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Study of LULC change due to sand mining in Yamunanagar, Haryana using Geospatial Techniques

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Abstract: ***Sand mining is the activity of removal of sand from rivers, streams and lakes. Mining of sand can be done by various methods such as skimming, dry and wet pool mining, bar excavations and scalping. This mining activity causes negative impact on the environment depending upon the methods of mining used and the geology of the mining area. Mining activities leads to many serious environmental hazards such as soil pollution, deforestation, water pollution, depletion of ground water table etc. Present study has been carried out in Yamunanagar district of Haryana state for the assessment of changes in land use/land cover pattern with the help of remote sensing and GIS by using Landsat 8 satellite data. Two images of 2016 and 2019 were used to assess the change in land use. Supervised classification of the study area was done by ERDAS IMAGINE 2014 and land use/ Land cover maps were generated with the help of ARC GIS. Accuracy assessment was done in ERDAS IMAGINE. Study area was divided into 5 different land use classes. Changes in the land use / land cover like drastic reduction in sand area, increase in open area and reduction in green land and built up area was observed.***

Keywords-GIS, LANDSAT 8, ERDAS, Remote sensing, Sand mining

I. INTRODUCTION

Sand is natural resources formed by the weathering of rocks for a longer period of time and is naturally carried by streams. Sand is very important for day today life. It has been used in various forms such as in making concrete, brick making, filling roads etc. Sand also plays very important role in the protection of coastal environment as it reduces the impacts of the strong tidal waves before they reaches the shoreline. Sand also acts as a habitat for many marine organisms (Jonah *et al.*, 2015). Sand mining refers to process of removal of sand from rivers, streams and lakes. Mining of sand includes various methods such as skimming, dry and wet pool mining, bar excavations and scalping (Hill *et al.*, 1999). Due to increasing demand of sand for construction purposes a lot of legal and illegal sand mining is carried out creating an immense pressure on sand resources. Mining activities have resulted in many serious environmental hazards such as soil pollution, deforestation, water pollution, depletion of ground water table etc. (Bindhusri *et al*., 2015) that needs to be dealt with. Continuous removal of sand from river bed increases the velocity of water can lead to erosion of banks (Bagchi, 2010).

Various researches have been done to conserve land use land cover with the help of different satellite data. GIS can be used in demarcation, management and planning of sand mining zone. With the help of high resolution images like Cartosat and World view 2 legal and illegal sand mining can be demarcated accurately (Monalisa *et al*., 2015). With the help of GIS one can also estimate the volume of sand that can be mined from the mining area (Atejioye *et al*., 2018). Thus, during this study an attempt has been made to study temporal variations in land use land cover in Yamunanagar, district of Haryana, which is highly affected by rapid urban growth and excessive sand mining.

II. STUDY AREA

The mining activity is located at Gumthala North Block/YNR B16 in riverbed in Tehsil-Radaur and District-Yamuna Nagar, Haryana. Mining area is located between Latitude: 29°57′29″ to 29°56′26″N and Longitude:77°12′43″ to 77°12′48″E . The mining area (Fig. 1) is a river bed with gentle slope from North-South. The surface area is covered by alluvial mixed with river sand.

