Decadal Sodic Land Change in Bewar Branch Canal Command using Isodata Algorithm

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***Abstract*— Sodic land occurs due to high sodicity in soils accumulated naturally or anthropogenically. The excessive amount of salt in soil could lead to adverse effects, both, environmentally and socially. Bewar Branch Canal Command lies in semi-arid region of Uttar Pradesh. The study focuses on estimation of sodic land using the ability of Landsat 5 data for 2009 and Landsat-8 data for 2019 and Isodata algorithm to know decadal change in the branch canal command. The main benefit of Isodata algorithm is that it allows different numbers of clusters during iterations. The net decadal decrease in sodic land area from in Bewar Branch Canal Command from 2009 to 2019 has been estimated to be 9713.9 ha.**

***Keywords*— Sodic Land, Decadal Change, Landsat 5, Landsat 8, Isodata Algorithm.**

1. INTRODUCTION

Soil represents a considerable part of natural resources. The presence of excessive amount of dissolved salts in soil and ground water is a characteristic feature in many parts of the including India. These salts contain sodium, calcium and magnesium as the main cations, and, carbonate, bicarbonate, chloride and sulphate as associated anions. The origin and accumulation of salts in Indo-Gangetic plain is due to sodium chloride in the soils and ground water coming from Himalayan catchment (both from geological and rain water) and partly due to rainfall occurring in plains [3]. The soils with pH higher than 7 and electrical conductivity more than zero are characterized as sodic soils. These soils are widespread in India.

The mapping of sodic land of an area can be done by digitization, supervised or unsupervised classification [4]. It can also be mapped using salinity indices based on different spectral bands [1]. The paper adopted a collative approach that included the use of Landsat 2 MSS False Color Composites, top maps surveys, and restricted field controls to map saline soils and wetlands. The result showed that the separation of saline and waterlogged is feasible due to their distinct coloration and peculiar pattern on false colour composite imageries [2].

This study is focused on delineating sodic land from Landsat data using Isodata algorithm and thus, estimating decadal change in sodic land in Bewar Branch Canal Command.

2. STUDY AREA AND DATASETS

Bewar branch canal command lies in Lower Ganga Canal command with area of 200087.051 ha. The branch canal command comes under Upper Ganga basin. The extent of the study area is shown in Table I. Mainpuri, Etah and Kannauj districts cover approximate 98% of the area of branch canal command as shown in Table II.

TABLE I
EXTENT OF BEWAR BRANCH CANAL COMMAND

Command	Bewar Branch Canal Command
Latitude Range	27°47'36.055" N - 27°1'43.403" N
Longitude Range	78°39'32.989" E - 79°33'2.845" E

TABLE II
DISTRICTS IN BEWAR BRANCH CANAL COMMAND

Command	Districts	Percentage
Bewar Branch Canal Command	Farrukhabad	0.92
	Kanshiram Nagar	1.30
	Kannauj	10.53
	Etah	32.71
	Mainpuri	54.54

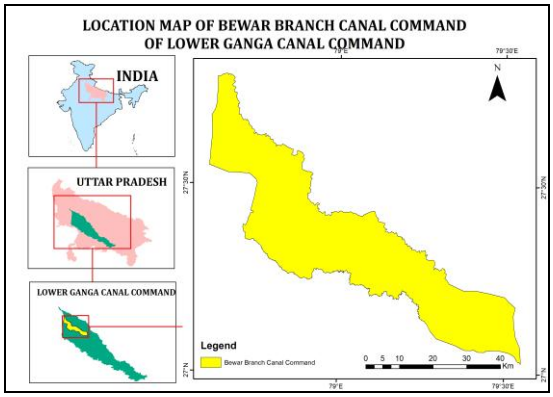

Fig 1-: Location Map of Study Area

Landsat series data as shown in Table III has been used to delineate sodic land due to its high temporal availability and free cost. Various vector datasets have also been used in carrying out this study as given in Table IV.

