MONITORING LAND USE/LAND COVER CHANGE AND CONSEQUENT EFFECTS ON WETLAND ENVIRONMENT-A CASE STUDY OF DEEPOR BEEL, ASSAM, INDIA

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Abstract:

Wetlands forms the crucial part of the natural environment as it involves habitat that supports a wide diversity of flora and fauna. Due to its significance, the study of wetlands is now an important field of research. Deepor Beel, the lone Ramsar site in the Brahmaputra valley has been facing immense pressure in the form of drastic changes of adjoining land covers and eco-sensitive areas due to rapid urbanization in Guwahati. In the present study, classified land use/land cover maps derived from multi-temporal satellite images revealed a remarkable increase in the built-up area (10.35 % in 2003, 14.50 % in 2008 and 22.38 % in 2016) and consequent decrease in the area coverage by vegetation (24.68 % in 2003, 21.94 % in 2008 and 17.42 % in 2016). The sewage flow from the dumping ground adversely affect the water quality of the wetland. Study also revealed varied chlorophyll seasonally and over the years, suggesting increasing algae biomass and stressful aquatic life. Such impact assessment of urbanization marked the need for conservation strategies to protect and preserve wetland environment and associated biodiversity besides ensuring sustainable livelihood of the dependent population.

Keywords: Land Use/Land Cover, Wetland, Deepor Beel, Assam, Remote Sensing

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Introduction

Wetlands are the transitional zone between land and water system where the water table is close to the surface and soils are characterized by waterlogging during a large portion of the year (Frohn et al., 2009). Wetland performs an important role in flood control, ground water recharge and provide habitat for unique types of flora and fauna adaptable in saturated soil (Mitsch and Gosselink 1993). Even though wetlands occupy only 6% of the global land area (Erwin, 2009), it is one of the important ecosystems due to its varied dominant species, water chemistry, soil characteristics and recreational value. Unfortunately, for a long period, conservation of wetlands has been neglected treating it as degraded land with low or no economic value (Barbier et al. 1997). In the era of rapid urbanization and industrialization, wetlands are going through area decline, landscape fragmentation, water pollution which creates a negative impact over the species present over there. Therefore, long-term monitoring of land use and land cover (LULC) change in the wetland environment is essential. In such monitoring and database generation, free availability of multi-temporal satellite images is proved as an important tool.

Deepor beel (beel- an Assamese word meaning- "lake"), the largest freshwater lake in the Brahmaputra valley of Lower Assam is located at the south-western part of the Kamrup district of Assam. It is also declared as Ramsar site under the Ramsar Convention in November 2002, for undertaking conservation measures based on its biological and environmental importance. The lake is rich in its aquatic life along with a great variety of plant species that adds to its natural beauty. Basistha and Kalmani rivers and rain water are the main feeding sources of the lake. The Deepor beel is situated in the elephant corridor of Rani Garbhanga region and thereby making the region more ecologically significant.

Due to increased urbanisation in Guwahati city, human settlements are encroaching towards the outskirts resulting in the filling up of parts of the Beel for construction purpose, sewage flow and waste dumping ground. The local inhabitants of the villages in the periphery of the beel rely on it for fishing, collecting fodder for domestic animals, cultivation of paddy in the nearby lands etc. Therefore, other problems like water pollution, loss of migratory birds, unrestricted fishing and fodder practices also took place. Due to its natural and ecological importance, Deepor Beel and its surrounding area should be be preserved and protected for the future generations. Even though, limited number of studies have been conducted over this area. Therefore, the present research focuses on the land use change around the beel and its impact on the wetland ecosystem.