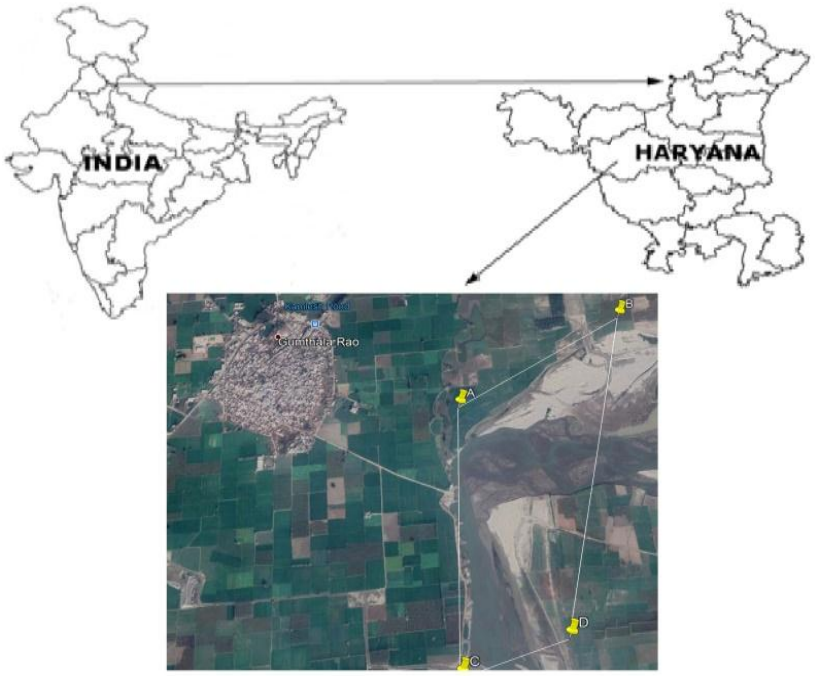

Fig. 1 Map of the study area(Village Gumthala Yamunanagar, Haryana

III. DATA SOURCE

The Landsat 8 satellite data of 2016 and 2019 was acquired to determine the changes in the land use. Software such as ERDAS, ArcGIS and Google earth are used for the processing of image.

TABLE I
Datasets Used In The Study

DATA SETS	DETAILS	APPLICATIONS
Landsat 8	Date- 23/042016 and 06/05/2019, Resolution-30m, Source-https://earthexplorer.usgs.gov/	Classification of image.
Software	ERDAS, ArcGIS and Google Earth.	Image processing

IV. METHODOLOGY

The landsat 8 image of 2016 and 2019 was downloaded from the USGS Earth explorer for the analysis of land use and land cover. Layer stacking and image enhancement was done in software (ERDAS IMAGINE 2014) to enhance its resolution to 15m. Mining area and a buffer of 10km was clipped from the image to get the area of interest for the classification of Land use and land cover. Remote sensing applications were applied to find the land use/land cover pattern of the study area. A supervised classification was performed on images by taking the training sets. The land use was divided into five different classes i.e. Open land, sand, Green land, Built up area and water body. Land use/land cover (LULC) maps were generated in ArcGIS 10.5 and with the help of LULC maps quantification of different classes and the change in their land use pattern was found out.

V. OBSERVATIONS OF LAND USE STUDY

Land use pattern of the study area (2016 and 2019) is presented with the help of land use land cover maps as shown in the Fig. 2 and 3.

