P: ISSN NO.: 2394-0344 RNI No.UPBIL/2016/67980 VOL-2* ISSUE-12* March- 2018
E: ISSN NO.: 2455-0817 *Remarking An Analisation*

Land Use and Land Cover Change Detection in Dhund Watershed (2d2a5) Using Remote Sensing Technique

R.D. Doi
Professor,
Deptt.of Geography,
University of Rajasthan,
Rajasthan

Mukesh Kumar
Research Scholar,
Deptt.of Geography,
University of Rajasthan,
Rajasthan

Abstract

The main objective of the paper is to investigate land use/land cover change in a hydrogeomorphic unit based on remote sensing data. Land use/land cover is an important component in comprehending the interactions of the human activities with the environmental setting, which helps in simulating changes. Land use/land cover change manifests complexities especially in semi-arid conditions. Watershed 2D2A5 is one of the five watersheds of the Morel Sub-catchment. More than two decades period has been taken to decipher land use/land cover changes. ArcMap 10.2 is used to prepare thematic maps based on visual interpretation on computer screen. Ground truths were also performed to check the accuracy of the classification. Crop land had decreased to 50.54 per cent of the total geographical area of the studied watershed during agricultural calendar 2013-14 that occupied 69.27 per cent of the watershed area in the year 1991. Built-up area, waste land and water resources also have experienced perceptible changes. Built-up (urban) had increased from 6.30 per cent to 20.45 per cent of the total area. It is envisaged that the urban land use is increasing by eating up crop land under prevailing demographic and economic constraints. Proper land use planning is essential for sustainable development of watershed 2D2A5, which is witnessing relatively faster urbanization due to proximity of Jaipur city being the state capital and the largest metropolitan city of Rajasthan.

Keywords: Land use, Land cover, Change Analysis, Sustainable Development

Introduction

Land use and land cover (LULC) change is a major issue of global environmental change. Scientific research community is concerned with substantive study of land use changes during the 1972 Stockholm Conference on the Human Environment, and again 20 years later, at the 1992 United Nations Conference on Environment and Development (UNCED). At the same time, International Geosphere and Biosphere Programme (IGBP) and International Human Dimension Programme (IHDP) co-organized a working group to set up research agenda and promote research activity for LULC changes. 'Land use/land cover mapping is essential component wherein other parameters are integrated on the requirement basis to derive various developmental indexes for land and water resource. Land use refers to man's activities and the varied uses which are carried out over land and land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others noticed on the land (NRSA, 1989)'. Land use includes agricultural land, built up land, recreation area, wildlife management area etc. Land cover includes: water, snow, grassland, forest, and bare soil. As indicated (Doi and Gurjar, 2010, p. 26) that 'satellite imagery provides a uniform database for rapid assessment and interpretation of spatial attributes in evolving a standard classification of land utilization pattern'. Land cover, defined as the assemblage of biotic and abiotic components on the earth's surface is one of the most crucial properties of the terrestrial system.

Land degradation results mainly due to population pressure. Over population makes people move towards sensitive areas like highlands. In such areas land use without considering the slope and erodibility leads to severe erosion and biotic depletion. The influence of road construction and other land use transformations of landscape had altered the runoff direction to greater extent. This fact is well established by comparing the slope map

generated from conventional data with the latest digital elevation models available of a given area.

'Application of remotely sensed data made possible to study the recent changes in land cover at low cost and with better accuracy (Kachhwaha, 1985)'. It is also envisaged that in association with Geographical Information System (GIS) that it provides suitable platform for data analysis, update and retrieval (Star et al. 1997; McCracker et al. 1998; Chilar 2000). As indicated that 'space-borne remotely sensed data may be particularly useful in developing countries where recent and reliable spatial information is lacking (Dong et al. 1997). These tools also provide efficient methods for analysis of land use issues and modeling of land use planning with due consideration of conservation measures. By understanding the driving forces of land use development in the past, managing the current situation with modern GIS tools, and modeling the future, one is able to develop plans for multiple uses of natural resources and nature conservation. The change in any form of land use is largely related either with the external forces and the pressure built-up within the system (Bisht and Kothyari, 2001).

