

Using Remote Sensing and GIS to Monitor Land Use-Land Cover Change in Jodhpur city and Surrounding Area

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ABSTRACT: Land use/land cover (LU/LC) changes were determined in an urban area, Jodhpur City Area, from 1990 to 2015 by using Remote sensing (RS) and Geographical Information Systems (GIS) technology. This study was carried out using the Landsat satellite imagery and Survey of India map. In the study area, the five LU/LC classes identified, mainly builtup area, other area, vegetation, mining area and water bodies. LU/LC maps were generated for four periods (1990, 2000, 2010 & 2015) using supervised classification technique on landsat satellite imagery and change statistics are computed. The change detection study of LU/LC for four period indicates that there is a significant increase in built-up area and mining area. It is also noted that significant amount of vegetation land, water body, and other area decreases during the study period due to express urbanization in the Jodhpur City area. Urban growth and land use change can be used by the public land use planners and policy makers to predictable and plan for the future.

KEYWORDS: LU-LC, Remote sensing, GIS, Change Detection.

I. INTRODUCTION

The LU/LC change detection study is very essential to have proper urban planning and management. The geographical distribution of land use in urban areas is of most important attention to the geographer, urban sociologist and city planners. It is a simple attempt to classify urban systems into structure that we can simply understand and give details. Though the proponents and many authors that had worked on these theories recognized the fact that every city has unique understanding and history and thus it is difficult to box into a unified theory or concept the changed process and pattern of any urban area. Remote sensing and GIS has been widely used in mapping land use/land cover changes. Remote sensing provides multi temporal data which gives valuable information about the process and pattern of land use/land cover change which may be analyzed and mapped in GIS. Urban growth and land use change can be used by the public land use planners and policy makers to predictable and plan for the future.

II. RELATED WORK

Land use and land cover are an important component in understanding the interactions of the human activities with the environment and thus it is necessary to be able to simulate such changes. Many researcher studied land use/land cover in different areas by using the different methods of land use/land cover change detection. Presently various scientists have been using RS and GIS technique for land use/land cover studies. The previous work mostly focus on land use, urban land use, change detection and GIS techniques.

Pathan et al.,(1989) have studied urban land use of Bombay Metropolitan using remote sensing data. Chakraborty et.al. (2001) studied land use indicators of a watershed in arid region, western Rajasthan using remote sensing and GIS and find out that land with scrub occupied maximum area. Kewalramani Gita (2002) studied the land use changes

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in the peri-urban interface of Mumbai: a case study of the Vasai-Virar lowlands. The dynamic changes in the land use of the area from agricultural to non-agricultural uses. Sudhira and Ramachandra (2007) conducted a study on characterising urban sprawl from remote sensing data and using landscape metrics. They analyzed the urban growth and sprawl of Bangalore city using two temporal satellite remote sensing images for the time span of 1992–2000. Images had been classified to extract built-up, water, vegetation, and open land. A paper by Jat et al., (2008) is another example which analyzed the Ajmer city (Rajasthan) for the time span of 1977–2005 using eight temporal satellite remote sensing data. They classified the images using supervised maximum likelihood classifier to extract ten information classes.

III. STUDY AREA DESCRIPTION

Jodhpur city is second largest city of Rajasthan state and geographically located at 26°N 18' latitude and 73° E 04' and at an average altitude of 224m above mean sea level. In general the contours are falling from North to South and from North to Southeast with maximum level of 370m and minimum of 210m. The present population is about 1.05 million and has been functioning as one of the engines powering the Indian economy. With each passing year, the landscape saw significant changes, long stretches of farmland giving way to clusters of enclosed factory campuses. Just as the manufacturing process of Jodhpur is well documented and acknowledged. The location map of the study area is shown in fig.1.

