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Remote Sensing and GIS-Based Land Use and Land Cover Change Detection Mapping of Jind District, Haryana

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ABSTRACT

The management and transformation of the natural environment or wilderness into the environment, such as fields, pastures, and settlements, is referred to as land use. The physical stuff that covers the earth's surface is known as land cover. Grass, asphalt, trees, water, and other forms of land cover are examples. Field surveys and in-depth study of remote sensing photos are the two basic ways for gathering information on land cover. The land use/land cover research provides information on current land usage and serves as a baseline study, along with other data, for Jind City's long-term land use planning and rural development. Settlement, agriculture land, water bodies, forest, and wasteland were the land use and land cover categories in Jind district in 2005, covering an area (in hectare) of 7683.73,254348.58,1697.03,395.42, and 6075.25. Settlement, farm land, water bodies forest, and wasteland were the land use and land cover categories in Jind district in 2020, covering an area (in hectare) of 8447.21, 252730.3, 1734.98, 6863.07, and 424.42. From 2005 to 2020, this report helps to give information on the changing patterns of land use and land cover. The modern technique for identifying changes in land use and land cover mapping is remote sensing and GIS. This technique improves the mapping's effectiveness, quality, and presentation of data.

1.Introduction

For any region's macro and micro level sustainable development, timely and accurate identification of land use/land cover (LULC) change is essential [1]. For environmental and development reasons, adaptable land use and land cover are critical in the age of automation. Land cover refers to land that is covered by natural components, whereas land use refers to land that is exploited for cultural activities [2–4]. Humans, the world's most powerful exterminators, are constantly changing land use and land cover. Through industry, urban planning, settlements, agricultural growth, and other means, humans have historically modified the terrain for their own well-being and survival [5]. Land use and land cover change can be studied using remote sensing data over spatiotemporal features as the structure, location, and quantity of landscapes expand or decrease in the form [6]. In this case, geospatial applications are the most effective tool for evaluating land use and cover [7]. GIS is a fantastic tool for planners because it allows them to integrate data from many sources and do spatial analysis that would have previously taken much longer. GIS is a set of data management tools that make use of geographic data to generate useful information. Creative solutions that make the best use of the resources can be derived from this knowledge. The use of remotely sensed data allowed researchers to analyze changes in land cover in less time, at a lower cost, and with more precision. Remote sensing and Geographic Information System (GIS) technology provide effective methods for analyzing land use concerns as well as tools for land use planning and modeling [8]. Satellite data combined with drainage, lithology, and land use land cover collateral data allows for a more accurate assessment of geomorphologic conditions [9] and the status of degraded landforms [10]. This data set is at the heart of the Geographic Information System (GIS), which makes spatial data processing and interpretation a breeze [11]. It also provides a powerful tool for monitoring degraded lands and environmental changes, as well as allowing for the investigation of other environmental variables connected to land use/land cover [12]. Adeniyi and Omojola (1999) used archival remote sensing and GIS methodologies, aerial pictures, Landsat MSS, SPOT XS/Panchromatic images, and topographic map sheets to analyze changes in the two dams -Sokoto and Guronyo - in the Sokoto-Rima Basin of North-Western Nigeria between 1962 and 1986[13]. Anderson (1976) found that the creation of remotely sensed data/images by various types of sensors flown onboard various platforms at various heights above the ground and at various times of the day and year did not lead to a simple classification scheme [14]. Byeong-Hyeok and Kwang-Hoon (2005) conducted fascinating research on forest reclamation monitoring in the abandoned mine of the Samtan coal mining area in Jeongseon-gun, Gangwon-do, Korea. Using multi-temporal satellite datasets, the effects of vegetation health for abandoned and forest recovered periods were investigated [15]. Coppin and Bauer (1996) looked at a wide range of digital change detection approaches that had been developed during the previous two decades. Compile a list of eleven distinct change detection techniques that have been found in the literature. [16]. Daniel (2002) compared five methods for detecting changes in land use/land cover, including classic post-classification cross-tabulation, cross-correlation analysis, neural networks, knowledge-based expert systems, picture segmentation, and object-oriented classification [17]. "A timely and accurate change detection of earth surface features offers the foundation for a better understanding of links and interactions between human and natural phenomena to better manage and use resources," according to Lu et al. (2004) [18]. Detecting changes that have happened, defining the nature of the change, quantifying the area extent of the change, and assessing the spatial pattern of the change are all significant components of change detection, according to Macleod and Congaltion (1998). Changes in land cover result in changes in radiance values, which can be remotely sensed[19]. This is the basis for using remote sensing data for change detection. Every parcel of land on the Earth's surface, according to Meyer (1999), is unique in terms of the cover it has. Land usage and land cover are two separate but intertwined aspects of the Earth's surface [20]. According to Moshen (1999), land use/land cover change can have more negative environmental, social, and economic consequences than benefits in some cases. As a result, data on land-use change is critical for planners to monitor the effects of land-use change on the area [21]. Ololade et al. (2008) used remotely sensed data from Landsat MSS in 1973 (4 bands), TM 1989, 1997, 1998 (6 bands), and ETM 2002 (6 bands), as well as topographic maps from 1969 and 2005, to map land-use/landcover mapping and change detection in the Rustenburg Mining Region. The maximum likelihood approach [22] was used to achieve supervised classification. Traditional ground methods of land use mapping, according to Olorunfemi (1983), are labor-intensive, time-consuming, and done seldom. With the passage of time, these maps quickly become obsolete, especially in a rapidly changing environment [23]. Arvind and Nathawat (2006) conducted a study on land use and land cover mapping in the Haryana districts of Panchkula, Ambala, and Yamuna Nagar. They found that the diverse climate and physiographic circumstances in these districts have resulted in the establishment of various land use land covers in these districts, with digital analysis of satellite data indicating that the majority of these districts are utilized for agricultural purposes [24.

