINE.
C. Visual analysis and interpretation is digitized using ARC GIS 10.2.2
D. Accuracy assessment of mapping done on satellite data by ground truth.
E. Statics generation and analysis of the output.

V. MAPPING OF SODIC AREA IN UNNAO

1) Map of salt affected land of Rabi season 2012 using satellite date of IRC 1C LISS-III is shown below-

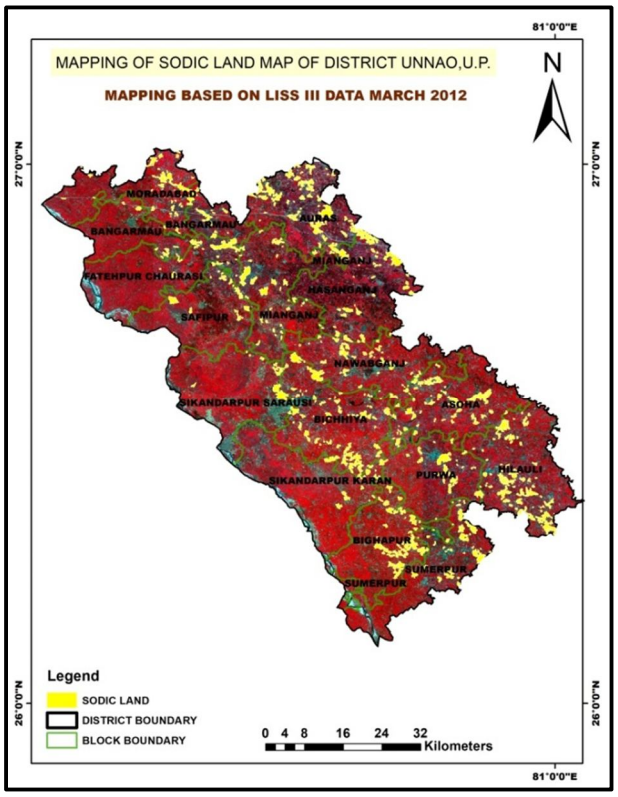

Fig.2 Sodic land map of Rabi season 2012

2) Map of salt affected land of Rabi season 2018 using satellite date of IRC 1C LISS-III shown below-

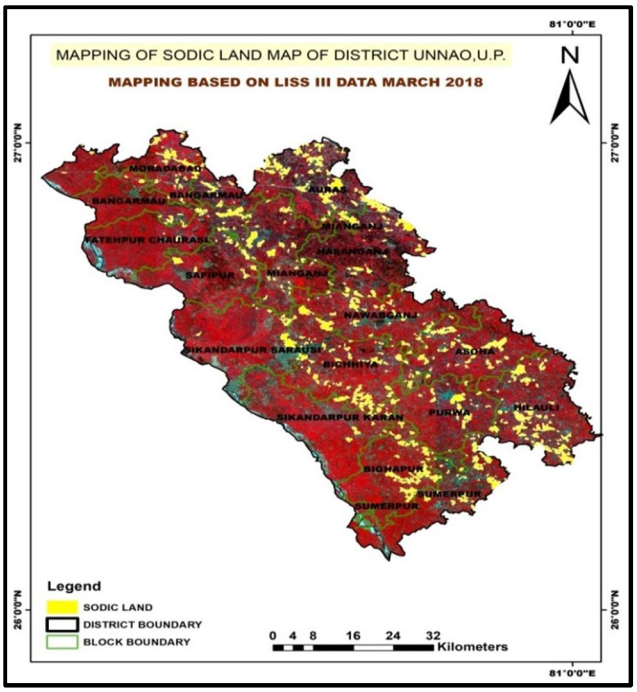

Fig.3 Sodic land map of Rabi season 2018

VI. RESULT & CONCLUSION

A. *Result*

Result of mapping based on satellite data LISS-III of Unnao district is given in the table below**:**

Table 2-statics of Sodic land area in Unnao

SEASON	YEAR 2018 (Area in ha.)	YEAR 2012 (Area in ha.)	Change in Salt affected Land Area (ha.)	% change
RABI	11054.62	14495.63	3441.01	23.73

1) *Comparative Map of Sodic Area In 2012 &2018*- Map shows salt affected area in different years (2012 & 2018). The area calculate in both year is represented in the table.