Arvind C. Pandy and M. S. Nathawat (2006) carried out a study on land use land cover mapping of Panchkula, Ambala and Yamunanger districts, Hangana State in India. They observed that the heterogeneous climate and physiographic conditions in these districts has resulted in the development of different land use land cover in these districts, an evaluation by digital analysis of satellite data indicates that majority of areas in these districts are used for agricultural purpose. The hilly regions exhibit fair development of reserved forests. It is inferred that land use land cover pattern in the area are generally controlled by agro–climatic conditions, ground water potential and a host of other factors.

Landsat Multispectral Scanner (MSS), Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) data have been broadly employed in studies towards the determination of land cover since 1972, the starting year of Landsat program, mainly in forest and agricultural areas (Campbell, 2007).

Study Area

Dhund watershed consist major part of Jaipur city, one of the most popular tourist destinations in Rajasthan. Located 265 km south-west from New Delhi, this heritage city is popularly known as pink city. With fascinating forts, magnificent palaces; this place reflects a glorious and royal past. The flamboyance of turbans, eye catchy architecture, rich culture, textiles and jewellery attract a lot of national and international tourists. The brilliance of this city can only be experienced by witnessing it. Being the city of colours, fairs and fests, this wonderful city with a royal touch to it invites a huge crowd. Some of the prominent festivals are the Elephant festival, Teej festival, Kite festival, Gangaur festival, Camel festival. longitude and 26°43'35"N to 27°08'37"N latitude covering 995.70 km2. The average terrain height above mean sea level is 390 m. The climatic characteristics of this watershed is semi-arid type. Temperatures remain comparatively on the higher end all around the year. The summer season begins from April and continues till July. The temperature rises to an average of 30 oC. The watershed experiences monsoon showers in the months of August and September with frequent thunderstorms. Jaipur receives over 650 mm of rainfall each year. With pleasant weather in the month of October; November to February, are the months when the study area observe winters. The temperature ranges in between 5-15 oC during this season. There are no traces of humidity in winters but the watershed is dominated by the dense cover of fog in mornings and evenings. The cold waves at times lead to freezing temperature in this season. Jaipur is extremely warm during summers and cold during winters, though the nights are cooler throughout the year. October to March sees a great rush of travellers from India and abroad. It is indeed the ideal time for touring Jaipur and attractions nearby. This place affluent in heritage, culture and art has numerous lovely attractions that facilitate you with a refreshing experience of this enriched place.

Objective of the Study

To analyze the pattern and trends of land use/land cover changes in Dhund watershed (2D2A5) over more than two decades period.