The main objectives of the study were as follows:

- Mapping of land use/land cover of Jind district (2005 and 2020)
- To analyze the change detection of land use/ land cover of Jind district

2. STUDY AREA

Jind City, the district headquarters, is around 125 kilometers from Delhi, India's capital. The Jind district covers an area of 2702 square kilometers. Between 29.03' and 29.51' N latitude and 75.53' and 76.47' E longitude, the district is located in Haryana's northwestern corner. Panipat, Karnal, and Kaithal are the districts to its east and north-east, respectively. Its northern boundary line defines the inter-state border. Haryana shares a border with Punjab's Patiala and Sangrur districts. It shares a border with Hisar and Fatehabad districts in the west and south-west, and Rohtak and Sonipat districts in the south and south-east, respectively. Except during the monsoon, the climate is characterized by dry air, scorching summers, and freezing winters. Winter begins in late November and lasts until the beginning of March. The summer season lasts from March to June. The southwest monsoon season lasts from July to mid-September. The post-monsoon or transition phase lasts from mid-September until the end of November. The district's average annual rainfall is 553 mm. The district's rainfall increases from west to east. During the southwest monsoon, the district receives about 77 percent of its yearly rainfall. The temperature starts to rise rapidly towards the beginning of March. The hottest months are May and June, when the average daily maximum temperature is around 41° C. According to the 2011 census, the district's total population is 1,332,042. Males account for 7, 12,254 of the total population, while females account for 6, 19,788. The district's overall male-to-female ratio was 1000:870. In the Jind district, 77.18 percent of the population lives in 307 villages, while the remaining 22.82 percent lives in five municipalities. In the district, there are no scheduled tribes. The district's literacy rate is 72.77 percent, with male literacy at 80.63 percent and female literacy at 58.15 percent. Jind, Narwana, and Safidon are the three sub-divisions of the district. Jind is subdivided further into two tehsils: Jind and Julana. The Narwana and Safidon sub-divisions each have only one tehsil, Narwana and Safidon. Julana, Safidon, Jind, UchanaKalan, and Narwana are the five VidhanSabha constituencies in this district. The location map of the research area is shown in Figure 1.