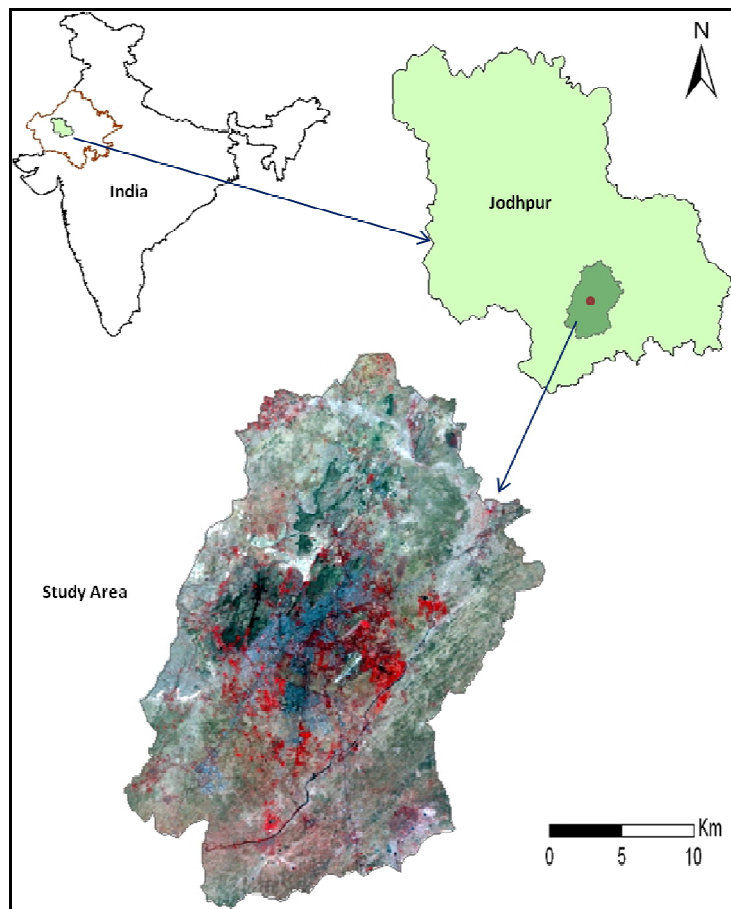


Fig. 1. Location Map of the Study Area.

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IV. DATA USED

In the present study we have used RS data, Ground truth data and SoI map. Landsat satellite data were used for land use/ land cover mapping. The Landsat TM sensor can obtain multispectral images with higher spatial, spectral, temporal, and radiometric resolution compared to Landsat MSS. Landsat TM has 7 bands. The properties of the Landsat satellite images are given in Table- 1.

Table 1. Basic Properties of Landsat Data

Year	Date Acquired	Spacecraft ID	Sensor ID
1990	Oct - 1990	LANDSAT_5	"TM"
2000	Oct - 2000	LANDSAT_7	"ETM"
2010	Oct - 2010	LANDSAT_7	"ETM"
2015	May - 2015	LANDSAT_8	"OLI"

V. METHODOLOGY ADOPTED

The SoI map is georeferenced with longitude and latitudes using the ArcGIS 9.2 software and demarcated the boundary of study area. In this study, four base years were defined to analyze LULC changes in Jodhpur City. The determination of these base years is a result and compromise of research needs and satellite data availability. A supervised signature extraction with the maximum likelihood algorithm was employed to classify the digital data of landsat for LU/LC mapping for the year 1990, 2000, 2010 and 2015. Before the image preprocessing and classification of satellite imagery began, an extensive ground truth survey. The LU/LC classified maps pertaining of four different periods were used for change detection study. The detailed methodology adopted is shown in fig.2.

