ISSN: 0974-5823 Vol. 6 (Special Issue, Nov.-Dec. 2021)

International Journal of Mechanical Engineering

Land Use Land Cover Change Detection Analysis Using Remote Sensing and GIS:A Case Study of Daund Tehsil, Pune, Maharashtra

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Abstract:

Land use land cover change is a dynamic process. As population pressure is increasing, the land use land cover pattern is also changing. Humans have negatively affected land use and land cover pattern over the world. One such negative impact of this alteration is salinization problem due to improper irrigation practices. In the present paper, an attempt has been made to find out changing land use pattern within a very short span of time i.e. 3 years (2012 to 2015) in Daund tehsil of Pune district in Maharashtra. It has been observed that among all land use land cover classes, saline land is showing highest increase in area (4.8%). Continuous improper management of irrigation water has contributed to this increase in saline land. The results highlight the need of managing irrigation water and also managing saline land problems, because if saline lands go on increasing at this rate soon agricultural land will be transformed to salt encrusted infertile land.

Keywords: *LISS III, GIS, Remote Sensing, Pure pixel and LULC.*

Introduction :

Due to urbanization and industrialization, global land use land cover pattern is changing drastically and at a fast space. Humans have modified the natural cover over the earth, as a result of which various negative consequences can be seen like biodiversity loss, deforestation, soil loss as well as increased saline lands, which in turn affects human activities. Growing urban pressure is the main reason behind unplanned changes in LULC. In the present study, a glimpse of such urban pressure, unplanned and improper irrigation can be observed which has led to the increase of saline lands in the Daund tehsil. In the present study, an attempt has been made to analyse LULC pattern using remote sensing data and GIS techniques. Saline land in the study area is increasing day by day due to improper irrigation which in turn is affecting agricultural practices. With LISS III satellite images of 2012 and 2015, an attempt has been made to detect changes in LULC pattern in the Daund tehsil. Supervised classification and Maximum likelihood classifier technique has been employed to detect changes in land use land cover classes.

Study Area

The study area is located on the western part of Pune district in Maharashtra (Fig 1). It extends from 18^0 17'47'' N to 18^0 40'11''N latitudes and from 74^0 8'47''E to 74^0 50'38''E longitudes. With the hottest month being May and June, Daund tehsil experience semi-arid type of climate. The highest temperature reaches up to 40^0 C. The temperature decreases to as low as 12^0 C in the month of December and January. Sugarcane is the predominant cash crop in this region followed by other crops like Jowar, Bajara, Wheat etc. Bhima and Mula rivers drain this region. River Bhima borders the region to the northern part and Mula drains western part of the region. Besides these rivers, there are many water bodies in this region like Victoria *talav*, Matoba *talav* and Khamgaon *talav*, which provide water to canal irrigation. It has been observed that land use land cover pattern is changing drastically, specifically saline lands are increasing and this is mainly due to over and unplanned irrigation. Salt encrustation has been observed specially during summer season when evaporation rate is much high.

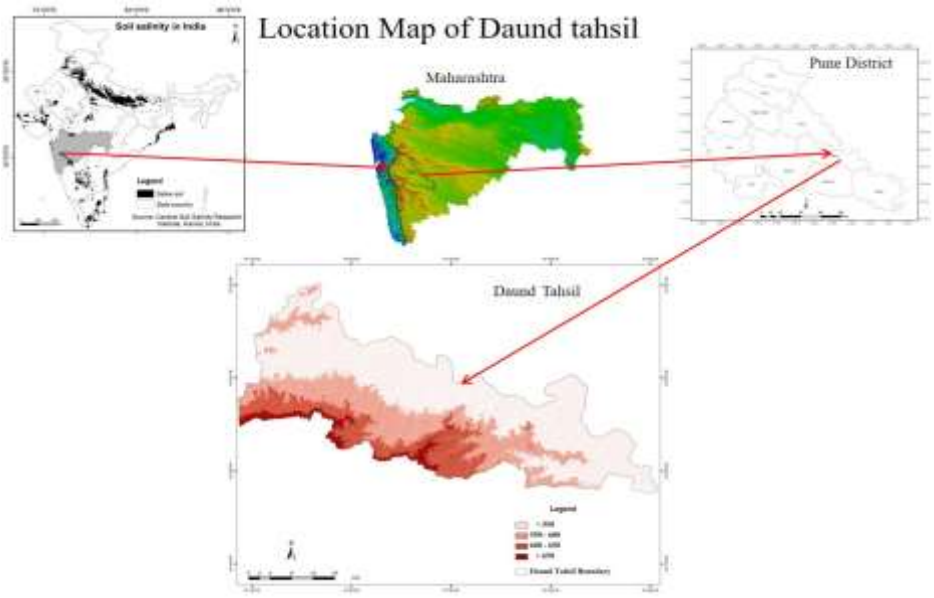

Figure 1: Study Area.

