Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 06, pp.52835-52841, June, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

SPATIO-TEMPORAL ANALYSIS OF LAND USE/LAND COVER SHIFT IN JABALPUR CITY, MADHYA PRADESH

[1]Dr. Lokesh Shrivastava, *,[1]Shashikant Nag and [2]Dr. Ritu Rani

[1]Department of P. G. Studies and Research in Geography, Rani Durgavati University, Jabalpur
[2]Govt. Mahakoshal Arts and Commerce Autonomous College, Jabalpur

ARTICLE INFO

Article History:
Received 03rd March, 2017
Received in revised form
16th April, 2017
Accepted 25th May, 2017
Published online 30th June, 2017

Key words:
Land use,
Land cover Change,
Spatio-temporal analysis, GIS,

ABSTRACT

Land cover changes and the direct or indirect interaction of these changes have drawn much consideration in recent years. Thus in this study, "spatio-temporal analysis of land use/land cover shift in Jabalpur City, Madhya Pradesh" analyzed to reveal the nature, extent and rate of changes. Multi-temporal landsat imagery (LS 5 Oct. 2009 and LS Oct. 2016) were obtained in this study. Arc GIS 10.2 had used for band combination (LS 5 band 4,3,2 and LS 8 band 5,4,3 combined for FCC). Erdas imagine 2013 had used for land cover classification. Land cover classified and four land cover classes were developed; built- up area, vegetation (include agriculture and forest area), water bodies and open space. Land cover maps were generated and change detection analysis was performed. Jabalpur city is located at $23^0$3' to $23^0$16' North latitude and $79^0$51' to $80^0$6' East longitude, at an altitude of 393 m. above mean sea level (MSL). Total area of the city is 276.36 km^2. The temporal land use/land cover changes revealed that the built up surfaces had been increasing significantly. For example, in 2009 built up areas were 85.9 km2 which increased gradually to 99.06 km2 in 2016, signifying +13.16% growths within 7 years intervals. Figures 3.3 portrayed the temporal change of trends of land use/land cover change during 2009-2016. This figure signified the remarkable land cover change on the category of built up surface exerting an unbelievable pressure on non-built up surfaces, in particular open spaces, water bodies and Vegetation. Further analysis also showed the extent and rate. It is found the built up area was on continuous increase and vegetation, water bodies and open space were continuous decrease throughout the study period.

Citation: Dr. Lokesh Shrivastava, Shashikant Nag and Dr. Ritu Rani, 2017. "Spatio-temporal analysis of land use/land cover shift in Jabalpur City, Madhya Pradesh", *International Journal of Current Research*, 9, (06), 52835-52841.

INTRODUCTION

Land cover (LC) changes and the direct or indirect influence of such changes have drawn careful and intense attention spatial change analysts including planners and managers of urban and/or rural landscape. LC shifts over time is an inevitable global phenomenon due to both temporary and permanent interest of the inhabitants in a particular area (Eludoyin, 2010). Land use (LU) denotes how humans make use of the biophysical or ecological properties of land and addresses the modification and/or management of land for agriculture, settlement, forestry and such other uses including those that exclude or prohibit humans from land, as in the designated nature reserves for conservation (Ellis, 2010). Land cover change can be regarded as one of the most sensitive indicators that echo these interactions (Zhou *et al.,* 2008). Currently though urban areas account only account for about 3% of the earth's surface, urban expansion resulted in significant and perhaps irreversible environmental consequences such as forest degradation, landscape fragmentation, air, water and noise pollution, increase in energy consumption, decreased infiltration and an increase in surface runoff (Braimoh *et. al,* 2002). Professor Albert Guttenberg defined LU as a key term in the language of city planning. According to a report by the United Nations' Food and Agriculture Organization, land degradation has been exacerbated due to absence of land use planning, the existence of financial or legal incentives leading to the wrong land use decisions or one-sided central planning for over-utilization of the land resources. As a consequence the result has often been misery for large segments of the local population and destruction of valuable ecosystems. Only, proper LU planning can ensure the long-term quality of the land, the prevention or resolution of social conflicts and the conservation of ecosystems of high biodiversity. And this will only be impossible, unless the LU practices and patterns and the qualitative changes over the years and decades are scientifically known. Remotely sensed multispectral data, such as air-photos or satellite images are the precise source providing systematic ability to assess LU shifts over large

Corresponding author: **Shashikant Nag,**
Department of P. G. Studies and Research in Geography, Rani Durgavati University, Jabalpur

areas on a regular basis (Jakubauskas, *et.al.*, 1997). Land Use and Land Cover (LULC) change denotes the human modification of earth's terrestrial surface. The LULC alterations are generally caused by mismanagement of agricultural, urban, range and forest lands leading to severe environmental problems (Seto *et al.*, 2002).Urban land use change is the spatio-temporal reflection of urban growth. Such change is influenced by a set of social, economic, and political factors. Different driving forces have been identified in various studies, including the effects of natural environment, demographics, economy, transport system, preference (by people) for proximity, neighbourhoods, and governmental policies (e.g., Cervero and Wu, 1997; Mayer and Somerville, 2000; Smersh *et al.*, 2003).