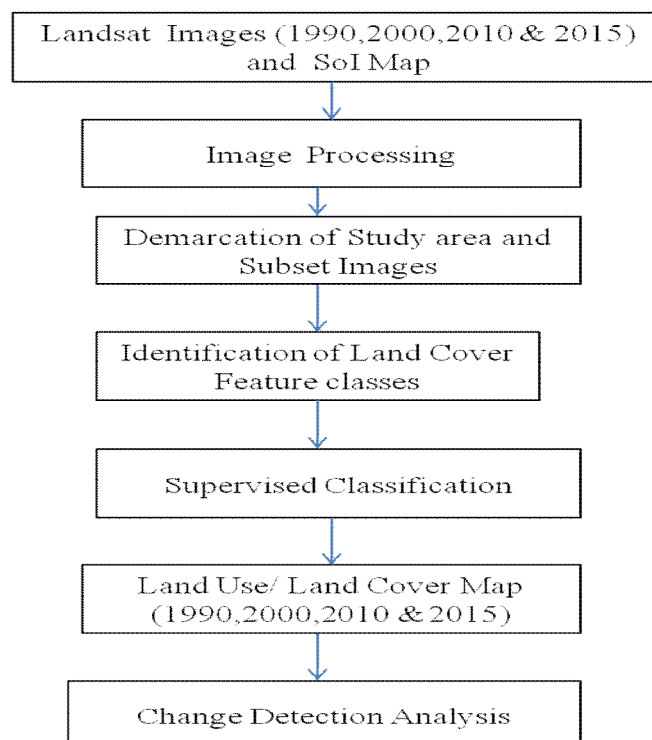


Fig.2. Methodology for LU/LC and Change Detection.

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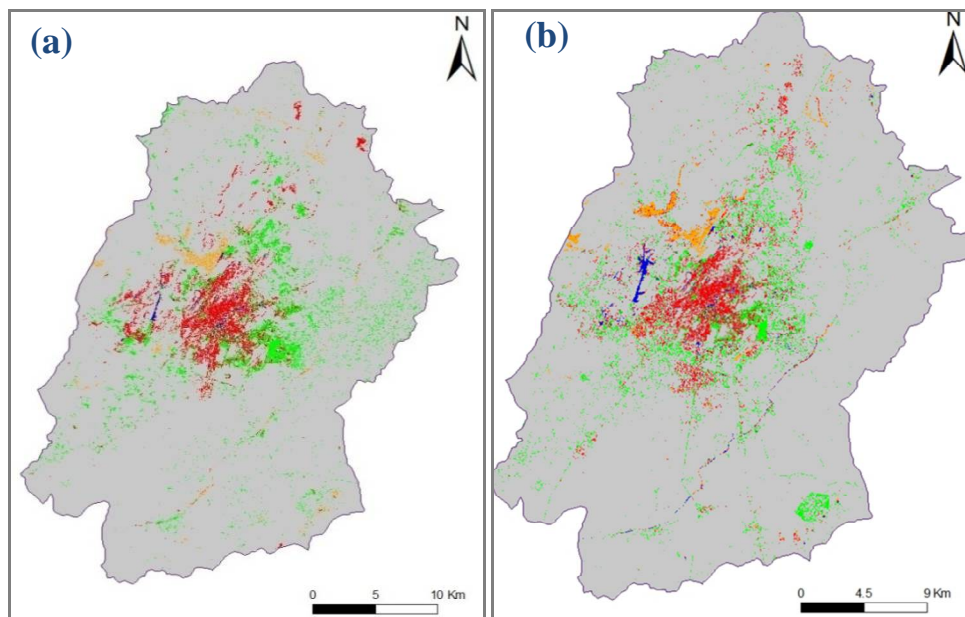
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VI. RESULTS AND DISCUSSION

The Studies of land use and land cover structure change usually needs development and definition of more or less homogeneous land use/land cover units before the analysis is started. The LU/LC features in the region comprises of various types, referred as classes. The features derived from the satellite image after validation by the ground observations, have been presented as five classes. These classifications types are as per the 'level classification' categories followed by National Remote Sensing Center (NRSC). In the field LU/LC features were obtained in conjunction with Imagery and derived five prominent features. The five land cover classes were selected are builtup area, other area, vegetation, mining area and water bodies. In order to use the supervised classification the training samples were created, then the supervised classification based on maximum likelihood algorithm has been used for classification because the other algorithms result was not satisfactory. The classified result maps are given in the Fig.3.



