



SPATIO-TEMPORAL CHANGES IN WATER BODIES OF RANCHI CITY AND ITS IMPACT ON PHYSICAL ENVIRONMENT

Rajeshree Das

Research Scholar

Department of Geography, Ranchi University, Ranchi

Abstract

The study has focused on portraying the spatio-temporal changes in water bodies from 1999 to 2018 and tried to assess the impact on physical environment based on the classified images of Ranchi city. To conduct the present research, satellite imageries of LISS III Resourcesat 1 (NRSC) and LANDSAT 7 (USGS) of 5 different years (1999, 2004, 2009, 2014, 2018) have been used. Supervised image classification approach with maximum likelihood classification has been selected for the generation of LU/LC maps. A total of 400 sample verification points has been taken to assess the accuracy of land use in both cases. The verification points have been selected by purposive random sampling method. Results reveal the consistent increase in built-up area and continues decrease in forest area, agricultural land, water bodies and open space.

Keywords : Land use/Land cover, Supervised image classification, Maximum likelihood classification, National Ambient Air Quality Standard.

Introduction

Geospatial Technology is mostly Geo-informatics technology which comprised of Remote sensing (RS), Geospatial Information System (GIS) and Global Positioning System (GPS) (Ranjan et al., 2016). Many scholars defined this term in many ways like Prakash (2006) defined as The group, integration, management, analysis and presentation of geo spatial data, models and knowledge that support disciplinary, multidisciplinary and transdisciplinary research and education (Bhatt, 2011).

The major four assignment of Geospatial technology are: (a) collection and processing of geodata, (b) development and management of a database of geodata, (c) analysis and modeling, (d) development and integration of logic and computer tools and software for the first three tasks. Similarly, Virrantaus and Haggren (2000) states that “Geoinformatics is the combination of RS and GIS (Bhatta, 2011; Ranjan et al., 2016).

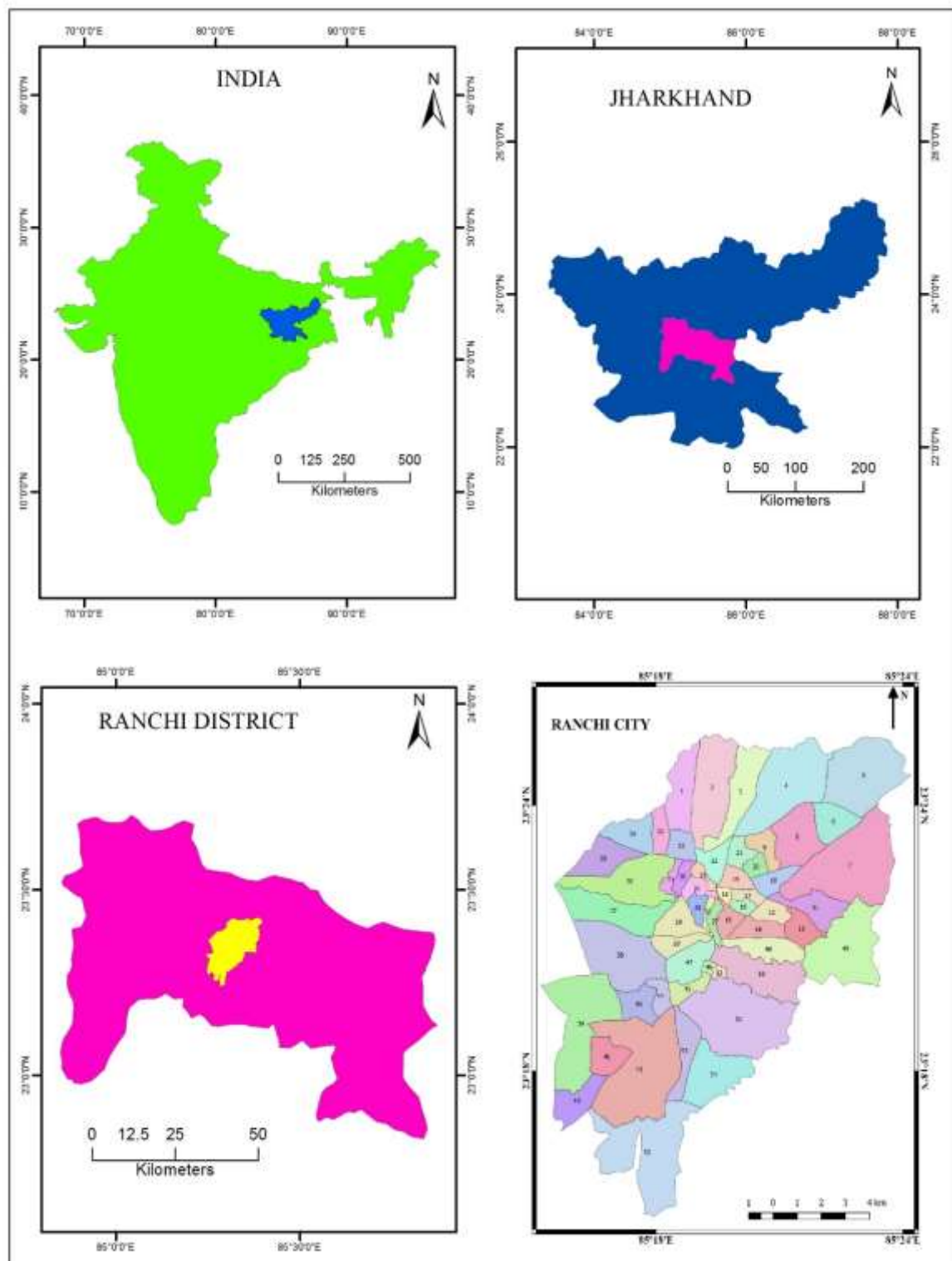
Here the matter of concern is Spatio-Temporal changes in water bodies of the city and its impact on physical environment. The growth of a city is ensuing of the process of urbanization. City is not an abstract thing; it is a social organism in which non-agricultural activities like production, consumption, and control are carried out. These activities give birth to institutions and social system, a system different from the rural society. The interrelations between the activities and the social systems are the theme of the urbanization process. Urbanization, thus, refers to the transformation of the society including some drastic geographic, economic and social changes (Smailes A.E.,1975). Land use and land cover is the fundamental structure which assess the arrangement of Earth's surface to monitor the situation and functioning of the ecosystem. LU/LC variations concerned by natural and human activity which is eventually lead to deforestation, global warming, biodiversity damage and the rise of natural disaster flooding (Lubis et al., 2011; Kindu et al., 2013; Ghosh et al., 1996; Prasad and Sreenivasulu, 1996). Land use/ land cover data groups are the basic ideas for conservational modeling and observing, carbon cycle supervision, hydrology and worldwide climate revolution analysis, natural resources management, policy-making, etc. (Tsegaye et al., 2014). Consequently it also pivotal involvements for ground water prospect areas . Various LU/LC features may affect the ground water, as the rapid urbanization effects, the impenetrable surface which will have very low infiltration of rain water and surface water, such as watershed area, riverbed, and water bodies will have higher water prospects. Similarly vegetation cover, agricultural land, forest cover, grassland etc. will consider the commendable ground prospects.

