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Temporal Changes of the Reclaimed Land of Villages of Raebareli Using Remote Sensing and GIS

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Abstract: Sodic land is one of the major problems that has become an extensive challenge in today's scenario, which act as a threat to global food productivity. Detrimental climatic changes are acting as a catalyst in the development of soil salinity, thereby increasing the problem in the upcoming future and ultimately effects the unaffected areas. This paper aims to integrate information from previously published literature about the extent, expansion rate, prevailing situation and current policies for handling soil sodicity as well as evaluating the sustainability of reclaimed sodic land. Since Sodic land reclamation has been done in the Indo-Gangetic region on a great extent in many states namely Uttar Pradesh, Punjab and Haryana in India. Although, in some areas, the reversion of reclamation has been reported. Therefore, this study has been done in one of the reclaimed sites of district Raebareli of Uttar Pradesh for sustainability assessment of sodic land using remote sensing, Geographic Information system (GIS) and necessary ground information. It was found that the villages of Singhpur and Tiloi blocks of Raebareli district were greatly affected by sodicity and had shown large extent of sodicity and reversion.
Keywords: Raebareli district, Sodic areas, Remote sensing, Reclamation strategies, GPS.

I. INTRODUCTION

Salt affected soils occur both naturally such as by mineral weathering or as the result of man's modification of the hydrologic processes which mobilize and accumulate salts within the landscape. And the process of increasing the salt content is known as salinization. Proper irrigation management can prevent salt accumulation by providing adequate drainage water to leach added salts from the soil. Characteristic of sodic are:

A. a- soil with a pH greater than 8.2.
B. a soil with an exchangeable sodium content in excess of 15% of exchange capacity.

The overall consequences of salinity in soil are:

1) Dangerous effects on plant growth and yield.
2) Damage to infrastructure (roads, bricks, corrosion of pipes and cables).
3) Reduction of water quality for users, sedimentation problems, increased leaching of metals, especially copper, cadmium, manganese and zinc.
4) Soil Erosion ultimately, when crops are too strongly affected by the amounts of salts.

Soils with high levels of exchangeable sodium are susceptible to clay dispersion which leads to sealing, low permeability, and low porosity (Rengasamy *et al*, 1984).

Since in India various areas of states of UP, Delhi, parts of Bihar and West Bengal are affected by sodic condition which adversely impact the agriculture productivity and there by impacting the economic condition of the country. To combat this situation many reclamations programme had been performed. But the reclamation of the degraded land(sodic) for the purpose of agriculture is often debated in terms of viability and longevity. it becomes very important to study the sustainability of the techniques or the processes used to reclaim a piece of degraded soil. And the aim of this study is to analyse the already reclaimed sodic land by testing various parameters. There by evaluating the sustainability of the reclaimed land.

Fig-1

Fig-2

Sodic areas of Raebareli District

II. MATERIALS AND MATHODS

A. Study Area

The study area covers the reclaimed villages of the Raebareli district of Uttar Pradesh. The area lies between 81.25E to 81.5 E longitude 26.5 N to 26.25 N latitude and covers a geographical area of about 17374.28ha which extent over 40 villages in Raebareli district of Uttar Pradesh, India, where barren sodic lands were found to be 3773.126 ha that was mapped in the site during the year 1986 and during 1997 reclamation of these mapped sodic areas was covered under Uttar Pradesh Sodic Land Reclamation Project (Phase-II). The area under this region comes within the Indo-Gangetic alluvial plain. The main rivers are Ganga and Sai of this district. Considerable fragment of this area is fertile and irrigated. Rice-wheat is cultivation is mostly observed in this region except in the barren lands due to sodicity. Other crops that are also grown in this area are pulse, barley, millet and poppy. It is mainly a rural district whose major population more than 90% lives in the rural areas.

B. Methodology

Remote sensing and GIS techniques have been used for the sustainability assessment of land reclaimed that was done between 1997-2007 under II phase of reclamation. Satellite data of before reclamation phase (1986) was of the satellite Landsat TM. The satellite data of the year 2008,2012,2016 that is post reclamation has been taken from IRS satellite resource sat-2 LISS-III. Then identification of sodic areas was done using these satellite data. There by the samples were collected during the field visit from the eight villages of two blocks namely Singhpur and Tiloi while noting down the coordinates of each sample point location have been recorded in the field through handset GPS. Soil samples of about 1/2kg to1 kg were collected in polybags, by digging up to 15cm. Each packet was tightly sealed to avoid any mixing of samples or pollutants from outside during the transportation. The samples gather from respective eight-point locations have been mentioned in the Table.