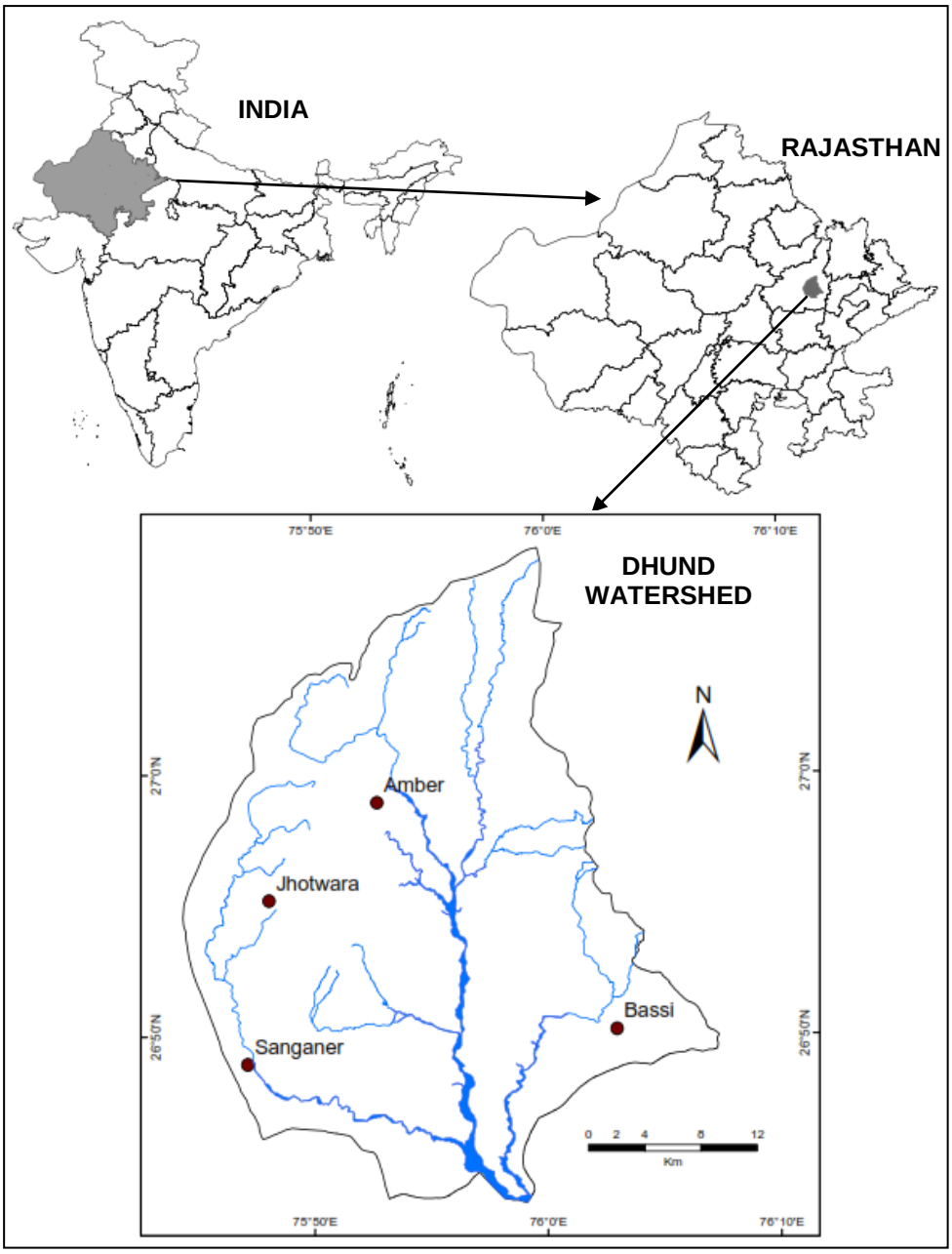


Figure 1: Location Map of the Study Area

Data and Methodology

Multi-temporal satellite data set observed by IRS-P6 LISS-III Landsat Enhanced Thematic Mapper (ETM+) and Survey of India District Planning Map drawn on 1:50,000 scales were used for the analysis (Table 1). LISS-III and ETM+ are optical sensors which have 4 and 8 multi-spectral bands between visible and infrared radiations.

Table 1: RS Data Used

Data	Observation Period	Spatial Resolution / Scale
IRS-P6 LISS-III	Nov.,2015 & March, 2016	24.00 m
Landsat ETM+	Sept., 2005 & March, 2006	14.25 m
SoI District Planning Map	1991	1:50,000

Digital land use/land cover classification had performed through unsupervised classification method, based on the field knowledge. Arc GIS 10.2 and Erdas Imagine 2011 are powerful tools for extracting the land use, land cover layer from satellite imageries and District Planning Map published on 1991. The land use land cover classes include agriculture land, wasteland, forest, built-up (urban, rural and mining), water bodies and river/stream. This classification is performed based on the classification scheme of National Remote Sensing Center (NRSC), Department of Space, Govt. of India.

Results and Discussion

The land under different classes of land use/land cover is presented in the Table 2. It is evident from the Figure 2 that about 70 per cent of the

studied watershed is under cropland in the year 1991, which is based on the District Planning Map series published by the Survey of India, Dehradun. This has been decreased to about 53 per cent and 50 per cent in the year 2005-06 and 2015-16 respectively as shown in Figure 3 and 4. While comparing the 2015-16 land use/land cover with the land use/land cover of 2005-06 shown in the Figure 3, it is noticed that under changed land use policy, the crop land could be restored to some extent. According to Rajasthan Land Revenue (Conversion of agricultural land for non-agricultural purposes) Rules, 2007, no permission shall be granted for conversion of the 'Land falling within the radius of 1.5 km of outer limits of abadi of a village for the purpose of an industrial unit of lime kiln or a crusher unit or an industrial area.' The dynamism of cultivated land and its decrease in per cent gradually may be justified by the fact that encroachment in fallow land by the cropping area in consequent to feed the ever-growing masses in the studied area.