Methodology

Freely downloaded Multispectral data with spatial resolution of 23.5m (LISS III) is being provided by BHUVAN. Two images with a difference of three years have been selected for the present study, viz. 9th April 2015 and 12th February 2012. LISS III data contains four bands viz. Green, Red and Infrared (2). LISS III images acquired on 9th April 2015 and 12th February 2012 are used in the present study. Images are selected on the basis of availability of data and also least cloud cover in the scene. LISS III images have been downloaded from BHUVAN site. LISS III data are in band form in .tif format. In ERDAS imagine 14, both the satellite images' band data are layer stacked to obtain respective false color composite images. With Maximum Likelihood Classifier, supervised classification is performed to obtain classes. Both the images are classified into six broad classes viz. Settlement, Barren land, Agricultural land, Agricultural fallow land, Water body and Saline land (Fig 2). For creating these classes AOI (Area of interest) is being carefully selected and mostly pure pixel have been taken into consideration. For saline land delineation, specifically GCP's collected from the salt affected field as well as saline land location from Google Earth has been verified. After obtaining LULC, area under each classes have been calculated and both the years' images have been compared and change detection analysis has been performed.

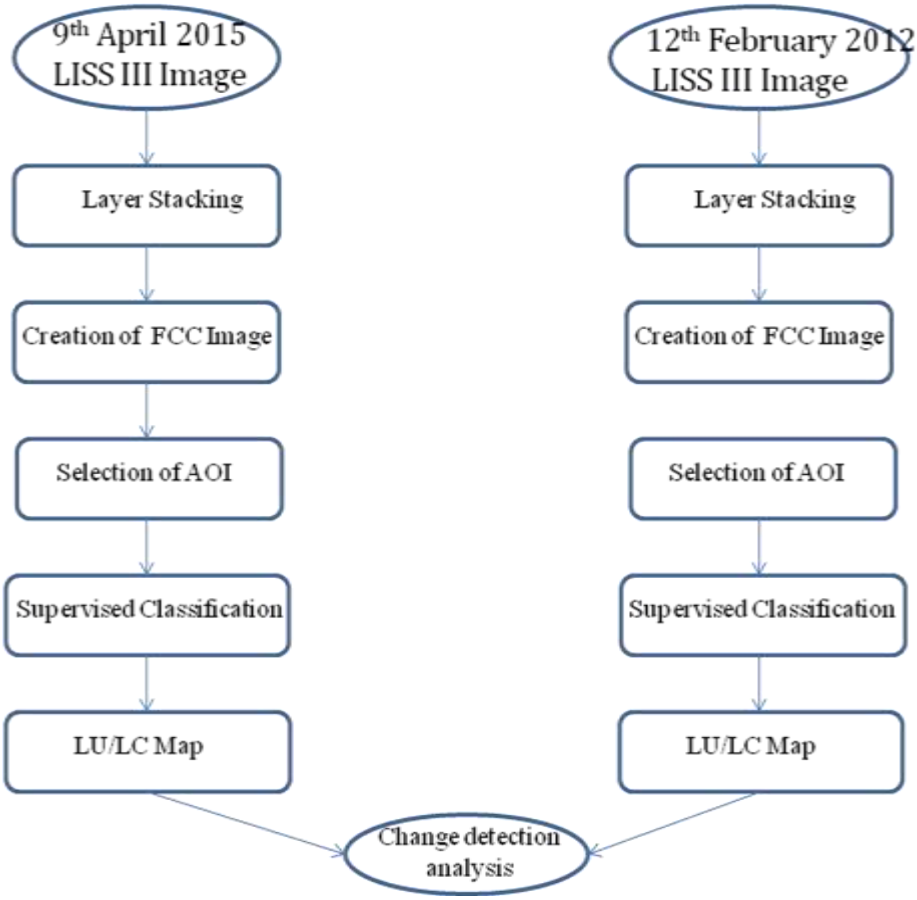

Figure 2: Methodology

Result and Discussion

Remote sensing based land use land cover change detection needs ground validation and cross checking. Broad classes like barren land, agricultural land and water body can easily be identified with the help of spectral signature, but classes like saline land where there is mixed pixel problem need much care for detection and selection of signature. It is because of this fine classes, ground truthing is of utmost need. For identification of saline lands in the present study, both field collected and Google Earth derived GCP's are used. Both the images are classified in to following classes, Barren land, agricultural land, agricultural fallow land, water body, settlement and saline land (Fig 3 and 4).