Aims of the study

- To produce land use and land cover maps of the study area for selected timelines.
- To analysis how the land cover of the study area is changing in terms of Built up area, Roads, open land, vegetation and Water body over the period of time.

MATERIALS AND METHODS

Data Collection

Base map of the study area was obtained from Official website of Municipal Corporation Jabalpur. To assess the LULC cover changes satellite imageries of at least two different timelines are required. So, satellite imageries of same dates but different years i.e., Landsat-5of Oct. 2009, Landsat-8of Oct. 2016 and DEM of AOI were downloaded from http://earthexplorer. usgs.gov/site and country map downloaded from http://www.diva-gis.org/gdata. (Fig. 1)

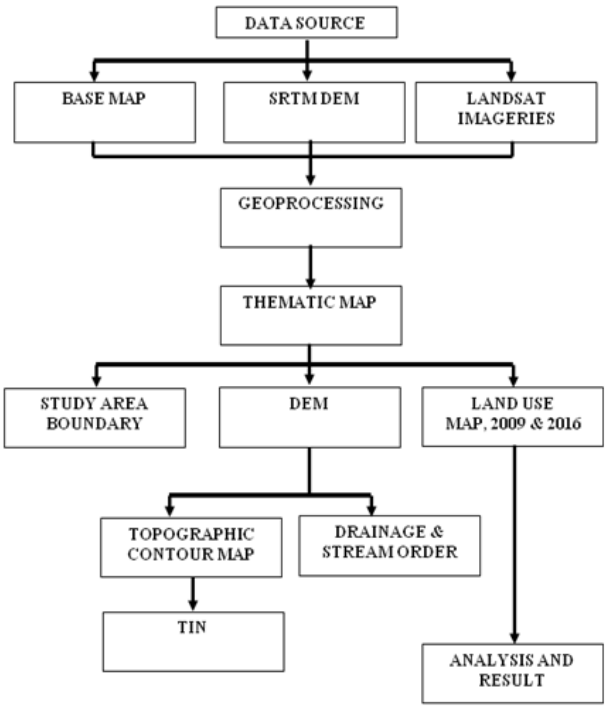


Fig. 1. Work Flow scheme

Data Processing

Scanned maps (raster) do not usually contain information as to where the area represented on the map fits over the surface of the Earth, and hence these maps have to be registered with the geographic coordinates. To set up the relationship between downloaded/scanned map and coordinate system, coordinates need to be aligned by geo-referencing raster maps (Pixel Images). Therefore, raster image is geometrically rectified and registered to the same projection viz., WGS84 and zone 44 (for JC). Firstly geo-referenced map had converted on kml (keyhole mark-up language) file, and then boundaries are digitalized. LU Signatures (Table 1) are identified in satellite imageries using ERDAS Imagine 2013, and Arc GIS 10.2 software is used for data processing. DEM of Jabalpur City obtained from USGS earth explorer. After mosaic the DEM and overlaying the boundary of Jabalpur city on DEM. Extract by mask tool used for DEM of Study area. Contour tool has used for contour map creation and elevation interval 20 meters has selected. Contour map has created. A Triangulated irregular network (TIN) is a digital data structure used in geographic information system (GIS) for the representation of continuous surface. Tin was created using 3D analyst tool.