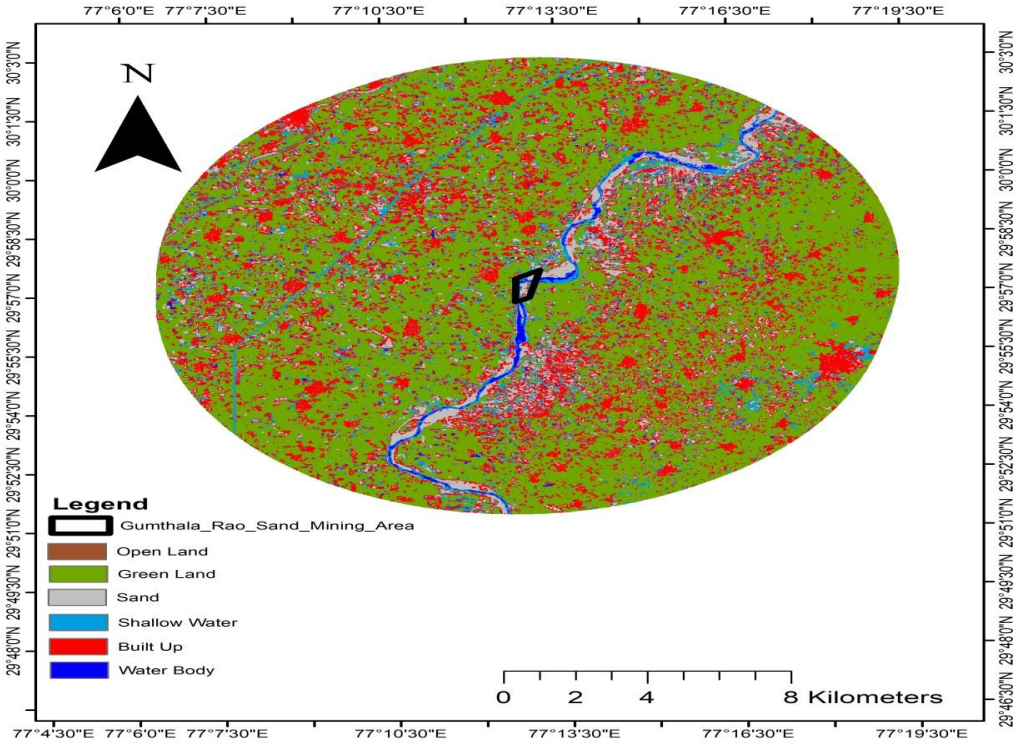

Fig. 2 LULC Map-2016

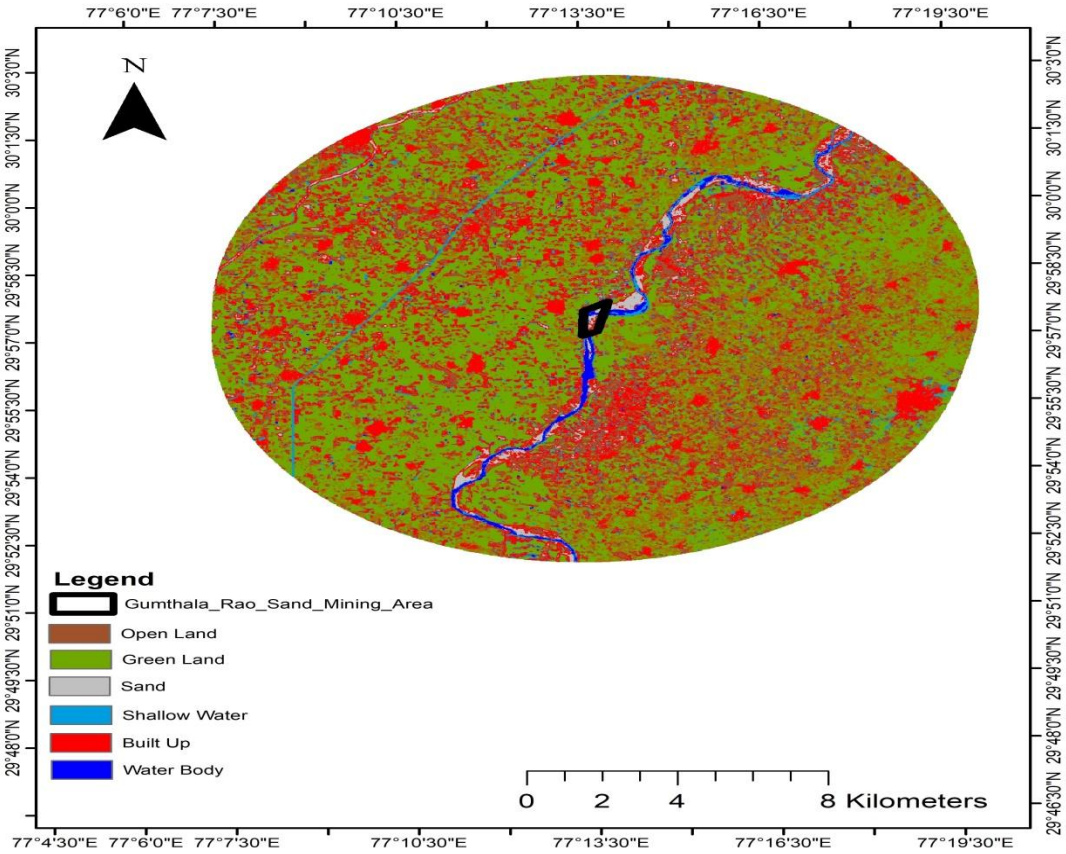

Fig. 3 LULC Map-2019

Area of different land use classes is calculated and shown below in Table 2.

