Land Use and Land Cover Change Monitoring of Agaratala Municipal Corporation Area Using Geospatial Technology

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ABSTRACT

Land use and land cover change is a critical compoenent for bio-physical assessment. It has an encompassing impact on all environmental aspects. So many scholars have performed land use change analysis at myraid scales on different parts of the globe. The present study also focuses the change analysis of different land use and land cover types of Agartala Municipal Corporation, Tripura, India. For the analysis geospational methods are used. Remote sensing data products are classified to figure out the different land use types namely waterbody, vegetation, cultivable land, builtup and vacant land. Accuracy assessment is performed which yeild more 80 per cent reflecting performace of the classification algarithms. The study shows that in the study area build up area is rapidly increasing at the cost of other land use types. This type of study is very important for urban planning as hapazard growth of cities may lead to serious negative externalities for the people living in the urban areas. The study is also important from the prespective of achiving sustainable Development Goal, 2030 where healthy urban living is emphasised.

I. Introduction

Land use and land cover (LULC) are often used interchangeably, but each term has a unique meaning. Land cover refers to the surface cover on the ground like vegetation, urban infrastructure, waterbody, bare land etc.

Land use refers to the purpose of the land services, for example, wildlife habitat, agriculture, etc. Land cover is the physical material at the surface of the earth. Land use is the description of how people utilize the land for the socio-economic activities. Land use and land cover change (LULCC) is the conversion of different land use types resulting from complex interactions between humans and the physical environment.

LULC maps play a significant and prime role in planning, management, and monitoring programs at local, regional, and national levels. On the one hand, this

type of information provides a better understanding of land utilization aspects. On the other hand, it plays a vital role in the formation of policies and programs required for development planning. LULC is very important for Sustainable Development goal for batter unban wellbeing.

The present study primarily focuses on monitoring land use land cover change of AMC area of the years 1991, 2001, 2011, and 2021. The paper also emphasizes built-up growth and its dynamics over the last two decades. To achieve sustainable urban development and check the haphazard growth of towns and cities, authorities associated with the urban development must generate planning models so that every bit of available land can be used most rationally and optimally.

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II. Literature Review

Land use and land cover change is universal phenomena. Many scholars have contributed different scholarly efforts on understanding the nature of change of land use and land cover pattern in different countries of the world. The Agartala is the state capital of the state Tripura, India. The state is located in the north eastern part of the country. The state also shares an international boader with Bangladesh. Agartala municipal area (AMC) is demarcated by 23° 45'- 23° 55' N latitude and 91°15'- 91°20'E longitude. The physical set-up of the study area literature rreview helps to indentify the research gap that can be fulfilled with the present studies.

Santra A et al. [1] worked on Land use changes in Agartala city, using socio-economic statistical data and multi-spectral satellite images. This study focused on Impact of Urbanization on Land use changes in Agartala. It is observed that percentage of residential land use is higher than any other category of the land use, but it decreased due to the increase of total area of AMC.

Debnath A, et al. [2] worked on Change detection in Land use land cover of Baramura hill region, Tripura, India. Using multi-temporal Landsat Thematic Mapper (TM) and Multi Spectral Scanner (MSS) data. Their study indicates the dense forest cover changing to open and degraded forest.

Saini R et al. [3] worked on Land use and land cover change using remote sensing and GIS in Srinagar, India between year 2008 -2016. The result shows that the LULC mapping of Srinagar study area for both the year indicates a continuous increase in built-up areas that comprises of urban, suburban and rural built-up.

Kumar S et al. [4] worked on Monitoring and Prediction of Land Use Land Cover Changes and its Impact on Land Surface Temperature in the Central Part of Hisar District, Haryana under semi-arid zone of India. This research has shown a significant change in land use in terms of expansion of built-up area from 3.7% (1991) to 6.2% (2011) by encroaching into agricultural land.

Nath B et. al. [5] worked on land use and land cover change modelling and future potential landscape risk assessment using Markov-CA (Cellular Automata) model and analytical hierarchy process on Dujiangyan city located in the Sichuan province of China. Their analysis shows future LULC scenario in the years 2025, 2030, and 2040 along with the future potential landscape risk (FPLR) pattern. Laari et.al. [6] worked on exploring Land use and Land cover change in the mining

areas of Wa East District, Ghana. They used Remote Sensing and GIS techniques for the assessment of land use land cover dynamics of mine. The study revealed the declining nature of the vegetation and the significance of using satellite imagery.