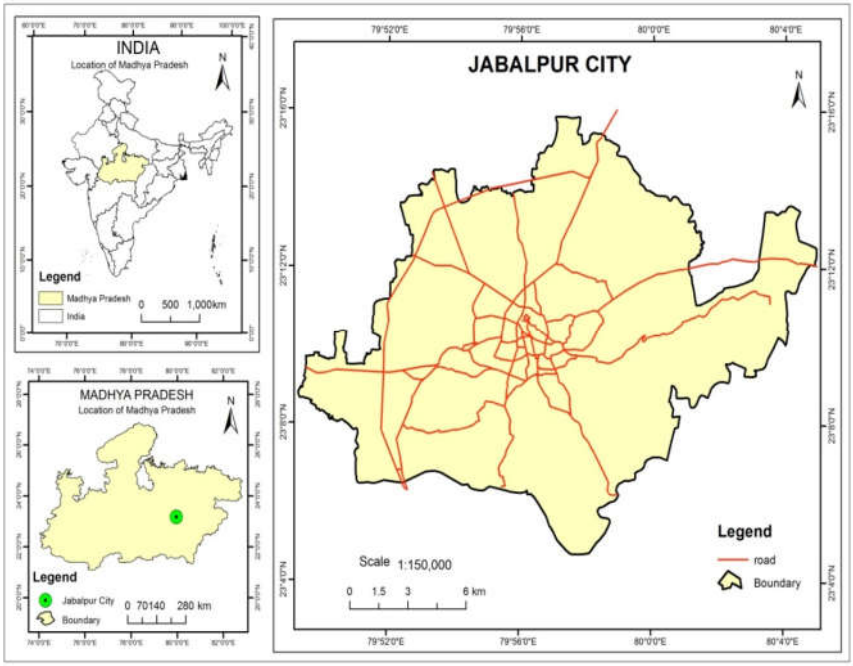
Table 1. Feature classes in LU classification etc

Theme	Feature Class	Feature Type	Source
Land Use	Place	Point	LANSAT, 5 & 8
	Road	Line	
	Boundary	Polygon	
	Built up Area		
	Open area		
	Vegetation		
	Water Body		
	Stream	Line	

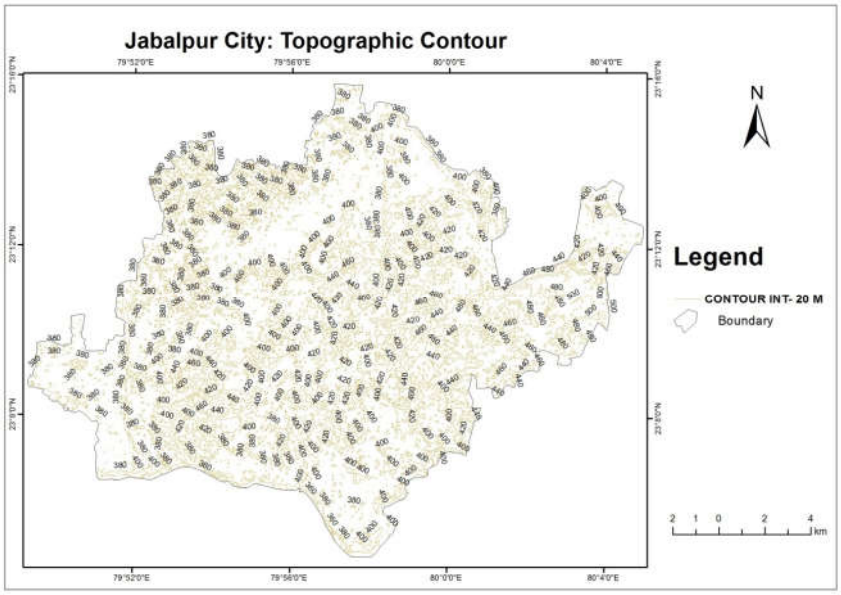
Study Area

Jabalpur City or JC (Map.1) is part of the Jabalpur congregation comprising of Municipal Corporation of Jabalpur (MCJ) and Cantonment Board Jabalpur (CBJ). This ancient city (traditionally also known as "Sanskardhani") is located in central India, in the state of Madhya Pradesh. Geographically, the city is located at $23^0$3' to $23^0$16' North latitude and $79^0$51' to $80^0$6' East longitude, at an altitude of 393 m. above mean sea level (MSL) (Map.2 & 3). Total area of the city is 276.36 km^2. The city experiences hot summers and cold winters, with temperatures ranging from an average low of around 9.8° C to an average high of about 41.7° C. Temperature during the peak summer month of May can soar to 47^o C. The rains usually break in the month of June, with the maximum number of rainy days experienced during the months of July and August. The city receives an annual average rainfall of 1,386 mm.