Objectives of the Study

The objective of the present study is to understand the Spatio-Temporal changes in water bodies since the formation of Jharkhand State and to analyse the impact on physical environment.

Study Area

Ranchi city lies at the intersection of 23° 22' N latitude and 85°20' E longitude on the north-west bank of Subarnarekha river within the Chhotanagpur plateau. Tropic of cancer also passes through Ranchi. This city is situated at an altitude of 629 m above the mean sea level. Ranchi is well known for its pristine natural set-up with pleasant climate, lush forests in its surroundings, hillocks and beautiful lakes. Area of Ranchi city as per Ranchi Municipal Corporation (RMC) boundary is 224 sq.kms. Which had 37 municipal wards. As per the census 2001, Ranchi City area had population of 8,47,093. But as per census 2011, Ranchi City area had population of 10,73,440 and it has 55 wards. Total area is having 177.19 Sq.kms. Among the 96 cities/towns in Jharkhand state Ranchi City is the third largest city.

MAP 1.1.**Map showing the location of study area**

Source: Survey of India, and Ranchi Municipal Corporation, further layers prepared by GIS

Research Method

To conduct the present research work, satellite imageries of LISS III Resourcesat1, NRSC and LANDSAT 7, USGS of different years have been used. Supervised image classification approach has been selected for the generation of LU/LC maps. A total of 400 sample verification points has been taken to assess the accuracy of land use in both cases.

Result and Discussion

The emphasis was taken off mainly influencing factors that are LU/LC map. The significance has decided based on the interrelationship between the various components like land, water, air, transport, climate etc which influence with major and minor effects .

Land Use/Land Cover Map

The repetitive coverage of satellite data plays a vital role in this aspect by depicting the status of Land use/Land cover over the time periods (Magesh et al., 2012; Hutti and Nijagunappa, 2011). A land use land cover map shows the changes in any area over the time period. LU/LC map displays that how much area has covered by forests, agricultural land, water bodies, settlement and other features. It can demonstrate that how the land is being used for human purposes. Land use/Land cover technique plays a dynamic role in groundwater potential zone. Because, it can have an influence on the runoff and recharge of groundwater zone (Magesh et al., 2012). In the present study, LU/LC maps of the different time period have been prepared using Maximum Likelihood Classification technique of supervised classification. The prepared LU/LC map of five different years has observed.

Loss of water bodies

When Jharkhand was part of Bihar and formed as an independant state in those days Ranchi was use to be summer capital of Bihar as it was a city of lakes, waterfalls and rivers. But now scenario is totally different as water rationing in severely stressed areas like Kanke, Bariatu and Ratu road is normal .

Government is working on plans to restore and reoriginate 100,000 ponds and dig 2000 new ones across the state, but these are on paper only. According to year 2017 report of Ranchi Municipal corporation, it said that 40 years ago there were hundreds of lakes and small water bodies but now there are only 42 remaining.