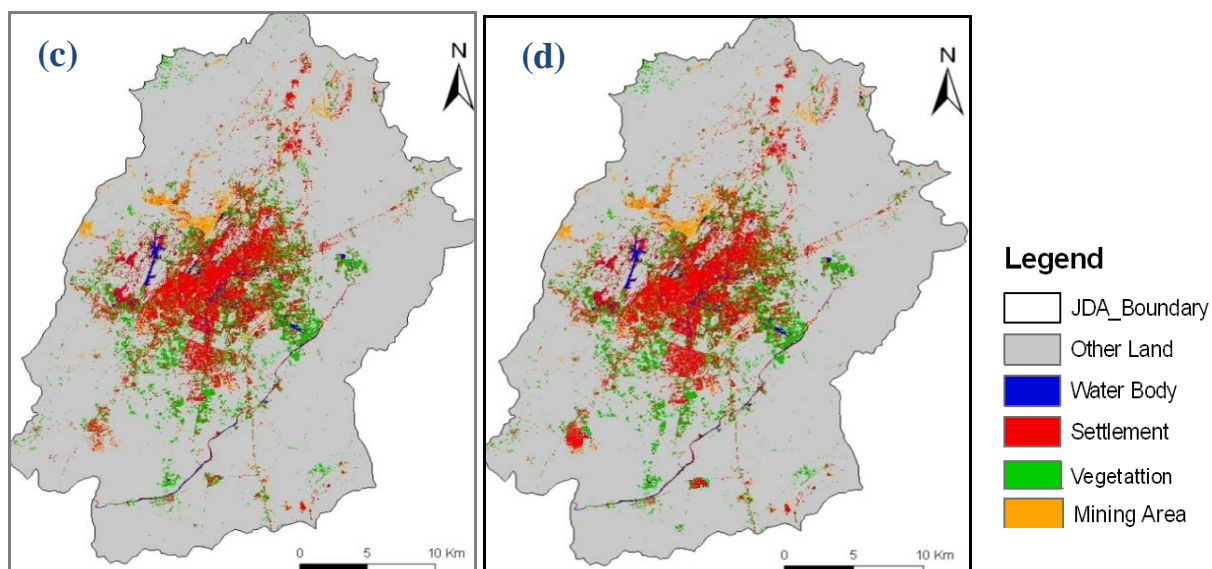


Fig.3. Supervised Classification Result- (a) 1990 (b) 2000, (c) 2010 and (d) 2015.

LULC Change Maps and Statistics

Using the approaches adopted in the methodology, land cover maps were generated for four periods (Fig.3) and area estimates and change statistics are computed. Individual class area and change statistics for the four periods were summarized in Fig.4 and Table-2. Among all the land cover types identified, and in the four periods, other area of land cover type is decreasing year by year and shows negative change because of increasing built-up area. In this study, it was found that there is approx 4% increase of vegetation land cover from 1990 to 2015. The water bodies in the study area are showing decreasing trend of 0.16% and built-up area there is increases by 17% due to increasing of human population. There is 24% decrease of other area (crop land, scrub land), there is 2.96% increase of Mining area since last 25 years of the total area. There is only one noticeable factor behind this change i.e directly or indirectly increasing human population and there need's.

Table-2 LU/LC Change Statistics (1990 to 2015).