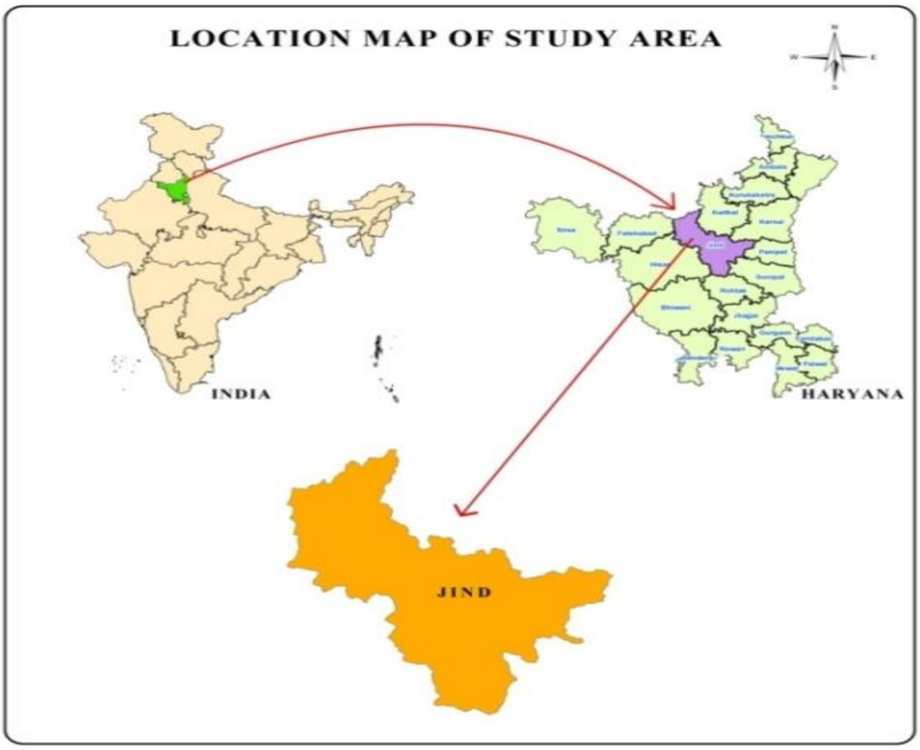

Fig. Location map of the study area

3. METHODOLOGY

Many writers believe that examining remote sensing data is necessary for specific applications of remote sensing data to land use/land cover and change detection that have been reported in the literature. LISS III data from the Indian Remote Sensing Satellite Resource Sat (IRS-P6) is appropriate for mapping land use/landcover since it has the best spatial and temporal resolution. With a 24 day revisit capability, the sensor offers 23.5 m spatial resolution data in the Green, Red, NIR, and SWIR bands. Its repeat cycle can be utilized to derive Kharif, Rabi, and Summer cropping patterns, as well as compare and contrast them. The technique flow chart is shown in Fig. 3.1.

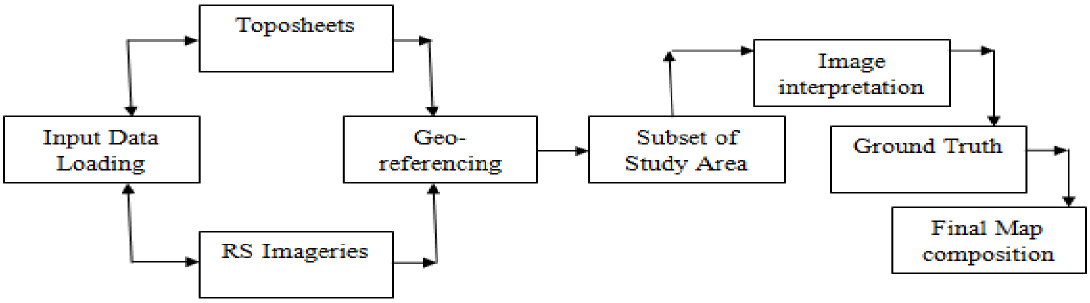

Fig3.1 Flow Chart of methodology

4. RESULTS AND DISCUSSIONS

The current study used IRS P6 LISS-III satellite data from 2005 and 2020 to map existing LULC in the Jind district. As illustrated in fig.4.2, five land use/cover types were interpreted and plotted. Table 1 shows the area of different land use/land cover groups in 2020. The 2005 land use/cover area and map were extracted from a HARSAC project to determine changes in land use/cover categories between 2005 and 2020. Table 2 and fig.4.1 depict the area covered by various land uses/covers in 2005.