The blame to all these problems are given to the construction activities, rapidly growing populations and lack of planning for the crisis.

Dhurwa, Kanke and Getalsud are the three major dams through which drinking water is supplied. These were built between 1962-71 and were planned to uphold a population of around 4-5 lakhs.

According to the 2016 revised master plan, new apartments blocks have kept forming around the city due to which the catchment area of the dams are shrinking in Dhurwa Dam by 23%, Getalsud Dam by 12% and Kanke Dam by 3.39%. According to Ground Water Directorate the ground water table has been dropped by almost 9 metres between 2009 and 2014.

Deterioration of Physical environment

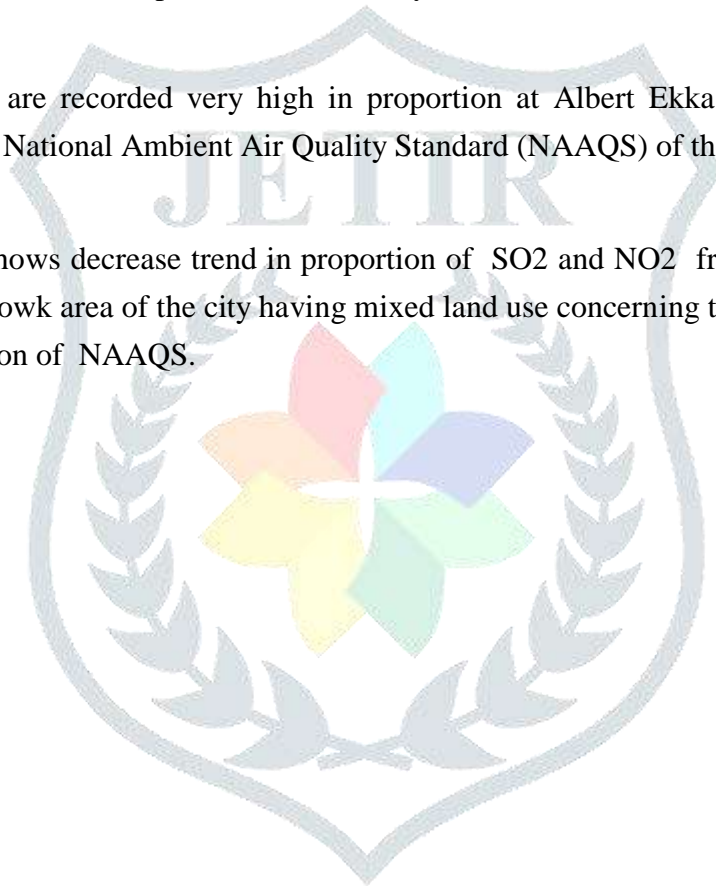
Due to expansion in urbanization the environmental quality is degrading very rapidly causing many problems through depletion in water and air quality, noise and problems of waste disposal etc.

Due to large disposal of waste by municipal, household, mining activities and industrial effluents, the water bodies like Subarnarekha and other streams are contaminated. These are the result of improper drainage system which leads to discharge of domestic liquid waste discharge to aquifers, which can further leads to excessive concentration of chemical and physical pollutants like heavy metals (mercury, lead & chromium), organic particles like hairs, food waste, vomit, paper fibers, plant materials), soluble organic material (ammonia, cyanide, hydrogen sulfide etc), toxins(pesticides, poisons, herbicides etc) and biological pollutants like bacteria, viruses, protozoa etc into ground water.

There is a wide variation in the water level in Ranchi city as it has been recorded as 5.49 mogul to 22.8 mogul at different sites of the city, which depends on the amount of rainfall receives by the region. There are also some areas that shows decline in water level trend that are Birsa Chowk, Pundag, Lowadih, Chauribasti, Chutia and Balsiring.

