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A Research of Urban Landscap Transform Detection in Guwahati Region

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Abstract – Urbanization is without a doubt the real transformation to land cover that significantly impacts biotic differing qualities. Changing urban landscape with high population growth and more interest for land is a significant issue in Metropolitan Guwahati. The general pattern of urbanization in Guwahati is unpredictable, various and divided which brings adjustment to common land cover inside the city. This complex urbanization process has adjusted the land surface characteristics inside the city. An examination of Landsat symbolisms has uncovered resulting diminishing of land cover with a different spatial heterogeneity of land surface temperature from 1991 to 2008. To direct the development, the proposed Master Plan for Guwahati 2025 has appointed some land use zoning. Anyhow the pressure of changing urban landscape has unmistakably seen over the eco-sensitive and Green belt areas, particularly towards the outskirts of the city. Because of scarcity of vegetation, a few hotspots on encompassing hillocks were distinguished, the surface temperature of which is as high as the downtown. Consequently, here an endeavor has been made to correspond variety in temperature with land use sort. The consequence of the present study is considered to be useful to create countermeasure to warm environmental issue in Guwahati metropolitan area.

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INTRODUCTION

Spatial data on land use/land cover is an important essential in planning, using and administration of regular assets. In the current setting of development planning, data on land use/land cover and the progressions over a period of time accomplish noticeable quality because of its essential prerequisite in all the planning exercises (NRSA, 2006). Land cover gives the connection between the biotic and abiotic components of the biological system and accordingly changes to land cover additionally change biodiversity, vanishing, increase soil erosion and surface run off. Urbanization, characterized by an ordinary land use sort of impenetrable surface area (ISA), and engineering structures has caused a real change to the land cover. The courses of action of urbanization govern the elements of global environmental debasement and therefore attract regard for feasible environment issues.

The ever increasing process of urbanization exerts pressure on natural vegetation cover and increase the atmospheric greenhouse gases (GHG) through automobiles and industry. Because the heat storage capacity of ISA and engineering structures, as well as waste heat from automobile and industry, the temperature difference (ΔT_{u-r}) between urban and in a rural area outside the urban settlement is found to be higher. Thus most of the areas of human disturbance such as towns and cities are characterized with closed isotherms indicating an area of the surface that is relatively warm. This process is well known as Urban Heat Island (UHI). The magnitude of ΔT_{u-r} is greater at night, under clear skies and with little wind. The difference between urban and rural sites grows with time after sunset and reaches a maximum difference after about 4 hours (Mills 2004).

In India, numerous metropolitan cities have additionally accomplished UHI in this decade. As of late, estimation demonstrated that Kolkata has encountered its hottest December 17 of this decade in 2009 with 19.4°c of least temperature (Bhattacharyya, 2009). Like Kolkata, Guwahati the real city of North-East India has likewise accomplished its hottest year in 2009 ("Hottest year in city since 1950", 2009). Guwahati as a door to North-East India is characterized by a wonderful change in urbanization in last few years. The population of Guwahati has increased from 809, 895 in 2001 to 963,429 in 2011 with an increase in population density from 3736 persons for every sq. km. to 4445 persons for every sq. km. separately (Census of India, 2011). The fast rate of urbanization has its impact on the vegetation cover and in this manner to the environment in the city.

During the most recent decade, the economic exercises inside the city were speeded up. Mechanical foundation and convergance of new organizations had changed the economic situation of the city at the outset of the 21st century. The development of new turnpike from Jalukbari to Khanapara brought real land use change in the areas non neighboring the customary downtown focuses.

The fast transportation framework welcomed a few commercial ventures, establishment to set up their structures close by the interstate, the vast majority of which were prior green belt or wetlands. Hence, the urbanization handle inside the city has quickened at a high rate than at any other time in recent memory in the recent past. The pressure of human settlement might be felt over the store backwoods, knolls and the green belt areas of the city.

In this paper, an endeavor has been had to explore the effect of land use/land cover change on the warm environment of Guwahati in the course of recent years. Quantitative remote sensing techniques have been received to explore the change. The other destination of the paper is to relate the land use/land cover change study with the proposed Master Plan for Guwahati Metropolitan Area-2025, "Land Use Zoning and Development Control Regulation". This will depict the human intercession in eco sensitive zones of the city and its effect to the warm environment of the city.