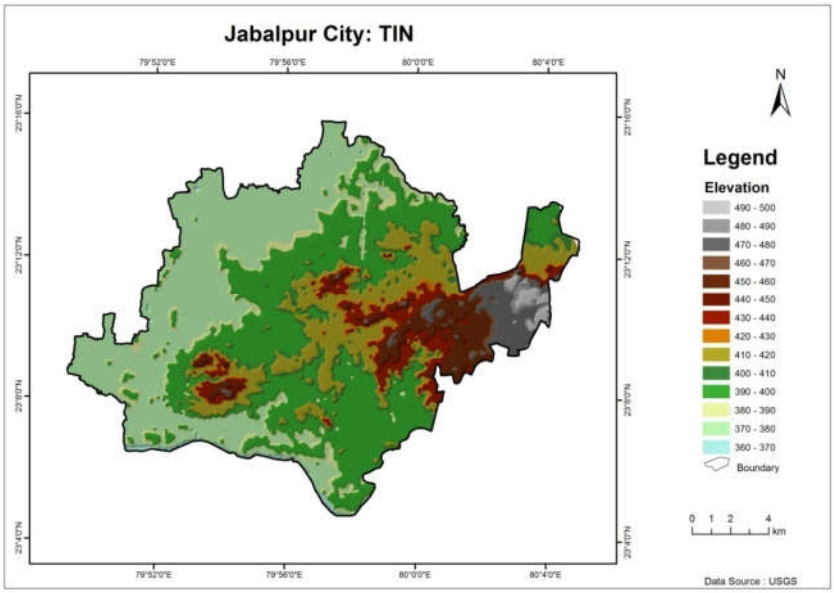
The peculiar topography of the city provides an excellent natural drainage pattern. The drainage of the city is divided into two distinct parts i.e. northern portion and the southern portion. The northern plain gradually slopes from east to north-west while the southern part of the town slopes towards the south. The storm water of the central city is channelized through Motinala and Omtinala which pass through the city and ultimately discharges into Pariat River, which then merges with Hiran River, a tributary of river Narmada. The southern side is drained off by Khandharinallah which discharges into River Narmada towards south-west (Map 4). Total Population of JC is 1,054,336 (Census of India 2011). It is divided eight zone and 79 wards Table is showing decade population of Jabalpur City. The sex ratio of Jabalpur city is 915 female populations per 1000 male populations. It is higher than the state urban average of 899 and national urban average 901. Literacy rate in Jabalpur City is 84.72 percent (male literacy



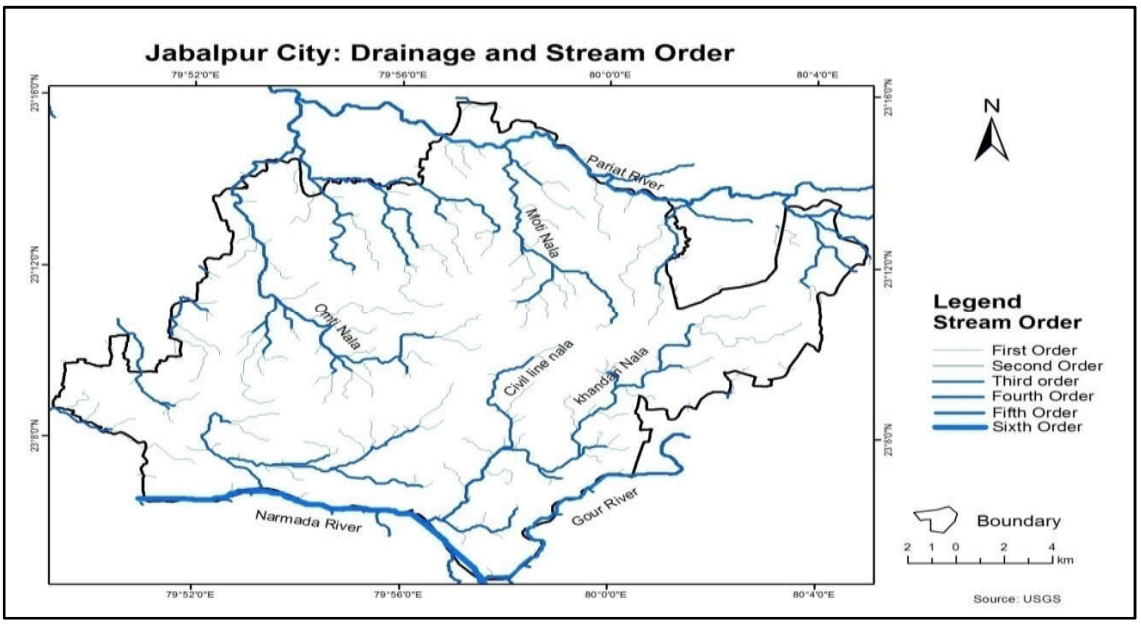
Map 1. Location of Study area



Map 2. JC, Topographic contour map



Map 3. JC, TIN



Map 4. JC, Drainage and stream order

rate of 60 percent and female literacy rate of 87.93 percent) higher than the state urban average of 79.67 percent and national urban average of 80.30 %. According to the Census 2011, population density in Jabalpur city is 3820 persons/km^2.