Table 1: Location of Sampling Points

S.No.	Locations	Longitude	Latitude
I.	Khara village	X:81.431788	Y:26.477298
II.	Ratwalia Manjhar village	X:81.429440	Y:26.429440
III.	Dandupur village	X:81.438262	Y:26.467716
IV.	Godhna village	X:81. 446893	Y:26.461664
V.	Kamae village	X:81.423358	Y:26.419960
VI.	Kishanpur village	X:81.408676	Y:26.407959
VII.	Purebahelia village	X: 81.415382	Y:26.406868
VIII.	Singhpur village	X:81.445829	Y:26.474905

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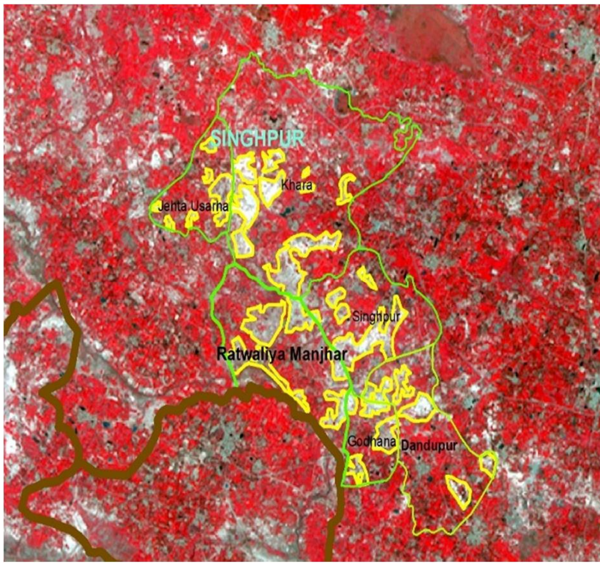

Fig-3 Villages of Singhpur Block

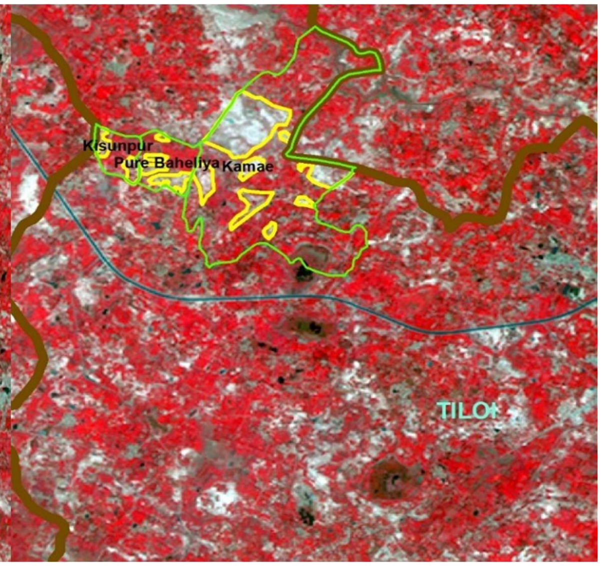

Fig-4 Villages of Tiloi Block

Fig-3 and Fig-4 above shows the eight villages whose chemical parameters were tested after collecting the samples.The white patches in the fig-3 and fig-4 represent the sodic areas of the respective labelled villages.

III. RESULT AND DISCUSSION

The analysis of each sample was done in the laboratory to evaluate the pH, Electrical conductivity (EC), Exchangeable sodium percentage (ESP), Exchangeable sodium ion, Cation exchange capacity (CEC). The value of each parameter shows the extent of sodicity of the soil.