SIGNIFICANCE OF THE STUDY

As expressed prior the city has encountered an exceptional population growth in the most recent two decades. To control the uneven urban development, the Guwahati Metropolitan Development Authority (GMDA) has proposed the Master Plan for Guwahati Metropolitan Area (GMA)-2025. The land use zoning and development control regulation of the plan has relegated some land use zones inside as far as possible. Notwithstanding, the Master Plan is still in a draft mode because of a few political issues. By and by, the general urban development in Guwahati is, no doubt planned by two primary authorities‟ viz. GMDA and Guwahati Metropolitan Corporation (GMC). As there is no motivation or regulation for keeping up the Land use zoning, subjects are pretty much hesitant in this respect. The Eco-sensitive zones (Hills and Wetlands) and the Green Belt of the city are persistently mediated with private structures. The connection among urban land use and heat island impact may give some knowledge in the development plans of the city. In the event that the connection between urban land use and heat island marvel could be appropriately verbalized, the powers may execute some counter measures to minimize the impact of micro environmental change in their development plans. This study may have critical effect to the land use strategy of the upcoming satellites towns of Guwahati Metro.

STUDY AREA

The proposed study fuses the Greater Guwahati in Kamrup (Metro) locale of Assam as the study area. The area is found between the scope of 26°2' N to 26°16' N and 91°33'e to 91°52'e longitudes. The study area is arranged on undulating plain with differing elevations of 50 m to 55 m above mean ocean level (MSL). To relate the study with the land use zoning of proposed Master Plan-2025, an augmented limit of Guwahati Metropolitan Area (GMA) with 328 sq. km is thought seriously about. The limit of Greater Guwahati Area is harmonized with the proposed adjusted limit of Master Plan for Guwahati Metropolitan Area-2025. The district depicted under the proposed altered limit constitutes of Guwahati Metropolitan Area, Sila-Matiya-Najirakhat-Bhulung area, Charmajulipam-Gandhmau-Ambari-Bamunsoalkuchi area and Panchniyapara-Sajjanpara-Gariyapara-Alibari-Tarapatipa area.

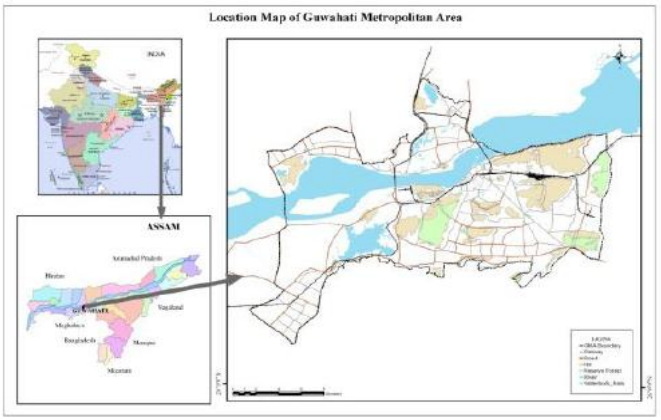

Fig 1: Location map of Guwahati Metropolitan area

Land Use and Land Cover Mapping

To investigate the progressions to the land use/land cover inside the study area, this study has considered three time period viz 1991, 2000 and 2009 with an interim of 9 years. For this, the study has taken three Landsat pictures of the expressed years; two of these are Landsat TM pictures of November 1991 and October 2009, while the other one is Landsat Etm+ picture of August 2000. Before handling the land use/land cover maps, picture geometric redress has been carried out utilizing GCP inferred from DGPS review. As the Landsat TM and Etm+ pictures were taken by distinctive sensors in diverse period, radiometric redress utilizing relative radiometric normalization (Hall et al. 1991) has been done. At that point the „supervised Classification‟ system with „maximum likelihood‟ has been embraced to characterize land use classes. The pictures are ordered to nine land use classes viz. high dense Settlement, low dense Settlement, trees and shrubs, dense vegetation, Open land, water, stream sand, agribusiness and farming momentum neglected land. The Settlement class envelops roads, structures, and other form landscapes. Vegetation speaks to live growth that has a green shade. The open land class can clash with some built up areas as it holds some brilliant cyan qualities. Water speaks to water bodies including waterway, bog and "nala" (channel).

Land use and land cover change in Guwahati, 1991-2009 -

The Land use and land cover change detail have been determined for six significant land use classes. From table1 it is clear that the most noteworthy change has

struck high dense Settlement. In the year 2000, it was increased by 56 percent from 1991.