III. Study area

Agartala is the state capital of the state Tripura, India. The state is located in the north eastern part of the country. The state also shares an international boader with Bangladesh. Agartala municipal area (AMC) is demarcated by 23° 45'- 23° 55' N latitude and 91°15'- 91°20'E longitude. The physical set-up of the study area is flat and homogenous terrain.
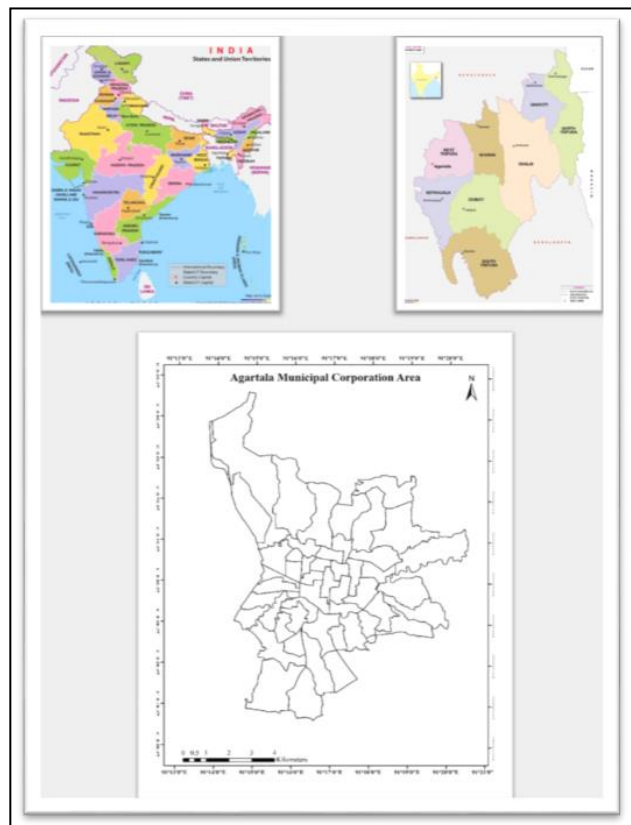

Figure 1: Map of the Agartala Municipality

V. Data and Methodology

Data acquisition and Processing: For begin the Land use Land cover change mapping of the Agartala Municipal Corporation (AMC) area, I downloaded the Landsat Thematic Mapper image for the year 1991, 2001, 2011 and 2021 from earth explorer. And then, I did Atmospheric correction, Band combination and FCC creation using appropriate image processing software. Based on the false colour composite different land use and land cover map was identified. For identification of land cover classes supervised classification was performed. And after getting a satisfying overall accuracy of the images area of different land use classes was identified. And the classes are water body, vegetation, cultivable land, built-up and vacant land.

Image Classification

To Identify the land cover classes of Agartala Municipal Area (AMC), supervised image classification is done. The following images are classified images of the AMC area for the years 1991, 2001, 2011, and 2021. There are five land cover classes shown using different colour codes. Blue colour showing water bodies, the dark green colour representing vegetation cover, the light green colour representing cultivable land, red colour showing built-up area, and light shade of yellow colour showing vacant land. For image classification maximum likelihood classifier algarithm is adopted as it provide better accuracy than other classification algarithms.

Accuracy Assessment

After doing image classification, it is necessary to check the accuracy of the classification of the classified image. Overall accuracy is measured for the performance of classified image.

IV. Result and Discussion:

After image classification and accuracy assessment area of land cover is calculated for different classes of the year 1991, 2001, 2011 and 2021.In the year 1991, water body, vegetation, cultivable land, built-up and vacant land was 2.60 sq./km, 19.39 sq./km, 43.51 sq./km, 4.26 sq./km and 7.37 sq./km respectively. Water body was slightly decreased in the year 2011 and again increased to 4.39 sq./km in 2021.Vegetation increased to 32.37 sq./km in the year 2001 and decreased in 2011 and continue and become 22.7 sq./km in the year 2021.There was large fall in