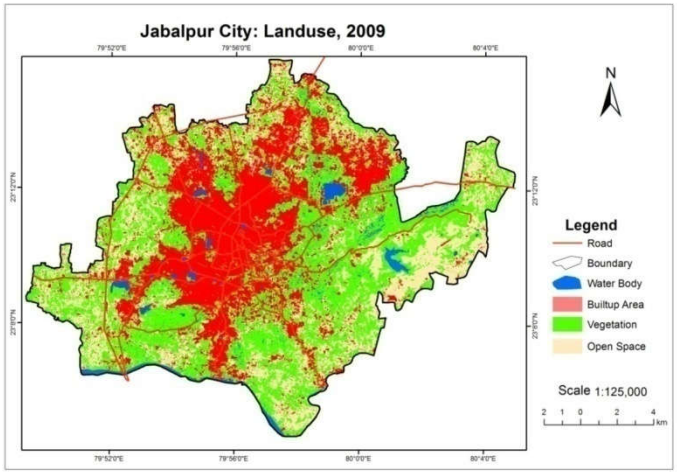
RESULTS AND DISCUSSION

Land Use change, JC

In the following pages the results of LU changes in JC are summarised and depicted by maps and charts. This study based on satellite images, analyzed to detect the LU changes in JC at different time lines. The categories of LU are built-up area, vegetation, water body and open space in two different times.

Land Use - Jabalpur City, 2009

Map 5. JC, Land use map, 2009



The results obtained from the study using satellite images of 2009; show that out of the total study area, 114.88 sq. Km. (41.57 %) area covered with vegetation, 85.9 sq. Km. (31.08%) area is acquired for built-up area, 69.78 sq. Km. (25.25%) area for open space and 5.8 sq. Km. (2.10%) area for water bodies (Map 5 & Fig. 2).

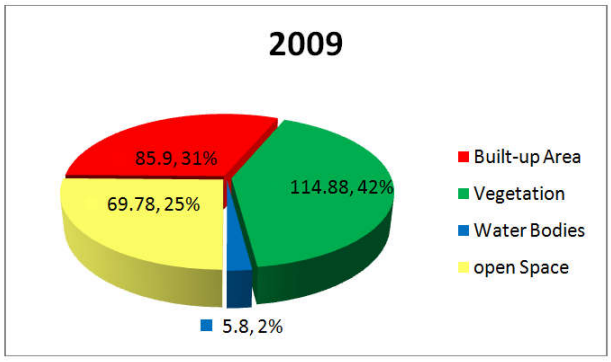
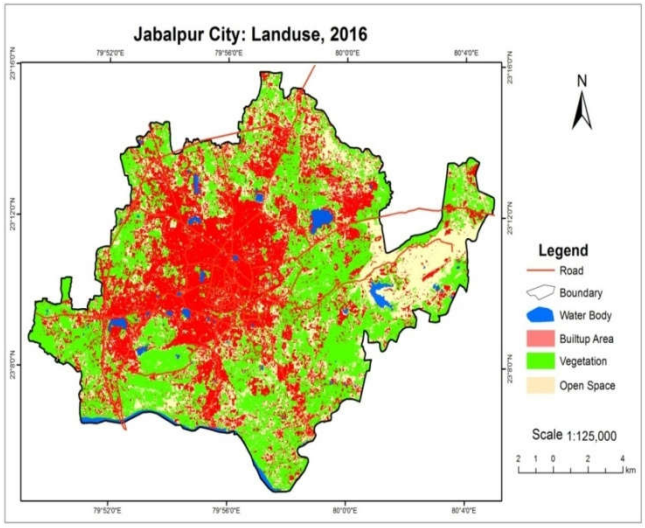


Fig. 2. Percentage distribution of Land Use, 2009

Land Use of Jabalpur City, 2016



Map 6. Land use map, JC, 2016

The results obtained from the study using satellite images of 2016; show that out of the total study area, 99.06 sq. Km. (35.84%) area is acquired for built-up area,107.40 sq. Km. (38.86 %) area covered with vegetation (include forest and agriculture), 65.03 sq. Km. (23.53%) area for open space and 4.87 sq. Km. (1.76 %) area for water bodies (Map 6 & Fig. 3).