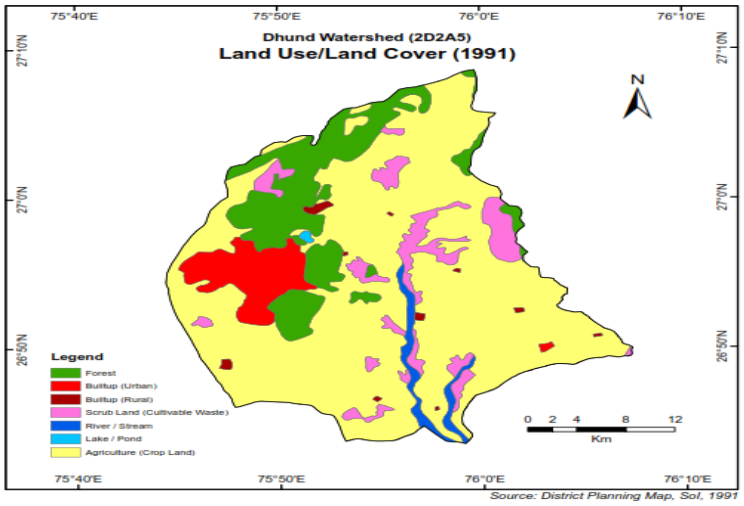
The forest land cover had been mapped as dense and degraded. There is a change though marginal from 1991 (14.69%) to 2015-16 (15.50%). Evidently, the forest cover had not witnessed any appreciable change due to policy of maintaining the status quo of such cover or forest conservation/protection policy over the years.

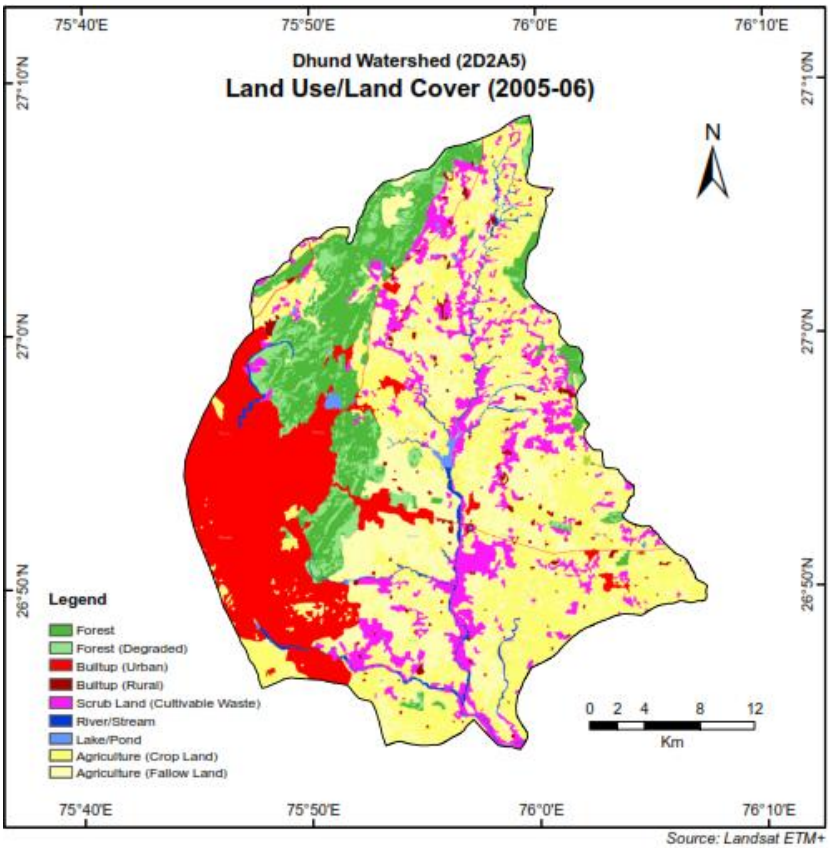
As a matter of fact, various socio-economic and technological factors are responsible for increased built up in conjugation with increasing population pressure and changed demographic attributes migration, mounting urban aspirations and break down of extended families into nuclear ones. Besides, institutional and cultural factors influenced the built up area as accessibility to land, labor, capital, technology and information are structured by local and national policies and institutions. Moreover the values, beliefs and individual perceptions of land managers and stake holders further amount to change land use in general and increased built up area in particular.