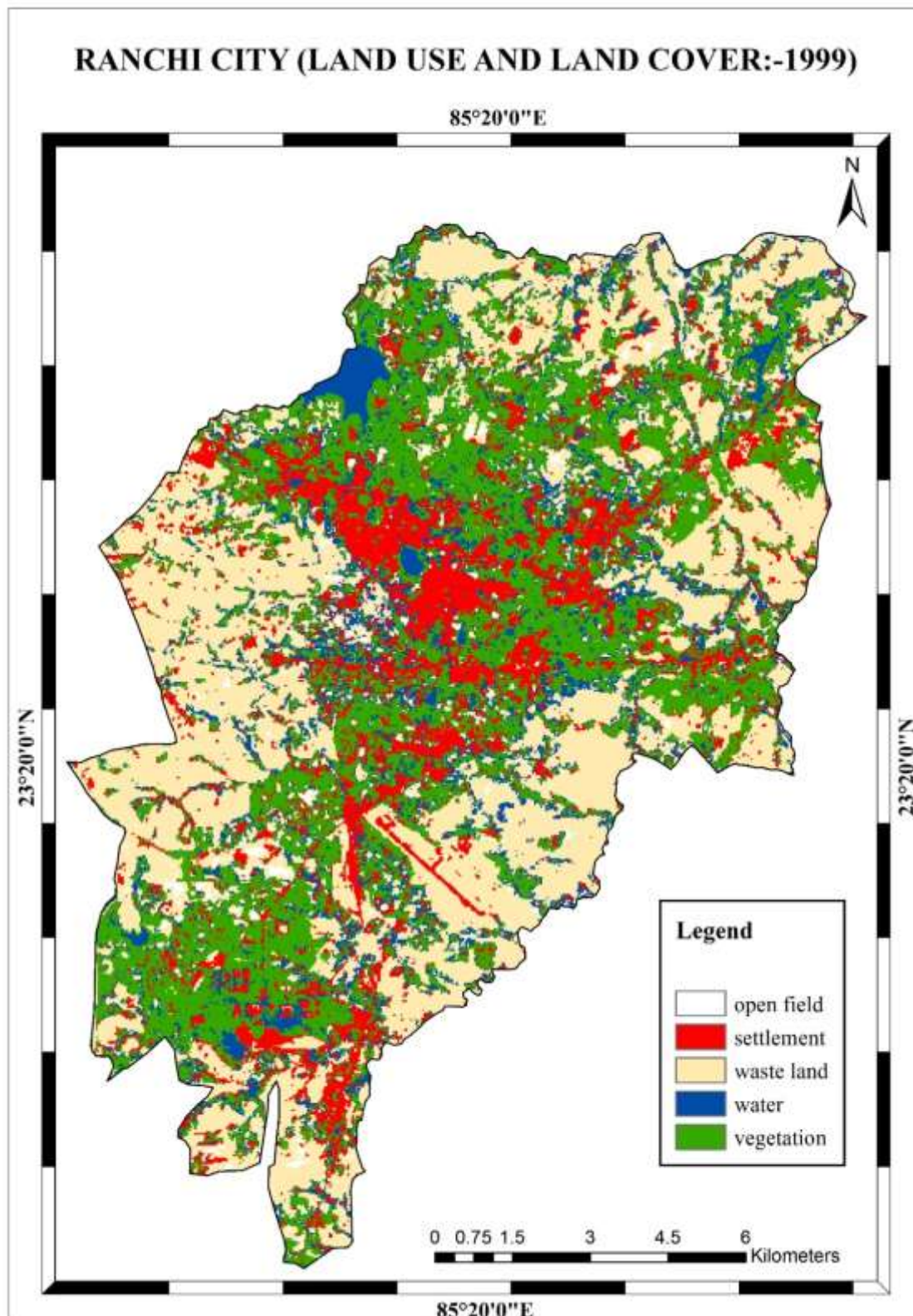
Air, Water, Animal, Infrastructure building and other and all natural resources that provide our basic needs and opportunities for development are all together form the physical environment. After formation of Ranchi as a new capital, there has been a lot of changes in its environmental conditions in different ways are as follows :-

- Day by day Increasing traffic is one of the major problem facing by the Ranchi City due to the high invasion of people from rural to urban areas, utilization patterns increase, increase in energy consumption levels, unplanned and fast urbanization, economic and industrial development shows higher rate of increase of air pollution in the City. It is observed from the air quality analysis of Ranchi City.
- RSPM and SPM are recorded very high in proportion at Albert Ekka Chowk in comparison of mentioned limit of National Ambient Air Quality Standard (NAAQS) of the Central Pollution Control Board.
- The Ranchi City shows decrease trend in proportion of SO₂ and NO₂ from the year 2010 to 2011. At Albert Ekka Chowk area of the city having mixed land use concerning to SO₂ and NO₂ (24 hourly average) no violation of NAAQS.