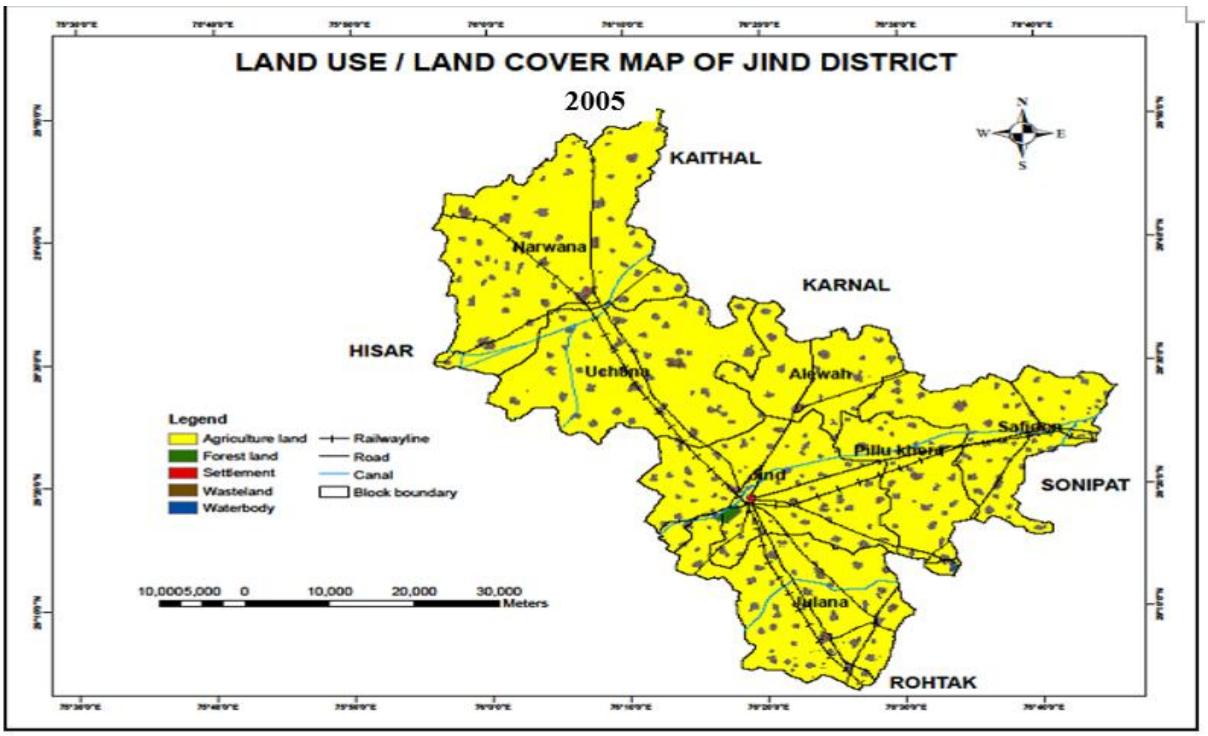

Fig.4.1: LULC map of Jind district

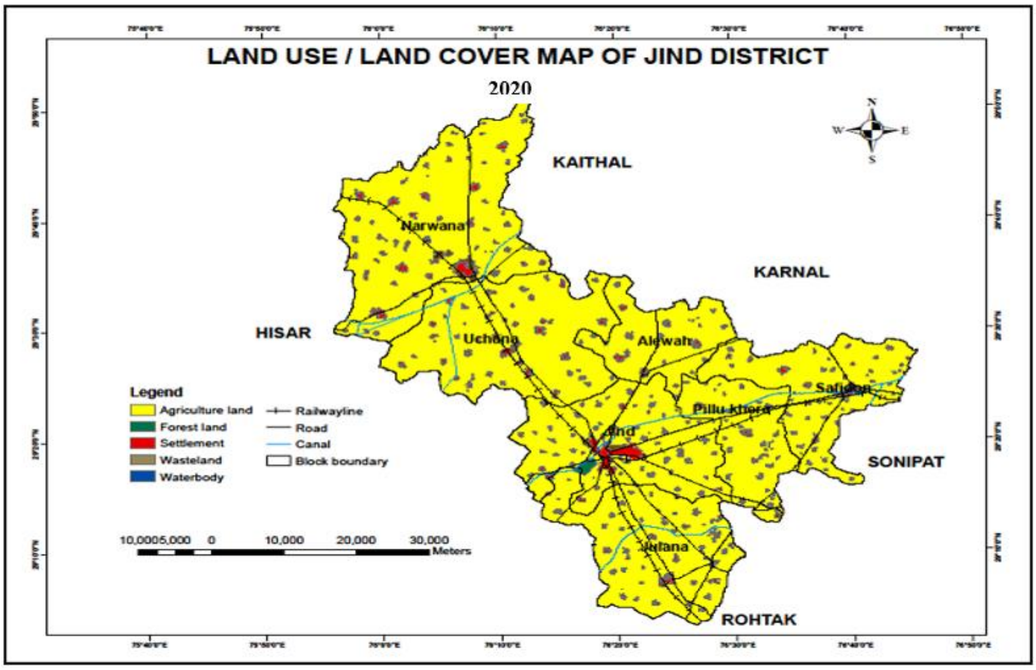

Fig.4.2: LULC map of Jind district

Table 1:**Area of different land use/ land cover categories in Jind district (2005)**