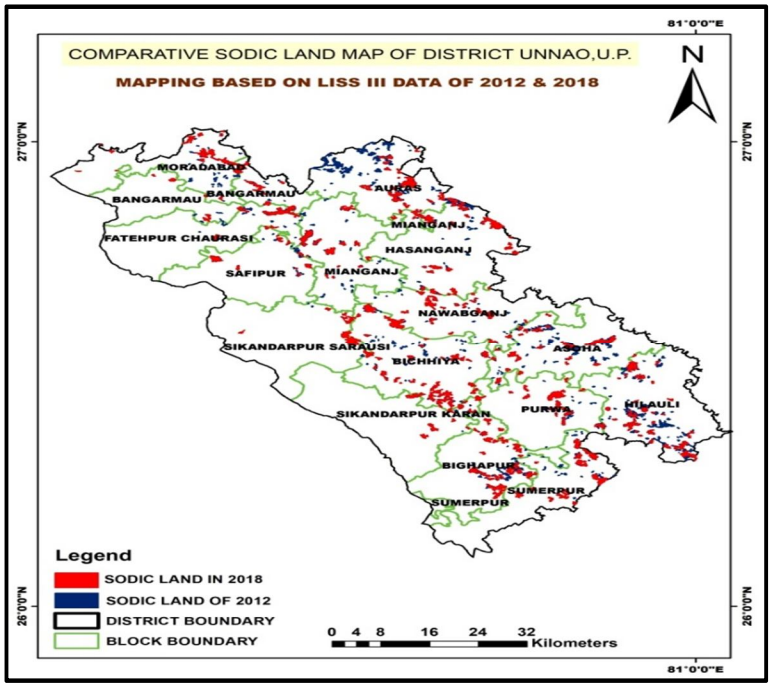

Fig.4 Map of sodic area in 2012 & 2018

2) *Sodic area in different blocks*- In statics analysis, it is found out that there are some regions which are severely affected by Salinity/Sodicity which is shown is graph below. Some of them are Auras, Bichhiya & Mianganj.

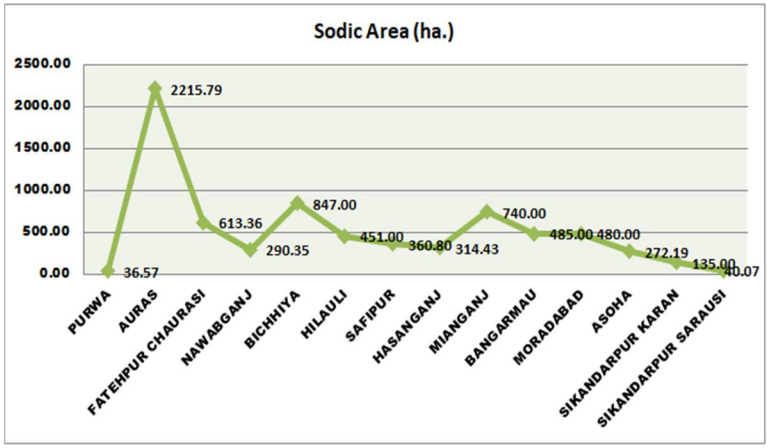

Fig. 5-Sodic area in different blocks of Unnao district

B. Conclusions

From this study, it is conclude that salt affected area in Unnao district is decreasing and there is noticeable decrease of about 23.73% of salt affected land area. So, Remote Sensing technique and GIS is an important tool for mapping and monitoring of Sodic Land as we notice decrease in the Sodicity cover in Unnao which was a part of World Bank project working on reclamation of Sodicity with the help of this technique. It is cost effective and also save time as compared to other methods of survey or monitoring from synoptic view and repetitively of Remote Sensing satellites. This study is also very helpful in examine the different reclamation procedure. There are several projects which are running by Government and other institutions. It is highly recommended that Govt. should include that area for reclamation processes which are left due to some reasons and remain Sodic till now. By these techniques it's easy to calculate the available area for the economic development of the nation.

VII. SUGGESTIONS

Sodic soils of the Gangetic plain in Central Haryana are rich in sodium carbonate and bicarbonate salts and showed high ESP and variable soil texture. Strongly sodic soils containing high Na_2CO_3 and $NaHCO_3$ salts, coarse soil texture and sodic ground water needs gypsum application @ 8–10 t ha^{-1} to reduce alkalinity in soil and water followed by leaching of excess soluble salts. Moderately sodic soil containing soluble Na_2CO_3 and $NaHCO_3$ salts and fine soil texture can be reclaimed by addition of 4–6 t ha^{-1} gypsum. Due to high clay content and presence of $CaCO_3$ concretions, slightly sodic soil showed drainage restrictions and waterlogging. It may be used for growing salt-tolerant rice and wheat crops. The addition of FYM in soils and cultivation of Dhaincha (*Sesbania* sp.) is suggested to improve physical properties, drainage conditions and reduce waterlogging.