Land Use/ Land Cover	Year 1990		Year 2000		Year 2010		Year 2015		2015-1990 (%) Extent	Rate of Change (%/ yr.)
	Area (km ²)	% Area	Area (km ²)	% Area	Area (km ²)	% Area	Area (km ²)	% Area		
Built up Area	24.97	4.20	68.98	11.61	114.42	19.26	131.25	22.09	17.89	+1
Other Area	496.01	83.50	422.04	71.05	367.50	61.86	348.57	58.68	-24.82	-1
Vegetation Land	62.24	10.47	79.31	13.35	86.36	14.54	84.85	14.28	3.81	+1
Mining Area	10.33	1.74	22.38	3.76	24.25	4.08	27.93	4.70	2.96	+1
Water bodies	0.45	0.07	1.29	0.22	1.47	0.25	1.40	0.24	0.16	0
Total Area	594	100	594	100	594	100	594	100	--	--

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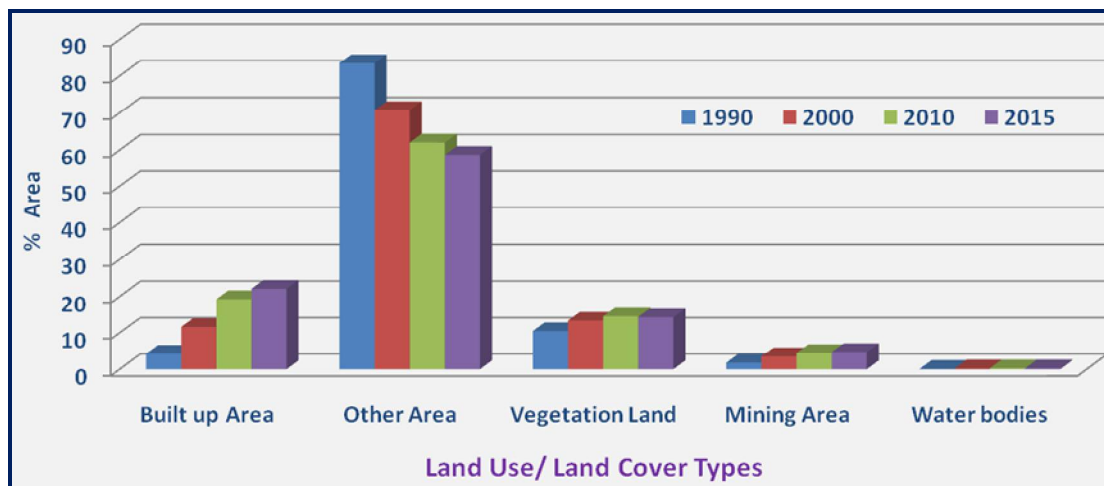


Fig.5. Nature of relative Land use/ Land cover change 1990 to 2015.

VII. CONCLUSIONS

This study has demonstrated the role of satellite remote sensing and GIS technology for producing accurate LU/LC maps and change statistics of the Jodhpur for four periods (1990, 2000, 2010 and 2015). The study shows that the land cover in different times showed significant change. There is significant growth of built-up area noticed. On the other hand there is decrease in water body and other area (crop land, scrub land). This study shows the direct impact of population growth on LU/LC change.