Land use/Land cover categories	Area in (Hectare)	Area in %
Settlement	7683.73	2.84
Agricultural Land	254348.58	94.13
Water Bodies	1697.03	0.63
Forest	395.42	0.15
Wasteland	6075.25	2.25
Total	**270200.00**	**100.00**

The above table shows the different land use and land cover categories in Jind districts. Agriculture land covers the highest area of Jind district followed by settlements, wasteland, water bodies, and forest.

Table 2: Area of different land use/ land covers categories in Jind district (2020)

Land use/Land cover categories	Area in (Hectare)	Area in %
Settlement	8447.21	3.13
Agricultural Land	252730.3	93.53
Water Bodies	1734.98	0.64
Wasteland	6863.07	2.54
Forest	424.42	0.16
Total	**270200.00**	**100.00**

The above table shows the different land use and land cover categories in Jind districts. Agriculture land covers the highest area of Jind district followed by settlements, wasteland, water bodies, and forest.

Table 3:Change in land use/ land cover categories in Jind district during 2005 to 2020

Land use/Land cover categories	Area in % (2005)	Area in % (2020)	Change in the area in % (2005 to 2020)
Settlement	2.84	3.13	0.29
Agricultural Land	94.13	93.53	-0.60
Water Bodies	0.15	0.64	0.49
Wasteland	2.25	2.54	0.29
Forest	0.63	0.16	-0.47
Total	**100.00**	**100.00**	

In the present study, it is found that due to urbanization, agricultural land converted into built-up land mainly in Jind city, which is a major urban agglomeration in the district. Built-up land is comprised of areas of intensive use with much of the land covered by concrete structures. Agricultural land may be defined broadly as land used primarily for the production of food grains and fodder. Water bodies in the district were increased to 0.49 % during 2005-2020. The term wastelands refer to degraded lands that are currently underutilized and are deteriorating for lack of appropriate soil and water management or on account of natural causes. The forest cover is mainly located in the southern part of the district.

CONCLUSIONS

The Jind district was chosen as a study area to map and analyzethe change in land use/ land cover from2005 to 2020. On the toposheets broad five major land use/ land cover categories were identified such as settlement, agricultural land, forest, wastelands, and water bodies, and the same categories were interpreted on IRS-P6 LISS-III satellite data of the 2020 year.The major findings of the study are the following:Settlement (Built-up) area increased from 1.01% in 1971 to 3.13% in 2005 i.e., 2.12% settlement area increased in the district during 2005-20.Agriculture land decreased from 95.04% in 2005 to 93.53% in 2020 i.e., 1.51 % agricultural land decreased during 2005-2020 in the district.Area of water bodies increased 0.15% in 2005 to 0.64% in 2020 i.e., 0.49% area of water bodies increased during 2005-20 in the district.Wasteland decreased from 3.64% in 2005 to 2.54 % in 2020 i.e.,1.10% during 2005-20.Forest area remains the same i.e., 0.16% in 2005 and 0.16% in 2020.

References

[1] Kumar, S., & Singh, R. (2021). Geospatial Applications in Land Use/Land Cover Change Detection for Sustainable Regional Development: The Case of Central Haryana, India. *Geomatics and Environmental Engineering*, *15*(3), 81–98. https://doi.org/10.7494/geom.2021.15.3.81

[2]Burley T.M.: Land use or land utilization? Professional Geographer, vol.13, no.6, 1961, pp.18–20. https://doi.org/10.1111/j.0033-0124.1961.136_18.x.

[3]Lo C.P.: Applied Remote Sensing, Geocarto International, vol.60, issue 4, 1986,p.60. https://doi.org/10.1080/10106048609354071.

[4]Chamling M., Bera B.: Spatiotemporal patterns of land use/ land cover change inthe Bhutan-Bengal foothill region between 1987 and 2019: a study towards geospatialapplications and policymaking. Earth Systems and Environment, vol.4, 2020,pp.117–130. https://doi.org/10.1007/s41748-020-00150-0.