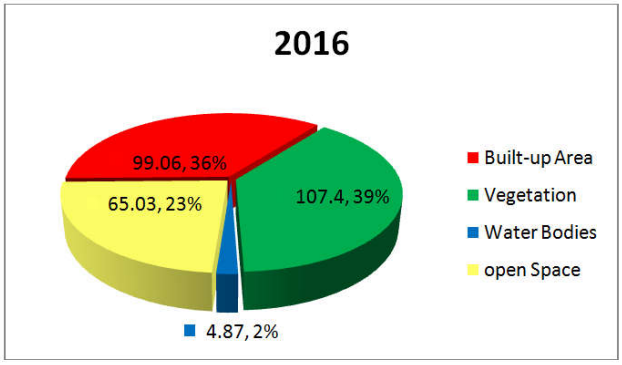
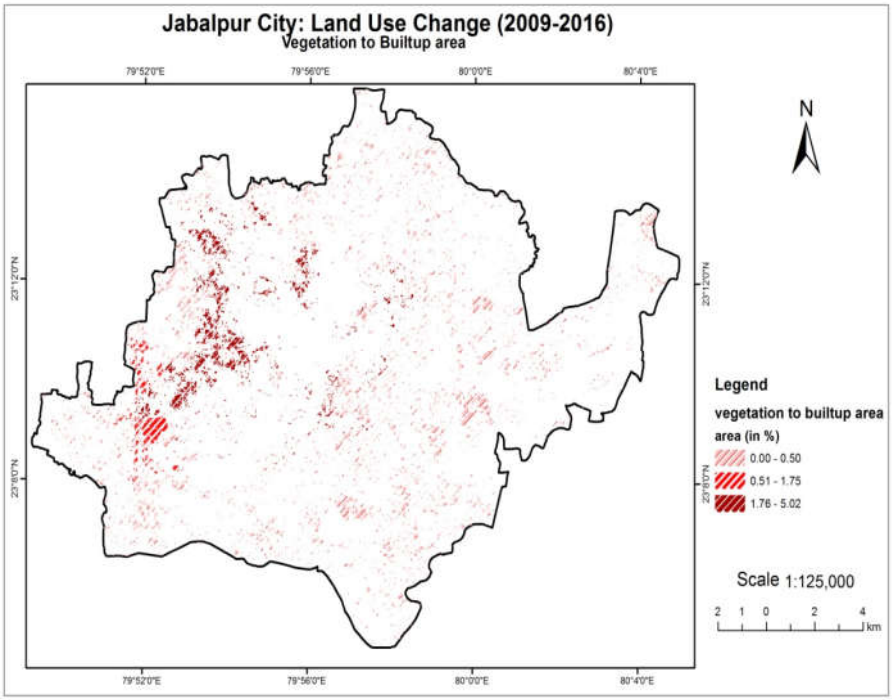
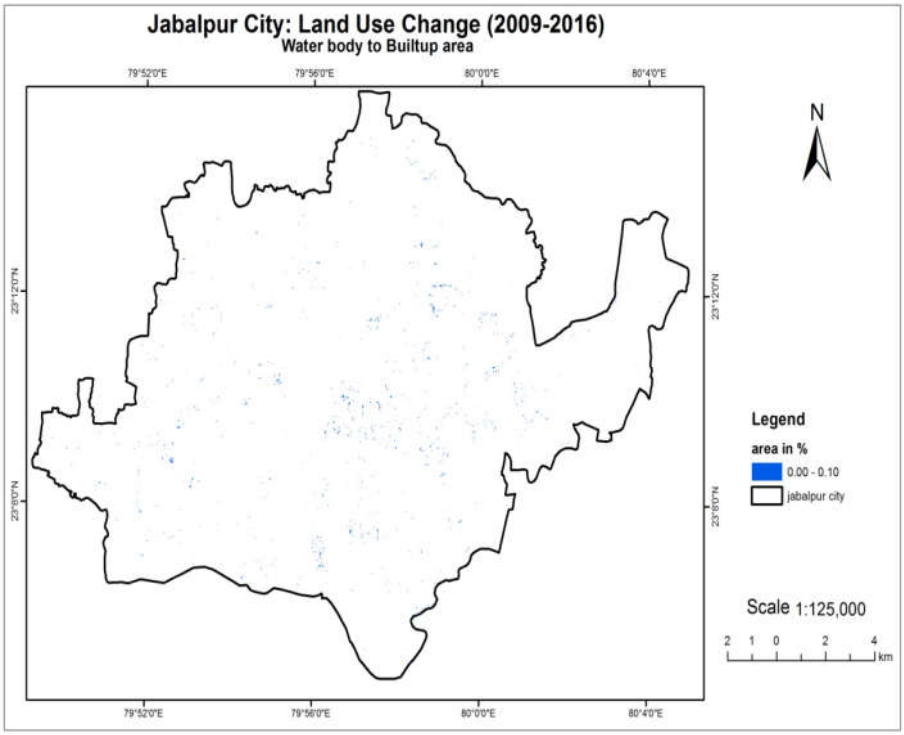