cultivable land, it decreased to 19.57 sq./km from 43.51 sq./km in the year 2001 and remain stable in the year 2011 and again decreased to 17.37 sq./km in the year 2021. Vacant land increased to 16.89 sq./km in the year 2001 due to decreased in agriculture. And it decreased to 10.41 sq./km in 2011 due to expansion of built-up area. Again, vacant land decreased and fall to approximately 6.00 sq./km in this year 2021.There was a sudden increase in built-up in the year 2011 that is 15.64 sq./km and it was 5.58 sq./km in the year 2001. And again, built-up increased to 26.67 sq./km in this year 2021.
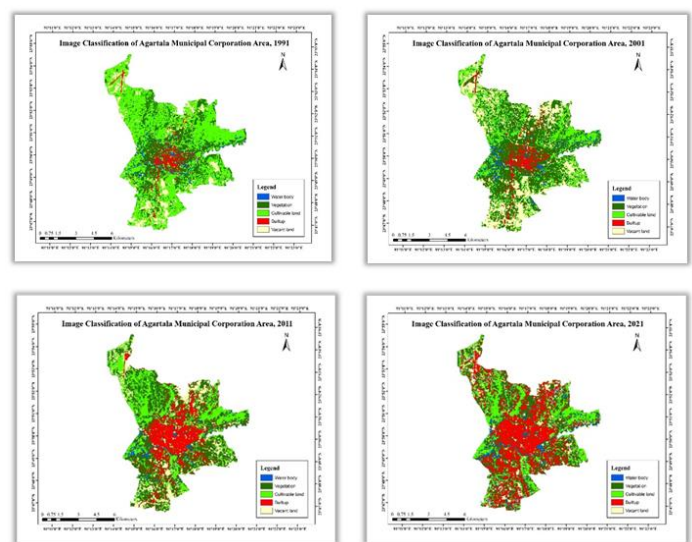

Figure 2: Land use and land cover change map of the study area.

Area of Agartala municipal service is expanding due to increase in population and built-up. In 1991, built-up cover in Agartala municipal service area was only 4.262 sq./km. After 10 years, in 2001, there was no huge change only 1.32 sq./km increased. But between 2001 to 2011 and 2011 to 2021 it shows a very high increment in built-up area. It is expected that after 10-year Built-up area could be approximately 40 sq./km.

Land Cover Class	Year 1991	Year 2001	Year 2011	Year 2021
Water Body	2.60	2.69	1.90	4.40
Vegetation	19.39	32.37	29.54	22.70
Cultivable Land	43.51	19.57	19.61	17.37
Built-up	4.26	5.58	15.65	26.67
Vacant Land	7.37	16.89	10.41	5.99

Table 1: Land use and land cover change in sq. km of the study area.

VII. Conclusion

Monitoring and assessment of the land use and land cover types are important for the better understanding the process of biophysical parameters.

These changes are also associated with the large scale climate change through cumulative accumulation of change in different places. In this study, land use and land cover monitoring is performed of Agartala Municipal Area, India, using remote sensing data product.

The study suffiently identified the changes of land use and land cover types and focuses the growth of build up areas within the study area. In this study, classical image classification method is adopted but different modern algarithms do also prive superior result than the traditional methods. The study is important from the prespective of urban planning and management because it gives planners to understand nature of change in urban ecosystem as well as future trend of city growth.

Acknowledgement

References

[1] Santra, A. Mitra, S. & Debbarma, D. (2018). Impact of urbanization on land use changes in Agartala City, India. Research Journal of Humanities and Social Sciences, 9(2),407-414.

[2] Debnath, A. Debnath, J. Ahmed. I, & Das N (2017). Change detection in Land use/cover of a hilly area by Remote Sensing and GIS technique: A study on Tropical forest hill range, Baramura, Tripura, Northeast India. International Journal of Geomatics and Geosciences,7(3),293-297

[3] Saini R., Aswal. P., Tanzeem. M., & Saini, S. S. (2019); Land Use Land Cover Change Detection using Remote Sensing and GIS in Srinagar, India. International Journal of Computer Applications. 178(46), 42-50

[4] Kumr, S., Ghosh, S., Hooda, R. S., & Singh, S. (2019). Monitorng and Prediction of Land Use Land Cover Changes and its Impact on Land Surface Temperature in the Central Part of Hisar District, Haryana Under Semi-Arid Zone of India. Journal of Landscape Ecology, 12(3), 117-140.

[5] Nath, B., Wang, Z., Ge Y, Islam, K., Singh, R. P., & Niu, Z. (2020); Land Use and Land Cover Change Modeling and FuturePotential Landscape Risk Assessment Using Markov-CA Model and Analytical Hierarchy Process.International Journal of Geo- Informatics,9 (2), 134; https://doi.org/10.3390/ijgi9020134

[6] Baommi, P. L., Guan Q., & Cheng, D. (2015). Exploring Land use and Land cover change in the mining areas of Wa East District, Ghana using Satellite Imagery. Open Geoscience, 7(1),618-626.