	2000	2009
	p.c. of change over '91	p.c. of change over '00
Trees & shrubs	-22.53	-1.72
Dense Vegetation	-4.88	-26.23
High dense Settlement	56.15	23.85
Low dense Settlement	-5.83	2.65
Open Space	-0.70	-16.71
Water	-9.44	-4.97

Table 1: Percentage of Major Land Use and Land Cover Change in the Guwahati Metropolitan Area (1991 to 2009)

However, the low dense Settlement area decreased by 5.83 percent in 2000, as most of the low density areas were converted to high dense Settlement areas. A most noticeable phenomenon that has arisen during 2000 is that the growth of new settlement areas along the national highway 37 from Jalukbari to Khanapara. The high dense Settlement has further increased by 23.8 percent during 2009. The low dense Settlement areas along the national highway have changed to high dense Settlement areas till 2009. The modernization of LGBN International Airport at Borjhar has also caused major change to land cover in 2009.

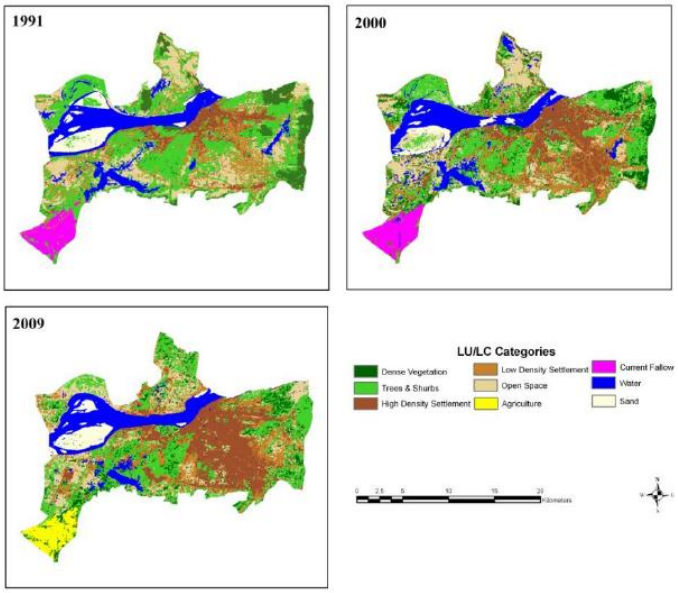

Figure 2: Land use and land cover maps of Guwahati Metropolitan Area.

The pressure of increased urban built up land with high and low settlement over the vegetation cover can obviously been seen in the fellow use/ land cover maps in figure 2. The dense vegetative cover indicates a declining rate with 4.8 percent in 2000 to 26.3 percent in 2009. Most these areas are under the eco sensitive zone (Hills and Reserve Forest) of the proposed Master Plan-2025.

Land Cover change with reference to proposed Master Plan-2025 -

For the Guwahati metropolitan area the GMDA (Guwahati Metropolitan Development Authority) has proposed a plan as "Master plan for Guwahati Metropolitan Area-2025". The vision of the master plan 2025 is, "Guwahati city to be a standout amongst the most respected State capitals of India as Gateway to the North-East, with an interesting picture of its own". Inside the parts of land use planning the master plan has the procurement of green belt and eco sensitive zone as significant land use sorts. Green belt characterized by open space, enclosures and other recreational areas in the master plan. The knolls and store woodland of the city are considered as eco-sensitive areas.

Sl. No	Land Use Categories	Area in Ha.(excluding new towns)	% of Developed areas	Area in Ha.(including new towns)	% of Developed areas
1	Residential	8646	31.9	10383	31.7
2	Retail Commercial	360	1.3	447	1.4
3	Wholesale Commercial	81	0.3	417	1.3
4	Industrial	518	1.9	918	2.8
5	Public and Semi-Public	3270	12.1	3606	11.0
6	Composite use I	814	3.0	814	2.5
7	Composite use II	300	1.1	841	2.6
8	**Recreation & Open Space (Green Belt)**	3324	12.3	3728	11.0
9	Transportation	2853	10.5	3407	10.4
10	**Eco-Sensitive Zone**	6919	25.5	8245	26.0
	Total	27085	100.0	32806	100.0

Table 2: Proposed land use break-up in GMA

To understand the land use zoning of Guwahati, the settlement data derived from the land use and land cover maps (1991 to 2009) are compared with the Land use zoning plan of GMDA. The data thus derived has clearly shown the pressure of changing urban landscape over the Green Belt and Eco-sensitive areas (Table 3). Many built up areas with high and low settlement categories are identified over the two land cover classes. The built up areas considered here are the combination of low and high dense settlement type of the classified land use maps.