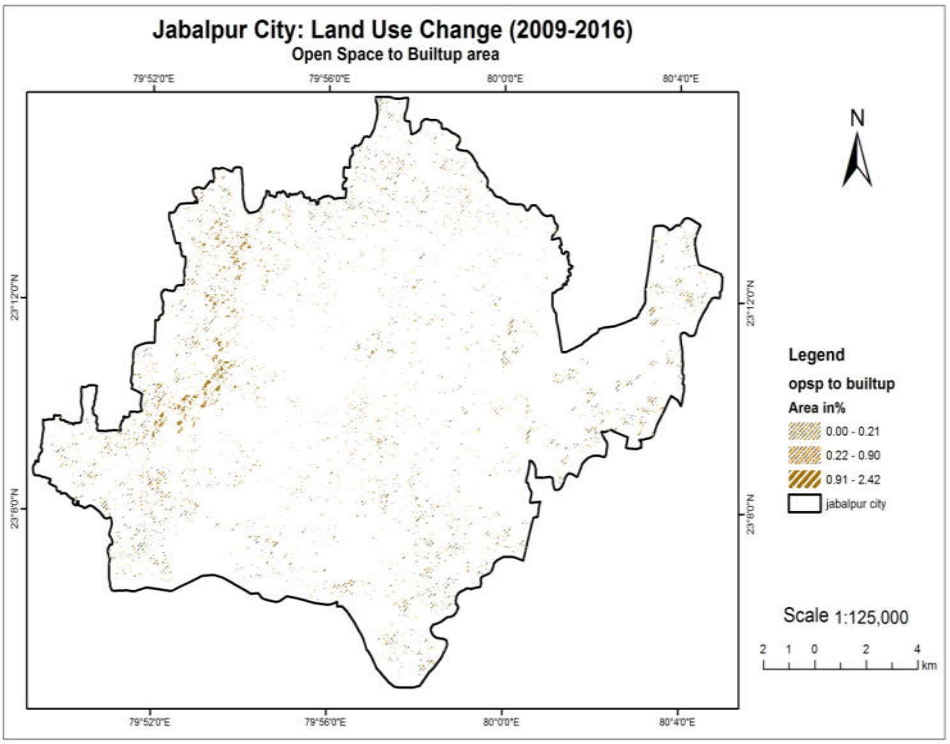
Fig. 3. Percentage distribution of Land Use, JC, 2016



Map 7.



Map 8.



Map 9.

Table 2. Estimated Land Use Change, JC

S. No.	Class	Area of Classes in 2009 (in km2)	Area of Classes in 2016 (in km2)	Changes Detected	Changes Detected (in %)
1	Built-up Area	85.9	99.06	+13.16	+15.32
2	Vegetation	114.88	107.4	-7.48	-6.51
3	Water Bodies	5.8	4.87	-0.93	-16.03
4	open Space	69.78	65.03	-4.75	-6.81
	Total	276.36	276.36		