Map – 1.2

Land Use and Land Cover Map of Ranchi City, 1999



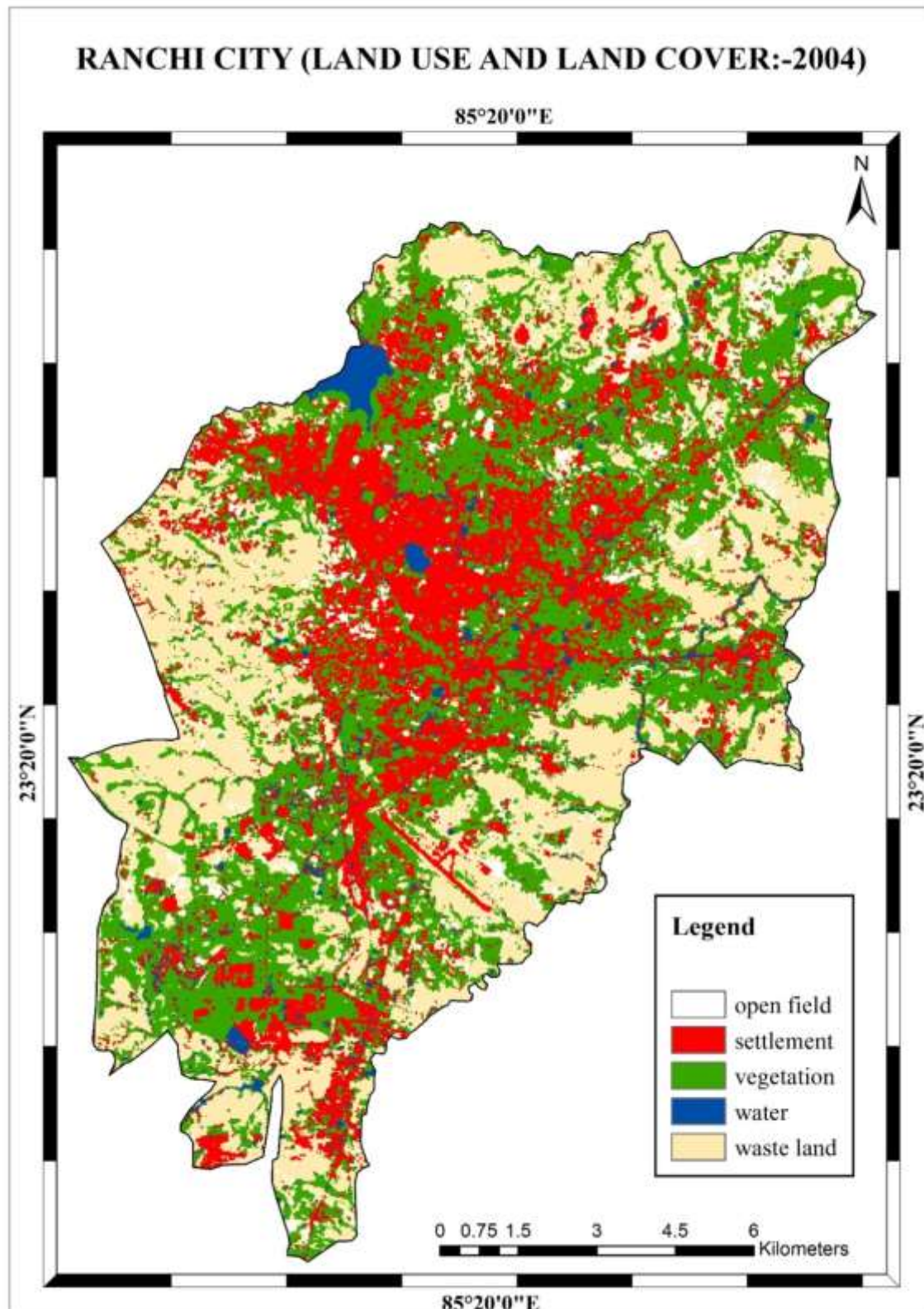
Source : Prepared from Landsat 7 Imagery, USGS

In this map of Ranchi City, land use and land cover is shown in the year 1999. From this map, it is clearly visible that northern part of the city was having larger vegetation as compare to the southern part of the city, as in 1999 people were more engaged in agricultural activities. The settlement is mainly compact in middle portion the city due to availability of

water and fertile land which results in wide ranging vegetation. The southern and northern part of the city have a little dispersed settlement. On the waste land as there is less availability of water and vegetation. At the top most northern part and some areas of south-east and south west of the city also have larger portion of waste land as in 1999 there were less number of industrial and commercial area.