Table 2: Land Use/Land Cover Pattern

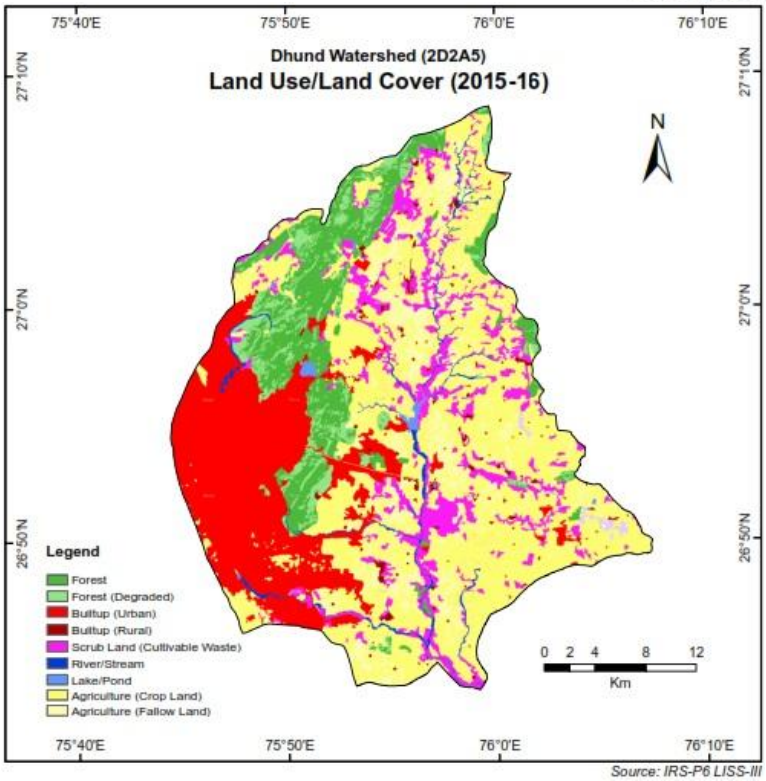
Category	Land Use / Land Cover	1991		2005-06		2015-16	
		Hectares		Hectares	%	Hectares	
Uncultivated	Forest	14629.05	4.69	11089.10	11.14	11091.26	1.14
	Forest (Degraded)			4335.61	4.35	4339.67	.36
	Builtup (Urban)	6269.74	.30	18206.96	18.29	20363.13	0.45
	Builtup (Rural)	529.82	.53	1104.63	1.11	1323.82	.33
Cultivable	Scrub Land (Cultivable Waste)	7143.87	.17	10468.94	10.51	10187.10	0.23
	Lake/Pond	150.51	.15	470.78	0.47	538.00	.54
	River/Stream	1877.79	.89	1443.13	1.45	1403.85	.41
Cultivated	Agriculture (Crop Land)	68969.22	9.27	27728.02	27.85	38996.25	9.16
	Agriculture (Fallow Land)			24722.82	24.83	11326.92	1.38
Total		99570.00	00.00	99569.99	100.00	99570.00	00.00

Source: Compiled by the Authors





Source: Landsat ETM+



Source: IRS-P6 LISS-III

A bar diagrammatic representation of the studied attributes of LULC in percentage and its two decadal analysis reveals the major share of LULC in agriculture followed by built up and forest land cover class

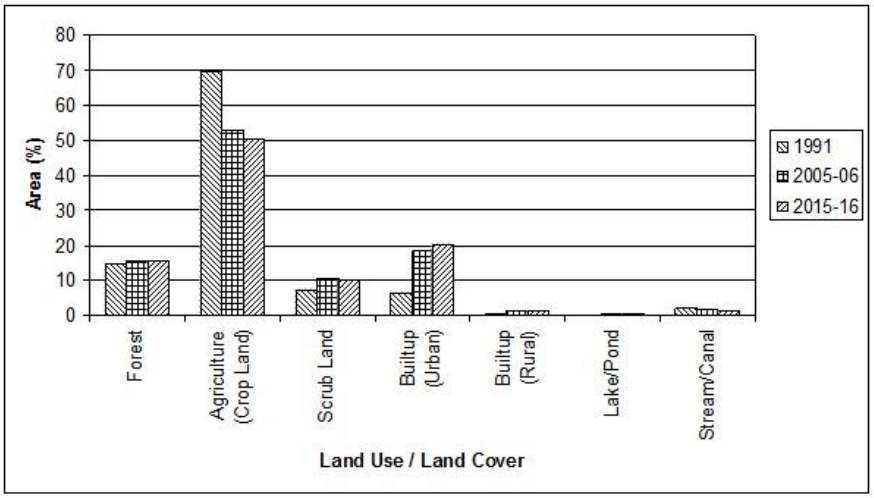


Figure 5: Distribution of Land use / Land cover during the three periods in the study area