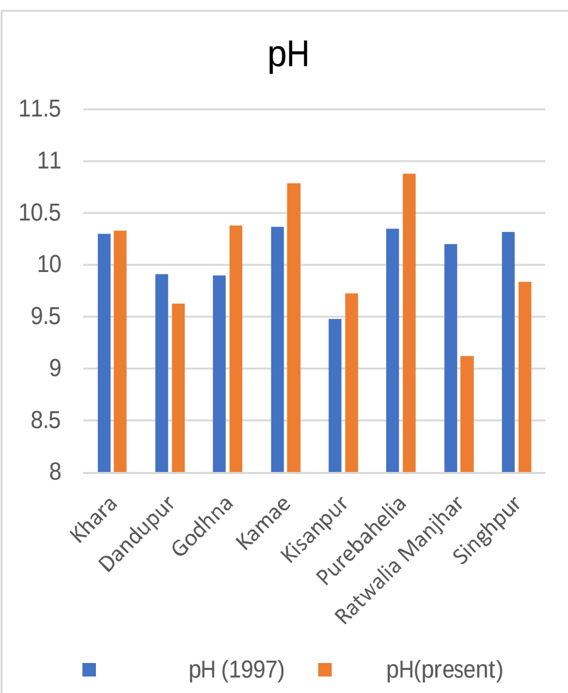

Fig-5

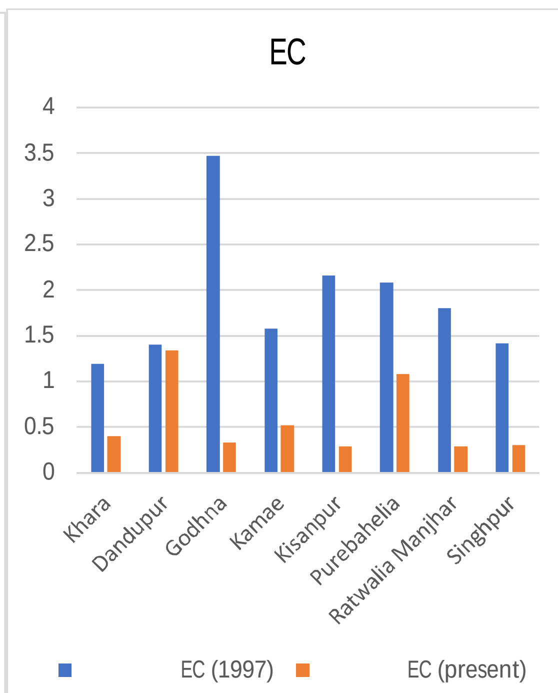

Fig-6

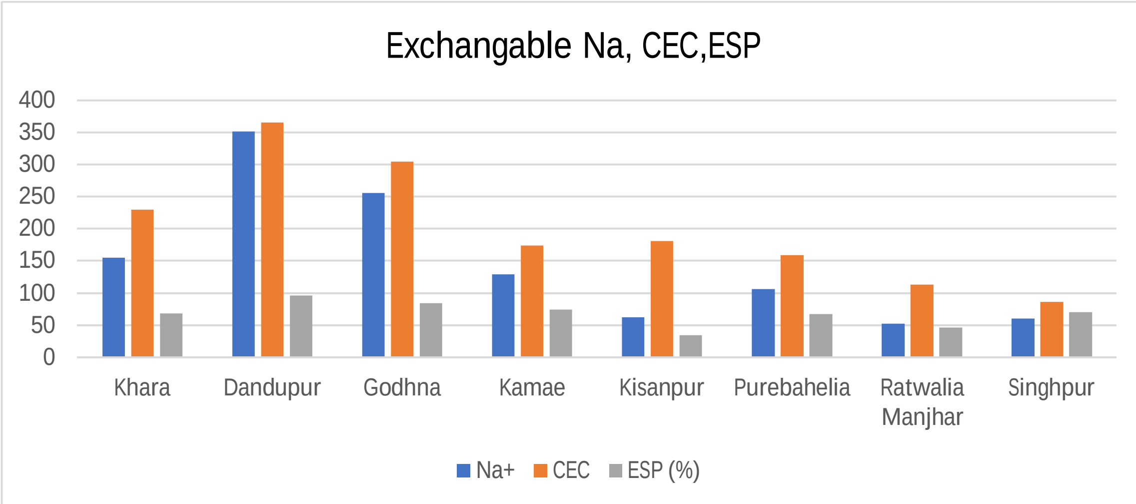

Fig-7

Absolute range of pH in which there is fine plant growths is between 6.0 -7.0. Although if pH of the soil is found between 8.5-10.0 it is considered to be sodic soil. From the above readings, pH value of all the eight villages is found either between 8-5-10 or even above 10. EC of the non-saline clay soil ranges between 0-1.1dS/m and that of sodic soil is found greater than 4dS/m. From the above readings, EC of all the villages is not under sodic category. ESP of the soil is calculated by formula:

$$ESP= \frac{\text{Na ion exchange capacity}}{\text{Cation exchange capacity(CEC)}} \times 100$$

If ESP of soil sample is found to be greater than 15% it is considered as sodic soil. And as per the above reading, sodicity is found in all villages with the sodicity less than 50% in Kisanpur and Ratwalia Manjhar with 34% and 45% respectively, while with the worse sodicity more than 80% is found in Dandupur and Godhna with 96% and 84% respectively. Taking about sodic area of each village were calculated by calculating the area of number of sodic patches/polygons found in that area with the help of arc gis software.