TABLE III
DIFFERENT SATELLITE DATASETS

SNo	SATELLITE	SENSOR	PATH	ROW	DATE	SOURCE
1	Landsat 5	TM	145	41	2009-02-04	Earth Explorer, USGS
2	Landsat 8	OLI	145	41	2019-04-05	Earth Explorer, USGS

TABLE IV
DIFFERENT VECTOR DATASETS

S No	Name	Type	Source
1	Bewar Branch Canal Command Boundary	Polygon	RSAC-UP, Lucknow
2	Lower Ganga Canal Command Boundary	Polygon	RSAC-UP, Lucknow
3	Uttar Pradesh Boundary	Polygon	RSAC-UP, Lucknow
4	India Boundary	Polygon	RSAC-UP, Lucknow
5	Canals	Polyline	RSAC-UP, Lucknow

3. METHODOLOGY

The flow chart explaining the methodology of the study is shown in Figure 2. It can be explained in following steps:

A. *Data Preparation*

Landsat 5 and Landsat 8 satellite data (as given in Table III) was ordered, downloaded, preprocessed, stacked and clipped for study area in ERDAS Imagine environment.

B. *Mask Preparation*

In ArcGIS environment, settlement mask for Bewar branch canal command was digitized using visual image interpretation using Landsat 5 and Landsat 8 data for 2009 and 2019 respectively.

C. *Unsupervised classification*

The unsupervised classification technique is better than supervised and digitization to estimate the sodic land categories (Yadav et.al, 2019). Using ISODATA cluster algorithm in ERDAS Imagine environment, an unsupervised classification was performed on stacked Landsat 5 TM data and Landsat 8 OLI data to extract sodic land for 2009 and 2019 respectively.

D. *Decadal Change Analysis*

The decadal change in sodic land in Bewar branch canal command is estimated from sodic land of branch canal command for 2009 and 2019 respectively.

E. *Decadal Change Map preparation*

The map showing change in sodic land area in the branch canal command is prepared in arcGIS environment.

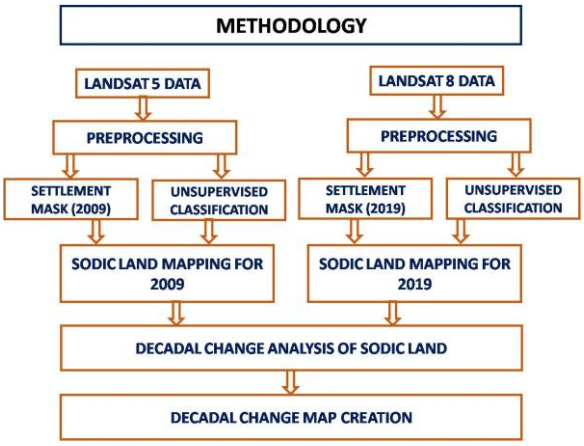

Fig 2-: Flow Chart for Methodology

4. RESULTS & DISCUSSIONS

A. *Landsat 5 and Landsat 8 Data:*

The False colour composite of Landsat 5 for 2009 and Landsat 8 for 2019 is shown in Fig 3 and Fig 4 respectively. These composites have been prepared after preprocessing, layer stacking and clipping of satellite data.

B. *Settlement Masks for 2009 and 2019:*

Settlement masks digitized from Landsat 5 for 2009 and Landsat 8 for 2019 in Bewar branch canal command are shown in Fig 5 and Fig 6 respectively.

C. *Sodic Land Extraction for 2009 and 2019:*

Isodata algorithm is one of most useful clustering algorithm which can be used for classification of different landuse/landcover classes due to allowance of different clusters during iterations. In this study, sodic land has been classified from 100 clusters, each for 2009 and 2019. Sodic land was overlapping with settlement in few areas. Settlement mask has been used to improve it. Sodic land extracted using Isodata algorithm is shown in Fig 7 and Fig 8 for 2009 and 2019 respectively.

Sodic Land area of Bewar branch canal command for 2009 and 2019 is 30890.5 and 21176.6 ha. This means a net decrease of 9713.9 ha in sodic land has changed in the decade.

D. *Decadal Change Analysis*

Sodic Land area of Bewar branch canal command for 2009 and 2019 is 30890.5 ha and 21176.6 ha. This means a net decrease of 9713.9 ha in sodic land has occurred in the decade. The map shown in Fig 9 shows increase as well as decreased sodic land in the branch canal command. The chart 1 shows amount of increased as well as decreased sodic land in the study area.