Map – 1.3

Land Use and Land Cover Map of Ranchi City, 2004



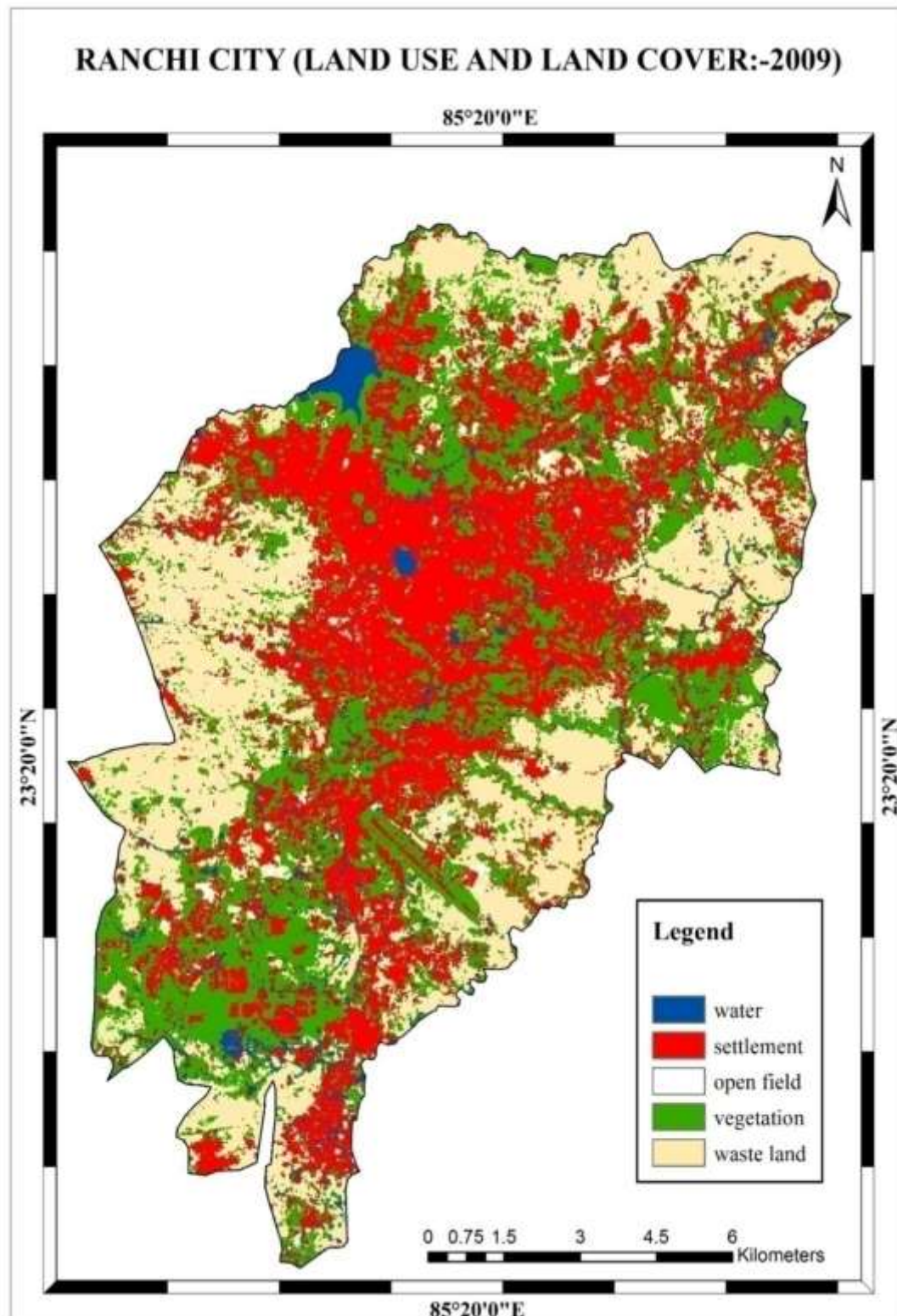
Source : Prepared from Landsat 7 Imagery, USGS

In this map, land use and land cover is shown in the year 2004. From this map, we can clearly see that the vegetation is still dense all over the city and even in the southern part there is growth in vegetation as compare to the year 1999. The settlement is mainly compact in the centre of city due to dense vegetation and availability of water and semi-compact settlements are also there in the southern most part of the city. The waste land area is comparatively less than in the year 2004, as commercial and industrial sector have started to boost after Ranchi became the capital. We can see that a little dispersed settlements are shown. The northern part of the city have smaller portion of open space in some areas.



Map – 1.4

Land Use and Land Cover Map of Ranchi City, 2009



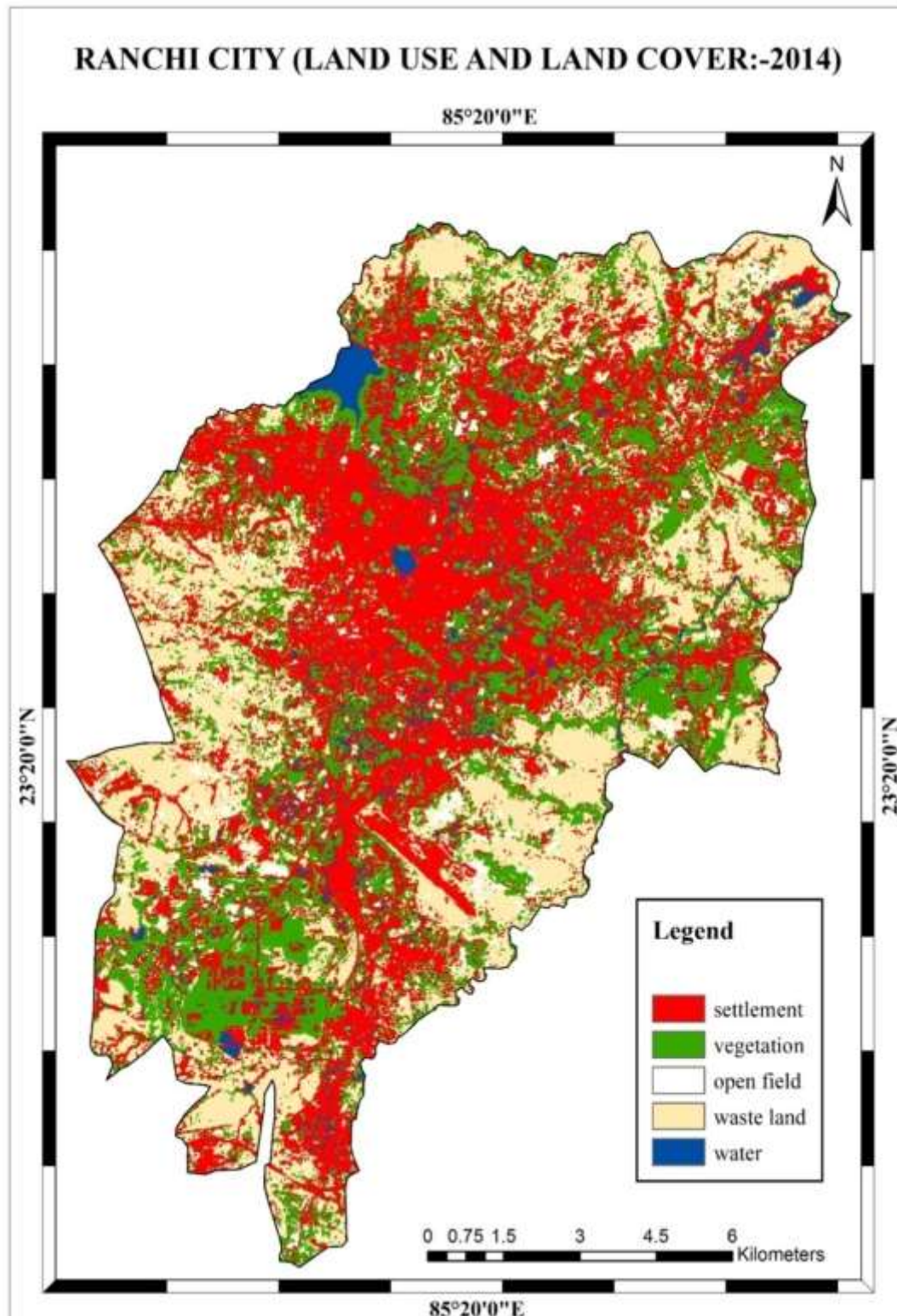
Source : Prepared from Landsat 7 Imagery, USGS