[5]Taloor A.K., Singh K.V.: Land use land cover dynamics using remote sensing and GIS techniques in Western Doon Valley, Uttarakhand, India. [in:]Sah-devS., SinghR.B., KumarM.(eds.), Geology of Landscape Dynamics, Advances in Geographical and Environmental Science, Springer, 2020, pp.37–51. https://doi.org/10.1007/978-981-15-2097-6_4.

[6]Stow D.A., Collins D., McKinsey D.: Land use change detection based on multi-date imagery from the different satellite sensor system. Geocarto International, vol.5,no.3, 1990, pp.3–12. https://doi.org/10.1080/10106049009354263.

[7] Ehlers M., Jadkowaski M.A., HowardR.R., BrostuenD.E.: Application ofSPOTdata for regional growth analysis and local planning. PhotogrammetricEngineering and Remote Sensing, vol.58, 1990, pp.175–180.

[8] Kumar S. (2018). Remote sensing and GIS-based groundwater prospects and quality assessment in Fatehabad district, Haryana", i-Manager's Journal on Future Engineering and Technology, Vol. 14(1), pp.48

[9] S. Kumar (2017). Geospatial techniques based geomorphologic mapping in Fatehabad district Haryana. International Journal of Creative Research Thoughts (IJCRT). Vol. 5(4). Pp. 3780-3788

[10] Kumar S. and Kumar G. (2019). Role of geospatial application in waterlogging and salinity assessment: a review. Our Heritage. Vol. 67 (1), pp. 1-10

[11] Arvind, Savita, Veer V., Kumar S., and Singh R. (2022). GIS-based review for monitoring the spatial distribution of Covid-19: a case study of Haryana. International Journal for research in applied science & Engineering Technology (IJRASET). Vol. 10(II), pp. 1093-1099. DOI: 10:22214/ijraset.2022.40405

[12] Kumar S. (2018). Monitoring Gangotri glacier using remote sensing and GIS technique. International Journal of Engineering in Computer Science and Engineering (IJERCSE). Vol. 5(1), pp. 21-25

[13]Adeniyi, P.O and Omojola A. (1999). Land use/land cover change evaluation in Sokoto - Rima Basin of Northwestern Nigeria based on archival of the environment (AARSE) on geoinformation technology application for resource and environmental management in Africa, pp. 143-172.

[14]Anderson, (1976). Land use and land cover classification system for use with remote sensing data. Geological Survey Professional Paper No. 964, U.S. Government Printing Office, Washington, D.C., p. 28.

[15]Byeong-Hyeok Y, Kwang-Hoon C, (2005). Application research of multi-temporal satellite image for forest reclamation monitoring in the abandoned mine area, Geoscience Information Center, Korea Institute of Geoscience and Mineral Resources.

[16]Coppin, P. and Bauer, M. (1996). Digital change detection in forest ecosystems with remote sensing imagery. Remote Sensing Reviews. Vol. 13, pp. 207-234.

[17]Daniel, (2002). A comparison of land use and land cover change detection methods. ASPRS-ACSM Annual Conference and FIG XXII Congress,

p. 2.

[18]Lu, D., Mausel, P., Brondizio, E., and Moran, E. (2004). Change detection techniques. Int. J. Remote Sensing, 20 (12), pp.2365-2407.

[19]Macleod and Congalton, (1998). A quantitative comparison of change detection algorithms for monitoring eelgrass from remotely sensed data. Photogrammetric Engineering & Remote Sensing. Vol. 64, No. 3, pp. 207- 216.

[20]Meyer, W. B., (1995). Past and present land-use and land-cover in the U.S.A. Consequences.pp. 24-33.

[21]Moshen, A., (1999). Environmental land-use change detection and assessment using with multi-temporal satellite imagery. Zanjan University.

[22]Ololade, O., Annegarn H.J, Limpitlaw D, Kneen M.A, (2008). Abstract of land-use/cover mapping and change detection in the Rustenburg mining region using Landsat images, IGARSS.

[23]Olorunfemi J. F., (1983). Monitoring urban land - use in developed countries - an aerial photographic approach, Environmental Int. 9, pp.27-32.

[24]Pandy Arvind C. and M. S. Nathawat (2006). Land use land cover mapping through digital image processing of satellite data - A case study from Panchkula, Ambala and Yamunanagar Districts, Haryana State, India.