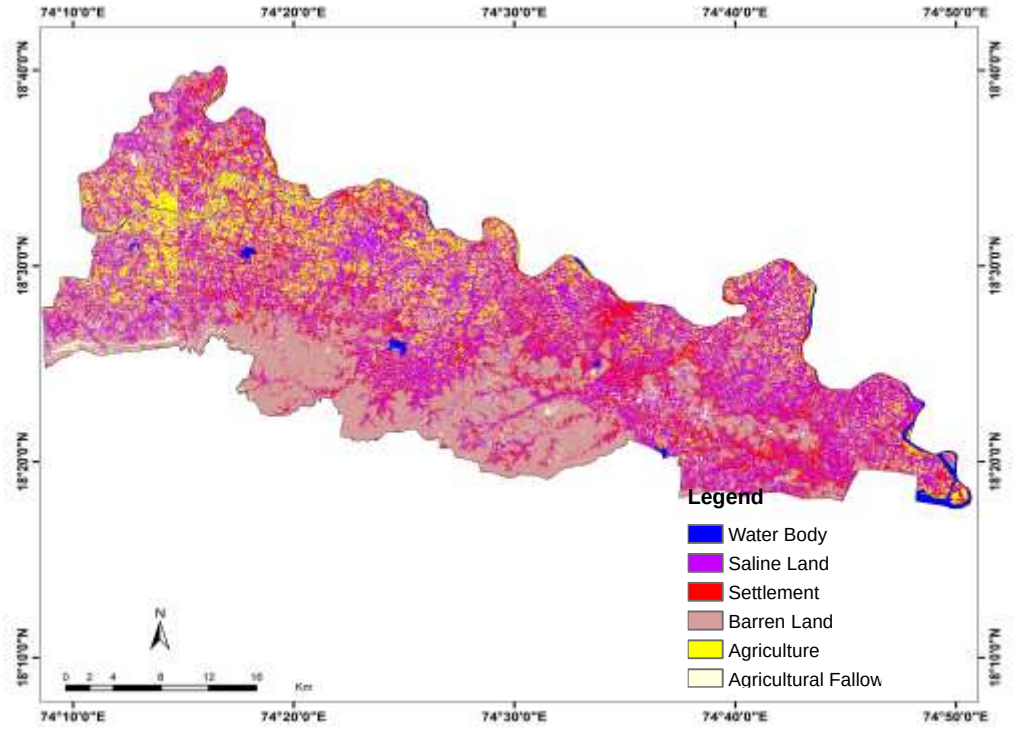

Fig 3: Showing Land Use Land Cover of Daund Tehsil in 2012.