VIII. ACKNOWLEDGMENTS

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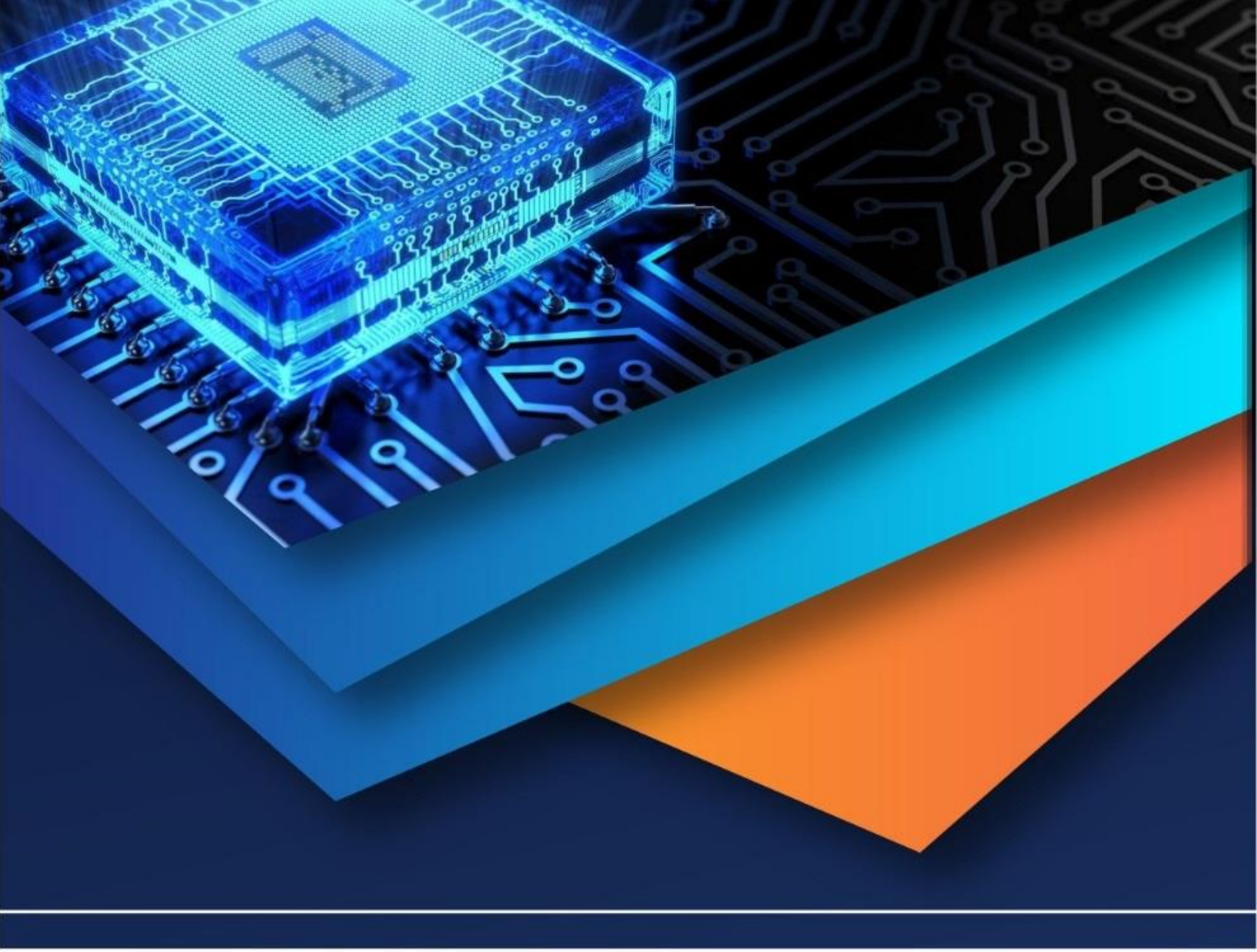

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