Out of the total 3728 hectare of green belt area in the comprehensive master plan, 721.8 hectare (19.36%) of area can be traced as built-up zone during 1991. The percentage of eco-sensitive zone which has been traced as built up area during that period was about 11% (900.83ha.).

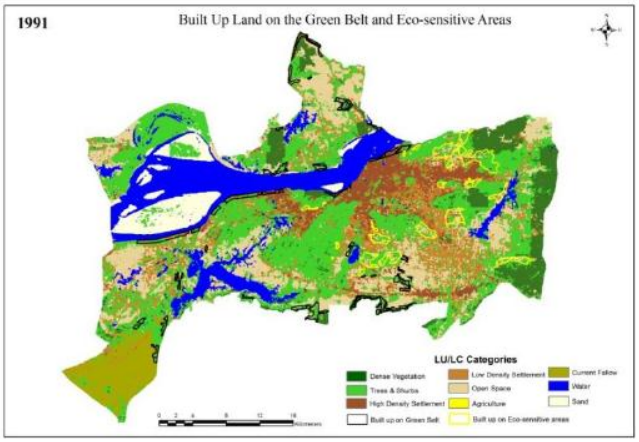

Figure 3: Built up areas on Green Belt and Eco-sensitive Area (1991)

Year	Built-up area on Green belt (hectare)	% of the total proposed green belt area	Built-up area on Eco-sensitive zone (hectare)	% of the total proposed Eco-sensitive zone
1991	721.79	19.36	900.83	10.9
2000	886.62	23.78	2128.73	25.82
2009	1028.5	29.03	2227.5	27.01

Table 3: Built Up areas on Green Belt and Eco-Sensitive Areas

While analyzing the land use patter of 2000 (figure 3), the built-up zone on the green belt has found to be further increased to 886.6 hectare (23.78%). The eco-sensitive zone has also changed significantly from 900.8 hectare to 2128.7 hectare. The pressure of increasing settlement has brought further changes to the green belt and eco-sensitive areas in 2009. In that year, the built up land on green belt and eco-sensitive zone increases to 29 percent and 27 percent respectively.

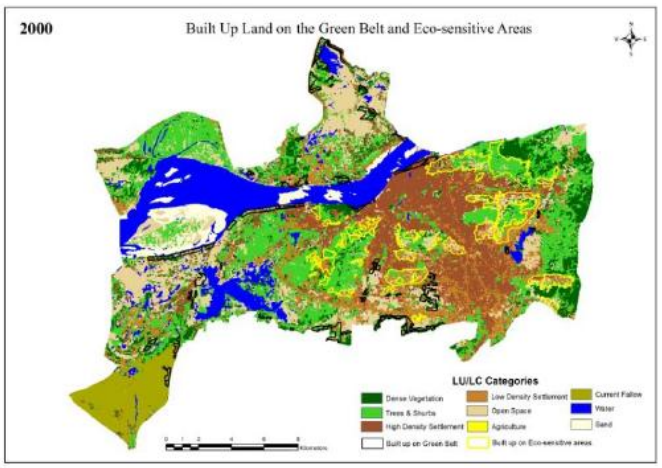

Figure 4: Built up areas on Green Belt and Eco-sensitive Area (2000)

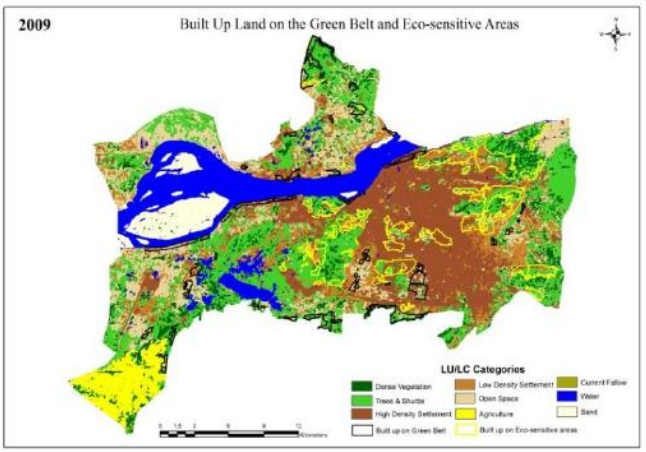

Figure 5: Built up areas on Green Belt and Eco-sensitive Area (2009)