In this map, we can see that vegetation is comparatively less than in the year 2004 and 1999, due to increase in urbanization. The settlement is mainly compact as it was in the year 2004 and 1999 but the density have increased and in the southern part there is semi-compact

settlement is scattered all over the city. The water bodies are also have lessen due to increase in urbanization. The waste land area are also have lessen.

Map – 1.5

Land Use and Land Cover Map of Ranchi City, 2014



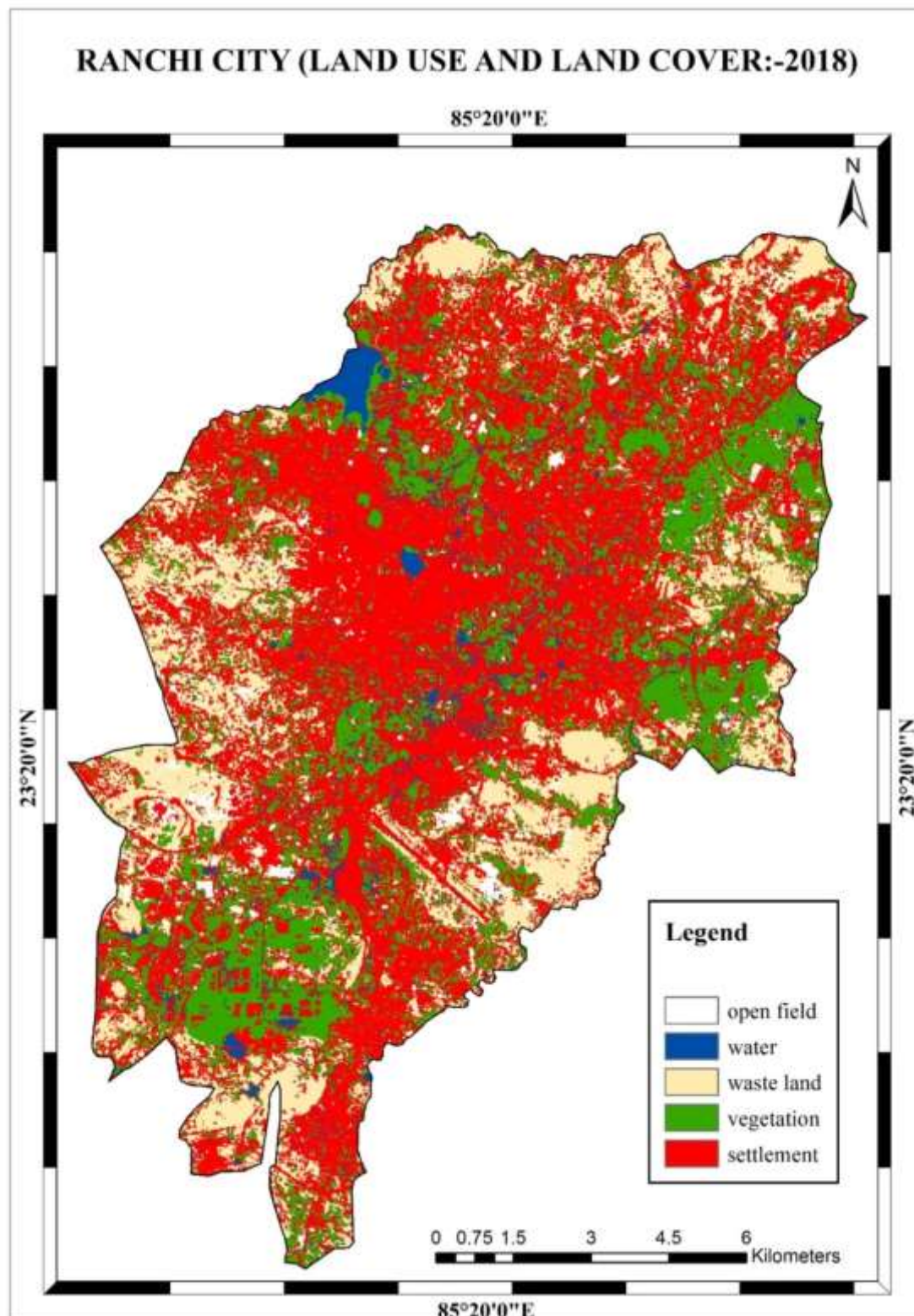
Source : Prepared from LISS III Resourcesat 1, NRSC