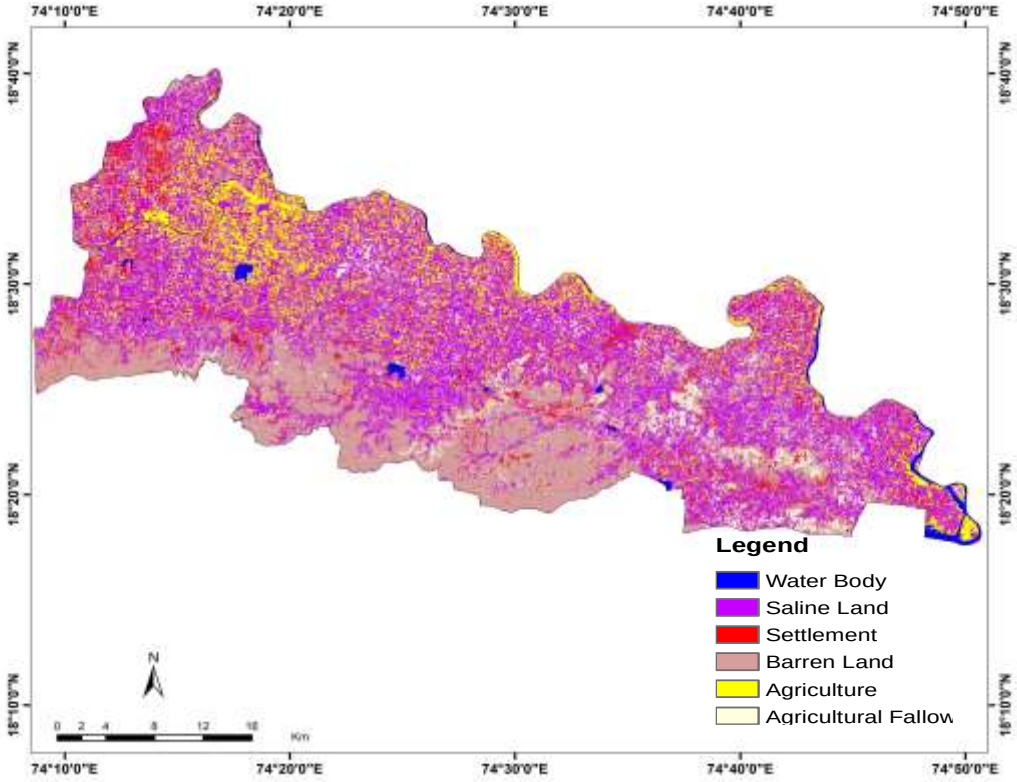

Fig 4: Showing Land Use Land Cover of Daund Tehsil in 2015.

In 2012 LULC map, it has been observed that barren land covers 359.15 sq. km area, agricultural land 223.15 sq. km, agricultural fallow land covers 81.19 sq. km, water body occupies 19.45 sq. km area, settlement covers 182.47 sq. km and saline land occupies 448.58 sq. km area.

In 2015 LULC map, it has been observed that barren land covers 304.39 sq. km area, agricultural land 212.31 sq. km, agricultural fallow land covers 84.40 sq. km, water body occupies 15.98 sq. km area, settlement covers 185.30 sq. km and saline land occupies 511.62 sq. km area. (Table 1)

Table 1: Area under various LULC classes in 2012 and 2015

Area under various LULC classes- 2012				Area under various LULC classes - 2015			
Classes	**Area in ha**	**Area in Sq. Km**	**Area in %**	**Classes**	**Area in ha**	**Area in Sq. Km**	**Area in %**
Barren Land	35915.15	359.15	27.33	**Barren Land**	30438.6	304.39	23.16
Agricultural Land	22315.41	223.15	16.98	**Agricultural Land**	21231.3	212.31	16.16
Agricultural Fallow	8118.59	81.19	6.18	**Agricultural Fallow**	8440.3	84.40	6.42
Water Body	1945.42	19.45	1.48	**Water Body**	1598.1	15.98	1.22
Settlement	18247.14	182.47	13.89	**Settlement**	18530.0	185.30	14.10
Saline land	44858.34	448.58	34.14	**Saline land**	51161.7	511.62	38.94
Total	**131400.05**	**1314.00**	**100.00**	**Total**	**131400.00**	**1314.00**	**100.00**

Change detection analysis shows that there is decrease in barren land cover by 4.17 %, agricultural land has also decreased by 0.83% and water body decreased by 0.26% from 2012 to 2015. Whereas agricultural fallow land has increased by 0.24 %, settlements have increased by 0.22% and saline land by 4.80% within a span of 3 years (Table 2). Among all the classes, saline land is showing a high rate of increase and this is mainly due to improper irrigation practices.

Table 2: LULC Change Detection Analysis Statistics

Classes	Area in % 2012	Area in % 2015	Change Detection (in %)
Barren Land	27.33	23.16	-4.17
Agricultural Land	16.98	16.16	-0.83
Agricultural Fallow	6.18	6.42	0.24
Water Body	1.48	1.22	-0.26
Settlement	13.89	14.10	0.22
Saline land	34.14	38.94	**4.80**
Total	**100**	**100**	

Conclusion

As population pressure is increasing, the land cover pattern is also drastically changing. But this changing pattern of land use has lot to do with improper management of irrigation facility and specially if the region is coming under arid and semi-arid climate. Wastage of irrigation water, improper irrigation and mismanagement of agricultural practices has affected agricultural land and salt encrustation has become a common concern in the area. Reluctant nature of the farmers is also one of the major reason behind increasing salinity in the area. Water is generally supplied to the field for longer duration and no proper care is being taken to put off the water supply. As a result of which, water gets logged in the field. Also, due to land disputes among farmers, the channels between the fields which were used to drain out water from the fields are closed. All this issues together are boosting up the salinization issue in the area and also making most of the fields salt encrusted creating problem for agricultural practices.

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