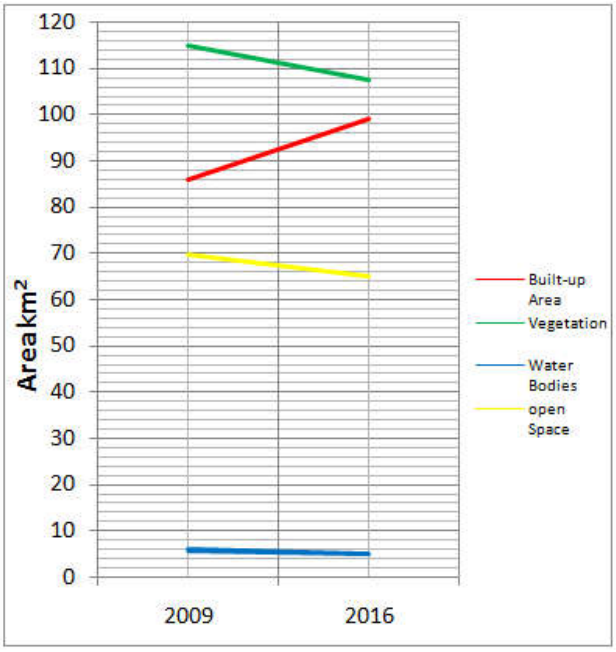


Fig.3. Spatio-temporal Modeling of Land Use Changes, JC

This map 7 represented land use change (2009-2016) vegetation converted to built-up area. Minimum 0.00 to 0.50 % change detected in eastern part, and north-east part of Jabalpur city. And Maximum 1.76 to 5.02% change detected in western part of Jabalpur City.

Above map is shown land use change on open space to built-up area. Maximum 0.91 to 2.42 % western part is converted open space to built-up area. Less than 0.21% change shown in southern part and north-east part of Jabalpur city. Above map 9 is represented land use change in Jabalpur city. Water body

converted to built-up area. Less than 0.10 % water body converted to built-up-area in the city.

Spatio-Temporal Land Use Changes, JC

Land use/land cover classifications and relative changes from 2009 to 2016 in the study area were depicted in map 3.1 and 3.2. Built-up areas showed dramatic increase while other non-built-up surfaces substantially decreased from 2009 to 2016. Expansion of built up surfaces has exhibited a consistent response since 2009 to 2016 in its areal extent. There had been a continuous conversion of non-built up surface to built-up environments. The temporal land use/land cover changes revealed that the built up surfaces had been increasing significantly (Table 2). For example, in 2009 built up areas were 85.9 km^2 which increased gradually to 99.06 km^2 in 2016, signifying +13.16% growths within 7 years intervals. Figures 3.3 portrayed the temporal change of trends of land use/land cover change during 2009-2016. This figure signified the remarkable land cover change on the category of built up surface exerting an unbelievable pressure on non-built up surfaces, in particular Open spaces, water bodies and Vegetation. Further analysis also showed the extent and rate.

Conclusion

This geospatial study of LULC changed in Jabalpur City, Madhya Pradesh brought out following interesting aspects in respect of land use. As part of this study several data based/supported maps have been created using Arc GIS software. A comparison of the LU categories between the selected time lines has brought to light. Very interesting aspects related to the LU aspects of the JC. Interestingly the population rise can be considered as a fuel for the increase in area under the built-up land category and that too at the expanded to vegetation area (forest and agriculture land). Vegetation land primarily is the result of conversion of some type of land area under forests of some sort. The change is shown built-up-area +15.32% vegetation area decrease -6.51% water body area changed -16.03%, open space area is changed -6.81%. Thus it is found that the built-up-area is increasing rapidly.

REFERENCES

Braimoh, K.A. and Onishi, T. 2007. Spatial determinants of urban land use change in Lagos, Nigeria. Land Use Policy: 24:502–515.

Cervero, R. and Wu, K.L. 1997. Polycentrism, commuting, and residential location in the San Francisco Bay Area. Environment and Planning A, 29, 865-886.

Ellis, E. 2011. Land-use and land-cover change, in: Cutler J. Cleveland (ed.), The Encyclopedia of Earth, Environmental Information Coalition, *National Council for Science and the Environment.*

Eludoyin, S.O. 2010. Geographic Information System Assessment of Land-Use and Land-Cover Changes in Obio/Akpor L.G.A., River State, Nigeria.

Jakubauskas, M.E. and Price, K.P., 1997. Empirical Relationships between Structural and Spectral Factors of Yellowstone Lodgepole Pine Forests. *Photogrammetric Engineering & Remote Sensing,* 63, 1375-1381 .

Mayer, C.J. and Somerville, C.T. 2000. Land use regulation and new construction. *Regional Science and Urban Economics,* 30, 639-662.

Seto K.C., Woodcock C.E., Song, C., Huang, X., Lu, J. and Kaufmann, R.K., 2004. Monitoring Land-Use Change in the Pearl River Delta Using Landsat TM. *Int. J. of Remote Sensing,* 23, 1985-2004.

Smersh, G.T., Smith, M.T., and Schwartz, A.L. 2003. Factors affecting residential property development patterns. *Journal of Real Estate Research,* 25, 61-75.

Zhou, Q., Li, B. and Kurban, A. 2008. Trajectory analysis of land cover change in arid environment of China, *International Journal of Remote Sensing*, 29, 1093-1107.

Websites

http://www.diva-gis.org/gdata
http://earthexplorer.usgs.gov/

****