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REFERENCES

- [1] C. A. Berlanga-Robles and A. Ruiz-Luna, "Land use mapping and change detection in the coastal zone of northwest Mexico using remote sensing techniques," *Journal of Coastal Research*, vol. 18, no. 3, pp. 514–522, 2002.
- [2] T. Fung and E. Ledrew, "Application of principal components analysis to change detection," *Photogrammetric Engineering & Remote Sensing*, vol. 53, no. 12, pp. 1649–1658, 1987.
- [3] Praveen Kumar Mallupattu and Jayarama Reddy Sreenivasula Reddy, "Analysis of Land Use/Land Cover Changes Using Remote Sensing Data and GIS at an Urban Area, Tirupati, India", *Hindawi Publishing Corporation The Scientific World Journal*, Volume 2013, Article ID 268623, 6 pages, <http://dx.doi.org/10.1155/2013/268623>.
- [4] H. Long, X. Wu, W. Wang, and G. Dong, "Analysis of urban-rural land-use change during 1995-2006 and its policy dimensional driving forces in Chongqing, China," *Sensors*, vol. 8, no. 2, pp. 681–699, 2008.
- [5] J. R. Jensen, *Introductory Digital Image Processing: A Remote Sensing Perspective*, Prentice Hall, Upper Saddle river, NJ, USA, 1996.
- [6] J. F. Mas, "Monitoring land-cover changes: a comparison of change detection techniques," *International Journal of Remote Sensing*, vol. 20, no. 1, pp. 139–152, 1999.
- [7] T. M. Lillesand and R. W. Kiefer, *Remote Sensing and Image Interpretation*, John Wiley & Sons, New York, NY, USA, 4th edition, 2000.
- [8] A. G. O. Yeh and X. Li, "Principal component analysis of stacked multi-temporal images for the monitoring of rapid urban expansion in the Pearl River," *International Journal of Remote Sensing*, vol. 19, no. 8, pp. 1501–1518, 1998.
- [9] Borana S.L., Yadav S.K., Parihar S.K. and Paturkar R.T. - Integration of Remote Sensing & GUS for Urban Land Use / Cover Change Analysis of the Jodhpur city, 33rd INCA International Congress on Integrated Decentralized Planning: Geospatial Thinking, ICT and Good Governance, 19 - 21 September, 2013, Jodhpur, Rajasthan, India.
- [10] Bhagawat Rimal (2011). Urban Growth and Land Use /Land Cover Change of Pokhara Sub-Metropolitan City, Nepal. *Journal of Theoretical and Applied Information Technology*, Vol.26, No. 2, ISSN 1992-8645

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- [11] Ahmed, B. and Ahmed R. (2012). Modeling Urban Land Cover Growth Dynamics Using Multi-Temporal Satellite Images: A Case Study of Dhaka, Bangladesh, *ISPRS International Journal of Geoinformation*, 1, 3-31.
- [12] Goodchild, M. F. (2000). Spatial analysis: methods and problems in land use management. in *Spatial Information for Land Use Management*, eds. M. J. Hill and R. J. Aspinall, (Gordon and Breach Science Publishers, Singapore), 39-50.
- [13] USGS - <http://glovis.usgs.gov>
- [14] GLCF – <http://www.glcg.umiacs.umd.edu>.
- [15] Borana S. L. (2015). Urban Settlement, Planning and Environmental Study of Jodhpur City using Remote Sensing and GIS Technologies, JNV University, Jodhpur, PhD Thesis, pp.225 (Unpublished).
- [16] Sudhira HS, Ramachandra TV (2007). Characterising urban sprawl from remote sensing data and using landscape metrics. *Proceedings of 10th international conference on computers in urban planning and urban management*, Iguassu Falls, 11–13 July.
- [17] M. K. Jat, P. K. Garg, and D. Khare, “Monitoring and modelling of urban sprawl using remote sensing and GIS techniques,” *International Journal of Applied Earth Observation and Geoinformation*, vol. 10, no. 1, pp. 26–43, 2008.
- [18] Pathan, S.K., Jothimani, P., Pendharkar, S.P. and Kumar, D.S (1989). Urban land use mapping and zoning of Mumbai Metropolitan Region using Remote Sensing Data. *Journal of Indian Society of Remote Sensing*, Vol.17 (33), pp 11-22, 1989.
- [19] Kewalramani Gita (2002), “land use changes in the peri-urban interface of Mumbai: a case study of the Vasai-Virar lowlands, managing the Urban Fringe of Indian Cities”, Institute of Indian Geographer, University of Pune.
- [20] Jat, M.K., Garg, P.K. and Khare, D. 2008 Modeling urban growth using spatial analysis techniques: A case study of Ajmer City (India). *International Journal of Remote Sensing* Vol.29 (2), pp 543-567.