An overview has been led during 2011 in some chosen purposes of Guwahati metropolitan area to check the persistent mediation of built up land over the green belt and eco-sensitive areas. The overview has uncovered that more than a large portion of (56%) of the landowners have their legitimate responsibility for lands. The general urban development in Guwahati is continuously planned by two principle authorities‟ viz. GMDA and Guwahati Metropolitan Corporation (GMC). Hence the disappointment to land use zoning regulation demonstrates absence of coordination between these two powers.

As there is no motivating force or regulation for keeping up the Land use zoning, subjects are pretty much hesitant in this respect. The Eco-sensitive zones (Hills and Wetlands) and the Green Belt of the city are ceaselessly interceded with private structures.

METHODOLOGY

This study was done in Guwahati city, Assam, India found roughly along 26011/ N scope and 92049/ E longitude. The city covers an area of 216 km2 comprising of for the most part commercial and local locations and some measure of modern area. The population of Guwahati has increased from 809,895 in 2001 to 963,429 in 2011 with an increase in population density from 3736 persons for every sq. km. to 4445 persons for every sq. km. respectively.10 The atmosphere of the city for most a piece of the year is hot and wet, with a dry winter and a blustery season from April to mid-October. The mean yearly precipitation is almost 160 cm.

Guwahati being the door of North East locale is experiencing fast urbanization and the urban population is expanding step by step. The issue of stormwater contamination is getting to be more terrible because of population growth, which brings about increased impermeable surfaces. One of the most repulsive issues in the city is the absence of legitimate waste and sewerage framework.

The channels are not legitimately developed and kept up. Some of them are joined with the waste water outlets of the private units by little empties. In most a piece of the city, the paramount roads are lined by lacking open surface channels and in numerous places there are no channels whatsoever. During the stormy season, generally parts of the city stay submerged and in this way, the surface water of the city get dirtied by stormwater. All through the city, no fitting planning has been presented in private, commercial, mechanical, public and semi-public areas and because of this, the water environment of the city is extremely influenced. Events of landslide and substance surge are more regular in the area because of disgraceful development work and tree-felling. Moreover these, there are no offices for groundwater energize, rainwater collecting also have no channel characterisation all through the city. Presently, there are no stormwater quality administration methods in place.

Sampling and analysis -

The estimation of any research facility analysis and test relies on the strategy for sampling. Correct collection of stormwater samples is therefore essential to be able to analyse the stormwater quality in the laboratory facilities.

Sampling sites were selected on the basis of surrounding land use and land cover in five land use zones namely, industrial, commercial, recreational, residential and heavy traffic zones. Grab samples of runoff were manually collected from the downstream direction of the road runoff in the designated sampling sites in the respective zones during the rainfall event. Each sample was tested within 24 hr of collection and all testing was conducted according to the test methods specified in APHA, Standard Methods for the Examination of Water and Wastewater.

Samples collected at each study location were analysed for pH, total suspended solids (TSS), total dissolved solids (TDS), sulphate (SO42-), nitrate-nitrogen (NO3-N), phosphate (PO4 3-) and potassium (K+).

CONCLUSIONS

During the most recent 20 years, the Guwahati metropolitan area has experienced wonderful change in urban landscape that brought about the misfortune of regular land cover. Therefore, the surface temperature of the city has increased and an unmistakable urban heat island is shaped in and around the settlement areas. All these have serious environmental and wellbeing outcomes. The land use regulation plan of Gmda"s Mater plan could be an instrument for maintainability of common land cover. At the same time the nonstop intercession of human settlement to common land covers in Guwahati metropolitan area has uncovered the disappointment of land use zoning and administrative movement. The metropolitan development powers ought to have strict regulation in the green belt and eco sensitive areas of the city. Social ranger service in the green belt areas, light shade surfaces in private units, plantation in the top of structures and trees along by the roads, may be a few countermeasures of the heat island impact in Guwahati metropolitan area. Result of such issue is a pressing need to support the nature of urban life.

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