Conclusions

Built up and crop land uses have shown appreciable changes both positive and negative respectively during the studied period in the watershed 2D2A5. This trend of change may be attributed to changing demography and socio-economic factors. Remote sensing data provides and objective tool to provide real time assessment pertaining to land use/land cover dynamics in context spatial dimension. It is a concern to the policy makers to satisfy the urban / rural population as the extension of built up land cover class in both the strata of the society further amounts to environmental, health and several socio-economic concerns.

References

1. *Arvind C. Pandy and Nathawat, M.S. (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.*
2. *Bisht, B.S. and Kothyari, B.P. (2001): Land-Cover Change Analysis of Garur Ganga Watershed Using GIS / Remote Sensing Technique, I. Indian Soc. Remote Sensing, 29(3): 165-174.*
3. *Blaser, T.J., Lyon, R.J. and Lank, K. (1992): Updating a Land Planning Database from Landsat 5 Thematic Mapper Data: Geographic Information Systems and Mapping Practices and Standards, ASTM STP 1126, A.I. Johnson, C.B. Pettersson and J. Fulton, Eds., American Society for Testing and Materials, Philadelphia, pp.132-154.*
4. *Campbell, J.B. (2007): Introduction to Remote Sensing, Fourth edition, The Guilford Press, New York, USA*
5. *Chilar J. (2000): Land cover mapping of large areas from satellites: status and research priorities. International Journal of Remote Sensing, 21(6-7): 1093-1114*
6. *Civco, D.L. (1989): Knowledge-based land use and land cover mapping, in Proc. of the 1989 Annual Meeting of the American Society for Photogrammetry and Remote Sensing, Baltimore, MD. pp. 276-291.*
7. *Doi, R.D. and Gurjar, D.V. (2010): Land Utilization Pattern in Watershed 2D2A3 (Morel Sub-Catchment) of East Rajasthan: A Data Comparison, Annals of the Rajasthan Geographical Association. Volume XXVII , pp. 14-27.*
8. *Kachhwala T.S. (1985): Temporal monitoring of forest land for change detection and forest cover mapping through satellite remote sensing. In: Proceedings of the 6th Asian Conf. on Remote Sensing. Hyderabad, pp. 77-83.*
9. *NRSA, (1989): Manual of Nationwide Land Use / Land Cover Mapping Using Satellite Imagery. National Remote Sensing Agency, Hyderabad.*
10. *Panigrahy, S., Parihar, J.S., Patel, N.K., Dadhwal, V.K., Medhavy, T.T., Ghose, B.K., Ravi, N., Pani, K.C., Panigraphy, B.K., Sridhar, V.N., Mohanty, R.R., Nanada, S.K., Tripathy, P.K., Misra, H.P., Bhatt, S.R., Oza, S., Sudhakar, S.K., Shudha Kumar and Das, P.K (1991): Rice acerage estimation for Orissa using remotely sensed data, Journal of the Indian Society of Remote Sensing, 19(1), 323-327.*
11. *Prakasam. C. and Biplab Biswas (2009): Land use, Land Cover Change Study in Ausgram I&II Blocks, Burdwan Dist, West Bengal Using Remote Sensing and GIS. Indian (2009) Journal of Landscape Systems and Ecological Studies Vol. 32 (2).*
12. *Rajan, K.S. and Shibasaki, R., (2000): A GIS Based Integrated Land Use/Cover Change Model To Study Human - Land Interactions.In: International Archives of Photogrammetry and Remote Sensing, Vol. XXXIII Part B7 (3), pp. 1212-1219.*
13. *Rajasthan Land Revenue (Conversion of agricultural land for non-agricultural purposes) Rules, 2007.*
14. *Star J.L., Estes J.E., McGwire KC, (1997): Integration of geographic information systems and remote sensing. New York, NY: Cambridge University Press.*
15. *Zhou, J. and D.L. Civco. (1998): A wavelet transform method to merge Landsat TM and SPOT Panchromatic Data. International Journal of Remote Sensing 19(4) :743-757.*