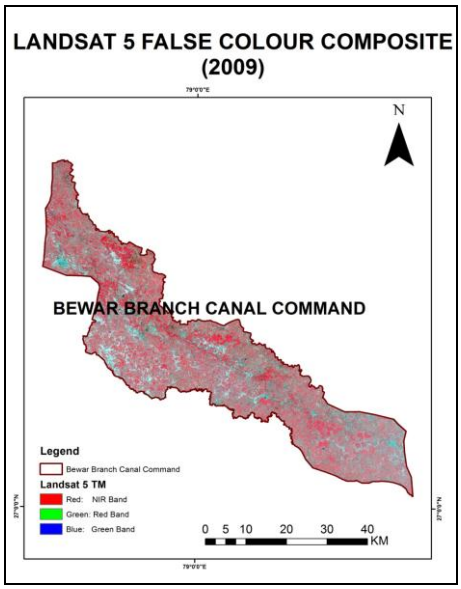

Fig 3-: Landsat 5 False Colour Composite of Bewar Branch Canal Command for year 2009

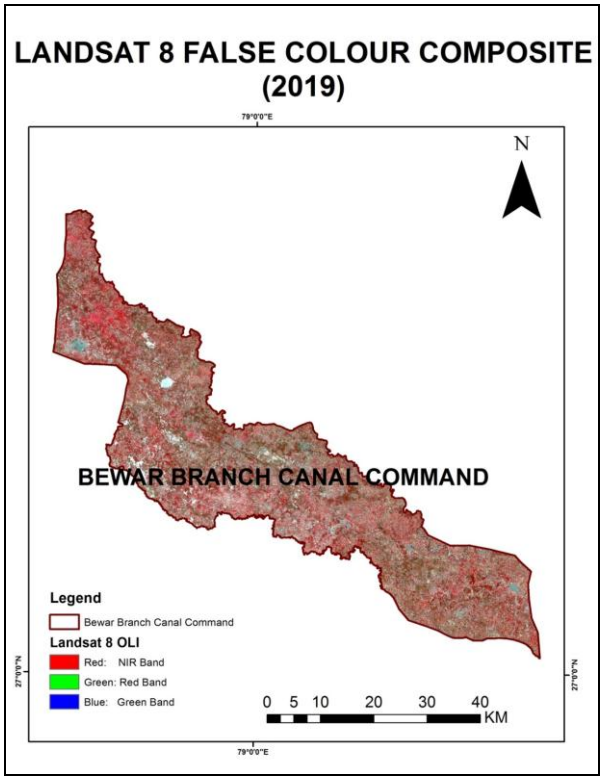

Fig 4-: Landsat 5 False Colour Composite of Bewar Branch Canal Command for year 2019