TABLE 2
Variation In Area Of Different Classes

Land use	Area(In Hectares)		Percentage change in area
	2016	2019	
Open Land	4000.01	7000	75
Sand	1658	444	-73.22
Water Body	1528.31	1765.37	15.51
Green Land	21300	20240	-4.98
BuiltUp	6678	6150	-7.91

VI. RESULTS AND DISCUSSIONS

The classified Landsat 8 image of 2019 was first evaluated to determine the current land use/land cover pattern of the study area and was compared to the land use/ land cover pattern of 2016. Fig. 4 shows the comparison of different land use classes.

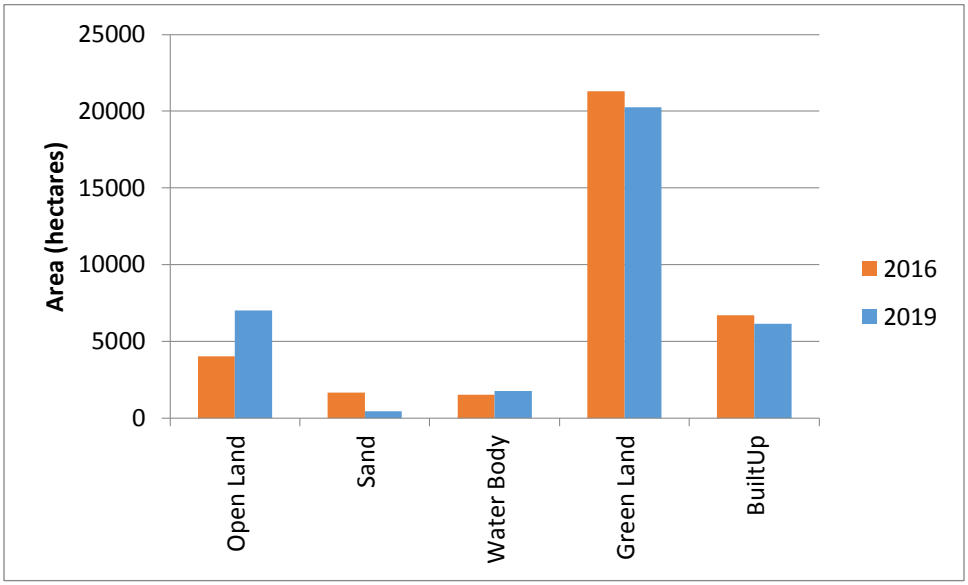

Fig. 4 Land Use comparison of the Study Area (2016 & 2019)

Results shows that sand area reduced from 1658 hectares to 444 hectares i.e. 73.22 % decrease during the study period. Since, sand is a replensihable material and it may recover every year. But study shows extreme reduction in the sand area, which is yet to be studied. The investigations shows that sand may have been extracted beyond its capacity to be recovered, which also caused to increase in open area. This increase in open area may be due to creation of haul roads to provide transport facility to mining vehicles. There is slight increase is water body. This increase in water body around the mining site may be due to presence of water in water canal in 2019 that was not there in 2016 in that particular month. Due to increase in open area reduction in Built up area is observed around the mining site. It has also been observed that there is reduction in Greenland (Forest and vegetation) in the study area due to increasing mining activities.

Increase in mining activities will effect adversely on abiotic and biotic environment of the area. Due to decrease in Green land nearby people those are totally dependent on forest and agriculture for their survival are affected. Loss of habitat of riverine biota may be seen due to excessive sand mining. Impacts due to transportation of sand on environment may include dust generation and increase of air and noise pollution. The effect of sand mining may also

be seen in on various socio economic factors. All these issues are to be dealt with for ensuring the ecological security of the area.

VII. CONCLUSIONS

The present study is helpful in assessment of variation in the LULC pattern due to sand mining with the help of GIS and image processing tools. The results of the study can be used to design the land used management plan of the mining area. Study area can be conserved if mining is done with help of proper land use management plan. Amount of sand to be extracted can be restricted and conserved by seeing the LULC maps of the study area.

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