In this map, we can see that there is decline in vegetation comparatively than in any years and there is immense growth in population which results in increase in settlement area. The

settlement is mainly compact at the centre and semi-compact towards the northern and southern part of the city and dispersed settlement is spread all over the city. The water networks have also lessen due to increase in settlement. The waste land and open spaces are also comparatively less than the other years.

Map – 1.6

Land Use and Land Cover Map of Ranchi City, 2018



Source : Prepared from LISS III Resourcesat 1, NRSC

In this map, it is clearly visible that there is massive decline in the vegetation and remaining vegetation is in the areas of southern and eastern part of city. The settlement can be seen all over the city, mainly the pattern is compact in the central part of the city and semi-compact towards the northern and southern part and dispersed pattern settlement is spread all over the city. The water is available through kanke dam which is in north-western part of the city and some other sources are also there at the southern part and central part of the city. The waste land is occupied by settlements which leads lessen in waste land.

Conclusion

In the present study, the efficacy of Geoinformatics has been demonstrated. From the above interpretation, it is clear that after becoming capital, Ranchi's vegetation cover was started declining and settlement area have increased due to large population and urbanization. The waste land area also shown declining due to development in various sectors like industrial, commercial etc. Even the groundwater prospect is controlled by various parameters, but Land use/ land cover is one of the important parameter, the water bodies like rivers have also lessen from the year 1999-2018, which also impacts on physical environment. Therefore Geoinformatics is proving as most vital, innovative and efficient tool for mapping, monitoring, and management of resources like land and water.

References

1. Ranjan, A.K., Anand, A., Vallisree, S. and Singh, R.K., LU/LC Change Detection and Forest Degradation Analysis in Dalma Wildlife Sanctuary Using Geospatial Technology: A Case Study in Jamshedpur-India, AIMS Geosciences, 2(4), pp 273-285, 2015.
2. Bhatta, B., Remote Sensing and GIS: Second Edition, Oxford University Press, 2011
3. Ranjan, A.K., Vallisree, S. and Singh, R.K., Role of Geographic Information System and Remote Sensing in Monitoring and Management of Urban and Watershed Environment: Overview. Journal of Remote Sensing & GIS, 7(2), pp 1–14, 2016.
4. Smailes A.E., "The Definition and Movement of Urbanisation," In Jones Ronald (Ed.) Essays on world Urbanisation, London, George Philip, 1975, p.1.
5. Lubis, J.P.G., and Nakagoshi, N., Land Use and Land Cover change detection using remote sensing and geographic information system in Bodri Watershed, Central Java, Indonesia, Journal of International Development and Cooperation, 18(1), pp 139-151, 2011.
6. Kindu, M., Schneider, T., Teketay, D. and Knoke, T., Land Use/Land Cover change analysis using object-based classification approach in the Munessa-Shashemene landscape of the Ethiopian highlands, Remote Sensing, 5(5), pp 2411-2435, 2013.
7. Ghosh, S., Sen, K.K., Rana, U., Rao, K.S., and Saxena, K.G., Applications of GIS for Land- Use/Land-Cover Change Analysis in a Mountainous Terrain, Journal of the Indian Society of Remote Sensing,

- 24, pp 193-202, 1996.
8. Prasad, T.L., and Sreenivasulu, G., Land Use / Land Cover analysis using Remote Sensing and GIS- A Case Study on Pulivendula Taluk, Kadapa District, Andhra Pradesh-India, International Journal of Scientific and Research Publications, 4(6), pp 1-5, 2014.
 9. Tsegaye, L., Analysis of Land Use and Land Cover Change and Its Drivers Using GIS and Remote Sensing: The Case of West Guna Mountain, Ethiopia, International Research Journal of Earth Sciences, 3(3), pp 53–63, 2014.
 10. Magesh, N.S., Chandrasekar, N., Soundranayagam, J. P., Delineation of groundwater potential zones in Theni district, Tamil Nadu, using remote sensing, GIS and MIF techniques, Geoscience frontiers, 3(2), pp 189-196, 2012.
 11. Hutti, B., Nijagunappa. R., Identification of Groundwater Potential Zone using Geoinformatics in Ghataprabha basin, North Karnataka, India, International Journal of Geomatics and Geosciences 2(1), pp 91-109, 2011.