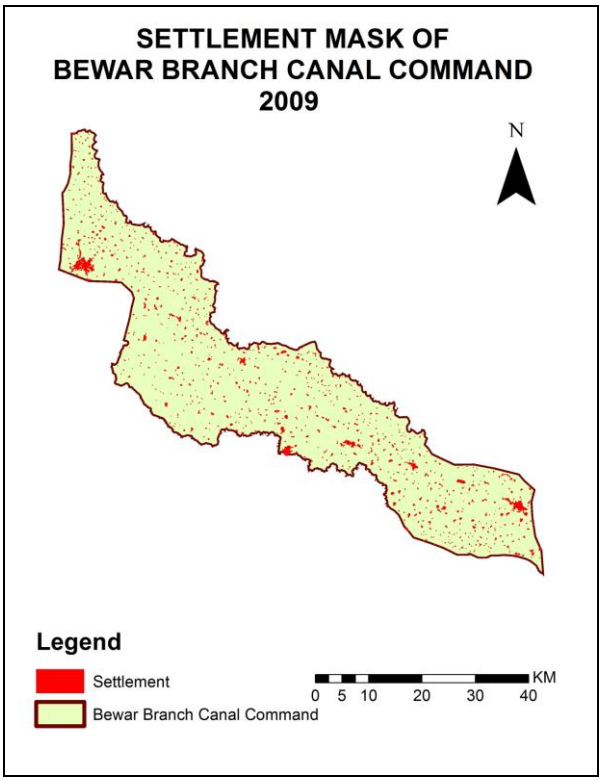

Fig 5-: Settlement Mask of Bewar Branch Canal Command for year 2009

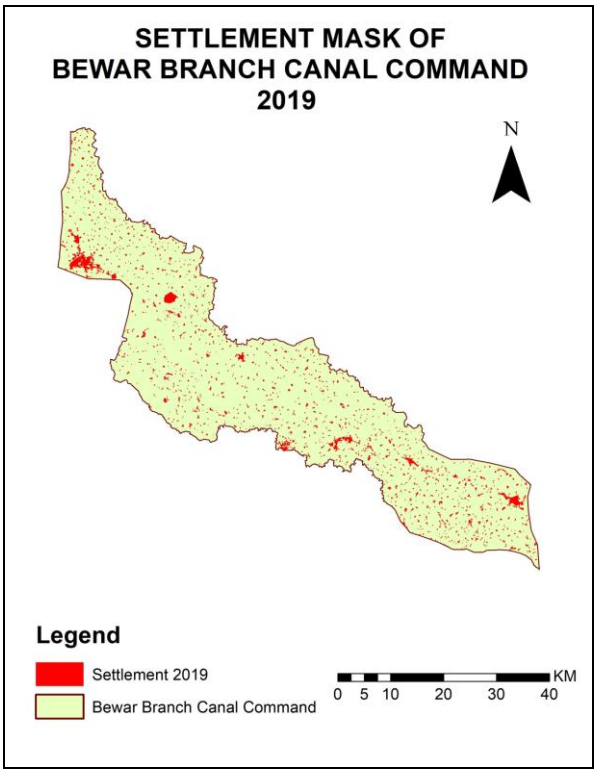

Fig 6-: Settlement Mask of Bewar Branch Canal Command for year 2019

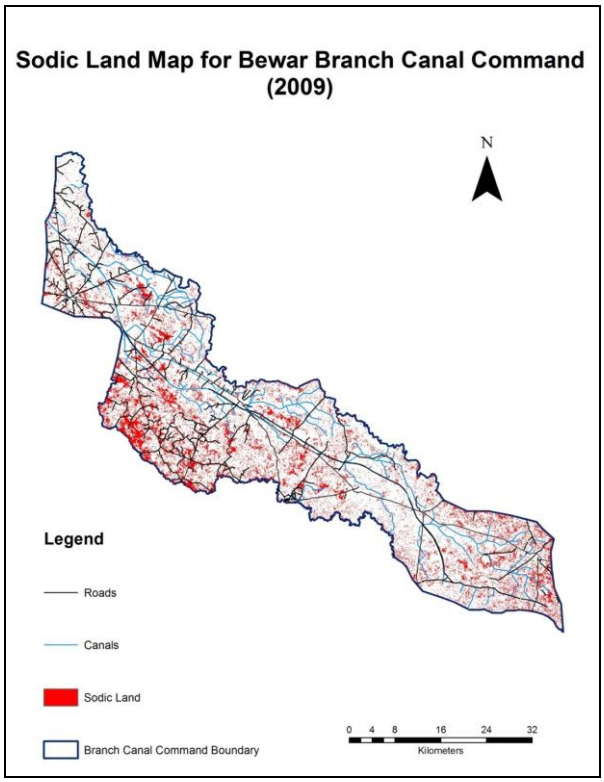

Fig 7-: Sodic Land Map of Bewar Branch Canal Command for year 2009

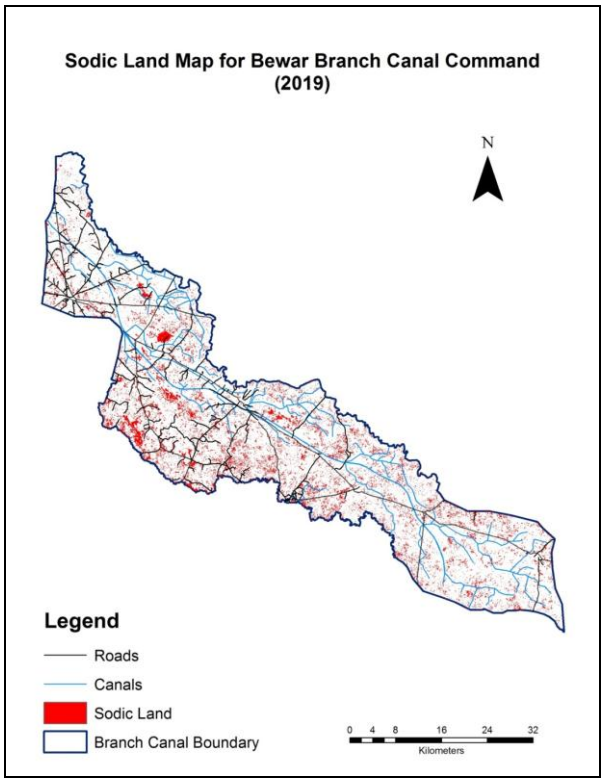

Fig 8-: Sodic Land Map of Bewar Branch Canal Command for year 2019

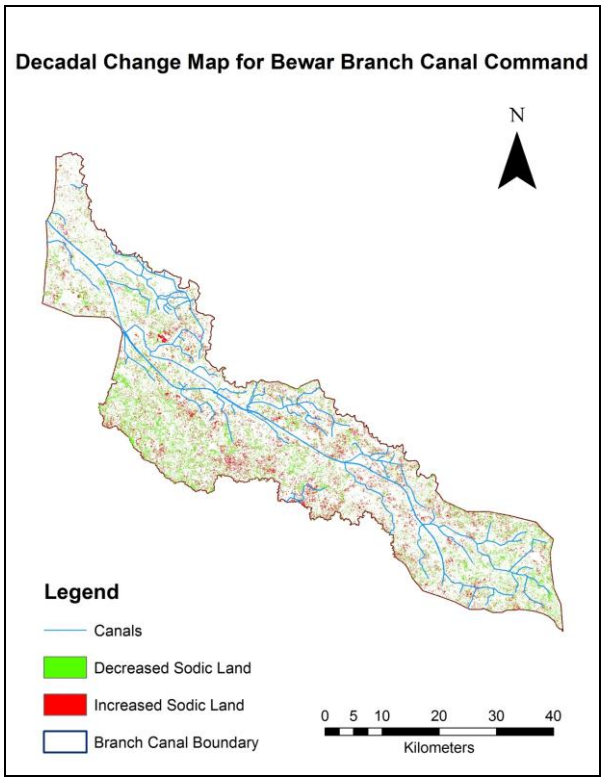

Fig 9-: Decadal Change Map of sodic land in Bewar Branch Canal Command

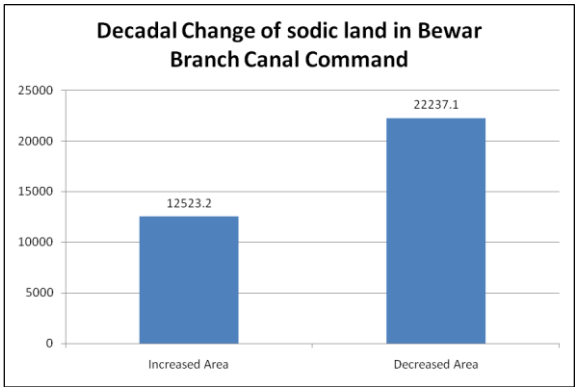

Chart 1-: Decadal Change of sodic land area in hactare in Bewar Branch Canal Command

5. CONCLUSIONS

Isodata Algorithm is capable of extracting sodic land from Landsat series dataset. The sodic land area of Bewar branch canal command for year 2009 and 2019 are 30890.5 ha and 21176.6 ha respectively. There is trend of decrease in sodic land in Bewar branch canal command. This indicates intervention of agencies for reclamation of sodic land in the branch canal command area. There is also redistribution of sodic land in the branch canal command.

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