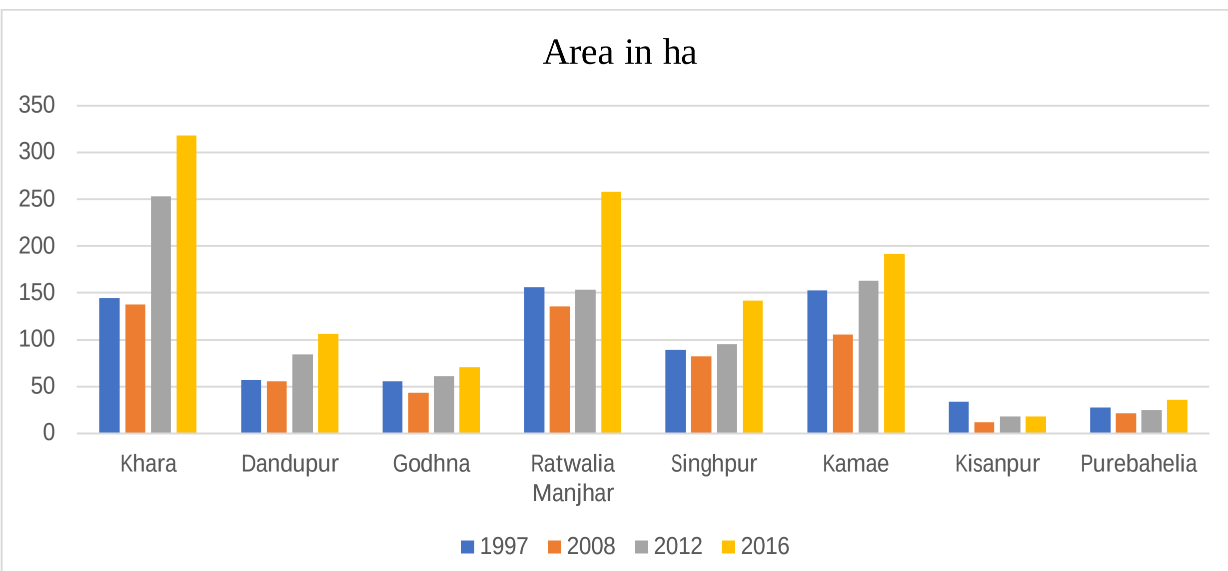

Fig-8

The above graph tells the sodic area found in hectare in respective villages in respective years and according to this kisanpur village has shown positive result while khara village was worse affected one.

IV. CONCLUSION

A. Through this study it has been found that sustainability of the reclaimed land can be studied using remote sensing and GIS techniques. As well as the areas that get converted back to original condition after reclamation can be observed and calculated using satellite data. It also helps us in easily track down the location, thereby helping in field visit. Moreover, information regarding status of the sodic land of the successive years can be taken from satellite data. Then by superimposing different data layers (district layer, block layer, village layer etc) over the downloaded satellite data using GIS can further be used for identifying sodic patches in the area of interest

B. Field visit revealed that certain areas had been entirely reverted back and salt accumulation over the entire region resulted in zero crop yield, whereas there were some regions salt accumulations was in forms of patches in between the field and in those areas the crops were observed around or surrounding the patches.

C. From the 8 villages from which samples were collected Khara village was in worse condition in terms of area as maximum sodic area has been observed in this village in the year 2016 while Dandupur and Godhna have shown severity of sodicity or intense sodicity with ESP greater than 80% despite of less sodic area hence it is observed that there is no relation between intensity of sodicity and extent of sodicity or sodic area. Among the eight villages Kisanpur has shown positive result with about 51% of reversion unlike the other seven villages that had shown complete reversion. One of the reason of this reversion was the abandoning of agricultural practices off the reclaimed land.Therefore, it is very important to keep continuing the agricultural practices along with green manuring.

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