Study Area

Deepor Beel (Latitudinal Extent:26°03'26"–26°09'26"N and Longitudinal Extent:90°36'39"–90°41'25"E) is located on the south-west corner of Guwahati city (Figure 1). It has a rich and diverse quantity of flora and fauna. Different species of aquatic vegetation are found in the lake. Area under the aquatic vegetation increases considerably during the monsoon period. Besides this, it is also rich in Avi fauna. Migratory birds, especially in winter season, concentrate here for breeding and fodder. Various species like Kingfisher, Open Billed Stork, a
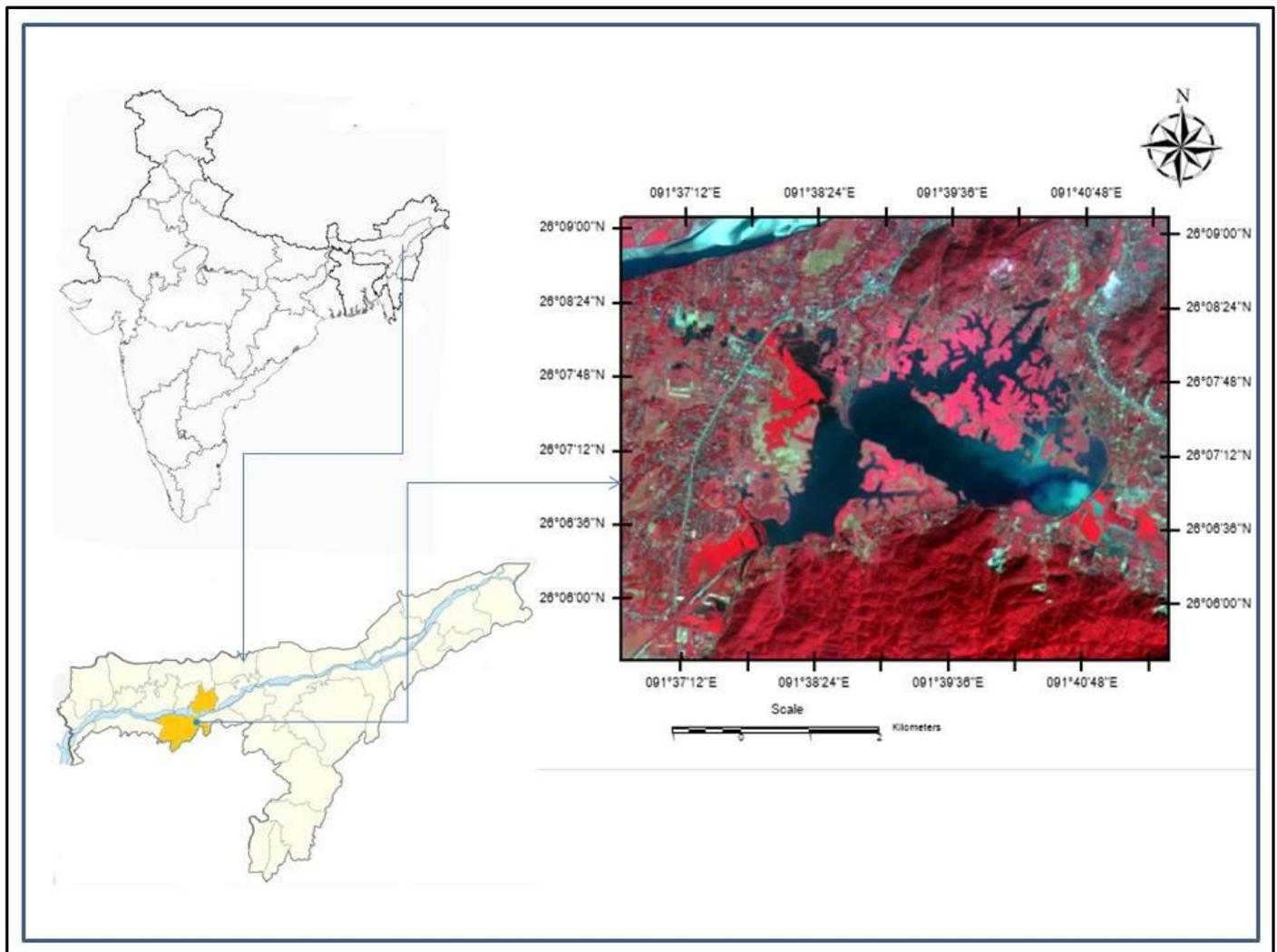
Fig.1- Location of the study area showing Deepor Beel wetland (as viewed on IRS – P6 LISS IV image, 2016).

numerous varieties of ducks, Fishing Eagles, Shoveler etc. are found in this wetland. There are also occasional visits of Elephant herds from the adjacent hills.

Data used and Methodology

The following data are used in the present investigation:

- Indian Remote Sensing Satellite (IRS-1C) Linear Imaging Self-Scanning Sensor (LISS)- III (26th March 2003) (23.5 m resolution)
- IRS-1C LISS III (23rd October 2008) (23.5 m resolution)
- IRS-P6 LISS IV (10th August 2016) (5.8 m resolution)

All the satellite images have been co-registered with each other. Different image enhancement techniques have been applied for better understanding of the area and its geographical features. To generate the land use land cover maps using multi-temporal satellite images, supervised classification is applied with maximum likelihood approach. Area statistics have been generated to depict the changes over years.

Results and Discussions

Using the LULC maps of three observation periods (Figure 2), it has been detected that area coverage by wetlands (10km^2 in 2003, 8km^2 in 2008; 6km^2 in 2016) and vegetation (7km^2 in 2003, 6km^2 in 2008; 4km^2 in 2016) was continuously decreasing whereas area coverage by built-up area (3km^2 in 2003, 4km^2 in 2008; 5km^2 in 2016) around the beel was continuously increasing from 2003 to 2008 and 2016 (Figure 3). The pattern of land use change in the Guwahati city is continuously increasing towards the suburb areas. The International Airport, the National Highway no. 37, railway line constructed by the Northeast Frontier Railway are the key aspects that plays major role in the land use pattern of the area. The greenery in and around the wetland area is no more to be seen. Due to the migration of population in search of livelihood around the wetland area has resulted in to filling up of the wetland for residential, educational, industrial purposes which severely affected the wetland ecosystem. The natural drainage pattern of the wetland gets blocked causing imbalance in the water level. Urban encroachment in agricultural land is another issue over there. Dumping of waste by the Guwahati Municipal Corporation (GMC) near Deepor Beel cause enormous water and land pollution which in turn resulted into the destruction of numerous species of flora and fauna in the wetland. Moreover, during the monsoon season the surface run off sweeps away the waste materials from the dumping site and mixing of this into the wetland water has deteriorated the water quality. This might have caused the oxygen level to fall which has resulted in the death of many fishes. This is confirmed by the low ORP (Oxidation-reduction potential) value (369 mV) near the dumping site, obtained by the testing of water samples collected in different zones around the wetland in 2017. Water near the dumping site is alkaline (pH value is 8.48) due to the mixing of different material from the dumping site with water in the beel. Also, lower value of chlorophyll is observed near dumping ground. Such kind of decline in water quality mainly affected the migratory birds that feeds on the fishes of the wetland and the village families because their livelihood completely depends on fishing. The sediment carried by the water is the cause of siltation and thereby decreasing the depth of the wetland. The establishment of brick kilns in the periphery of the wetland area is the reason of decaying of the soil cover and vegetation cover. The hills, lying to the north of the wetland, are getting destroyed for the construction of roadways along the wetland area.
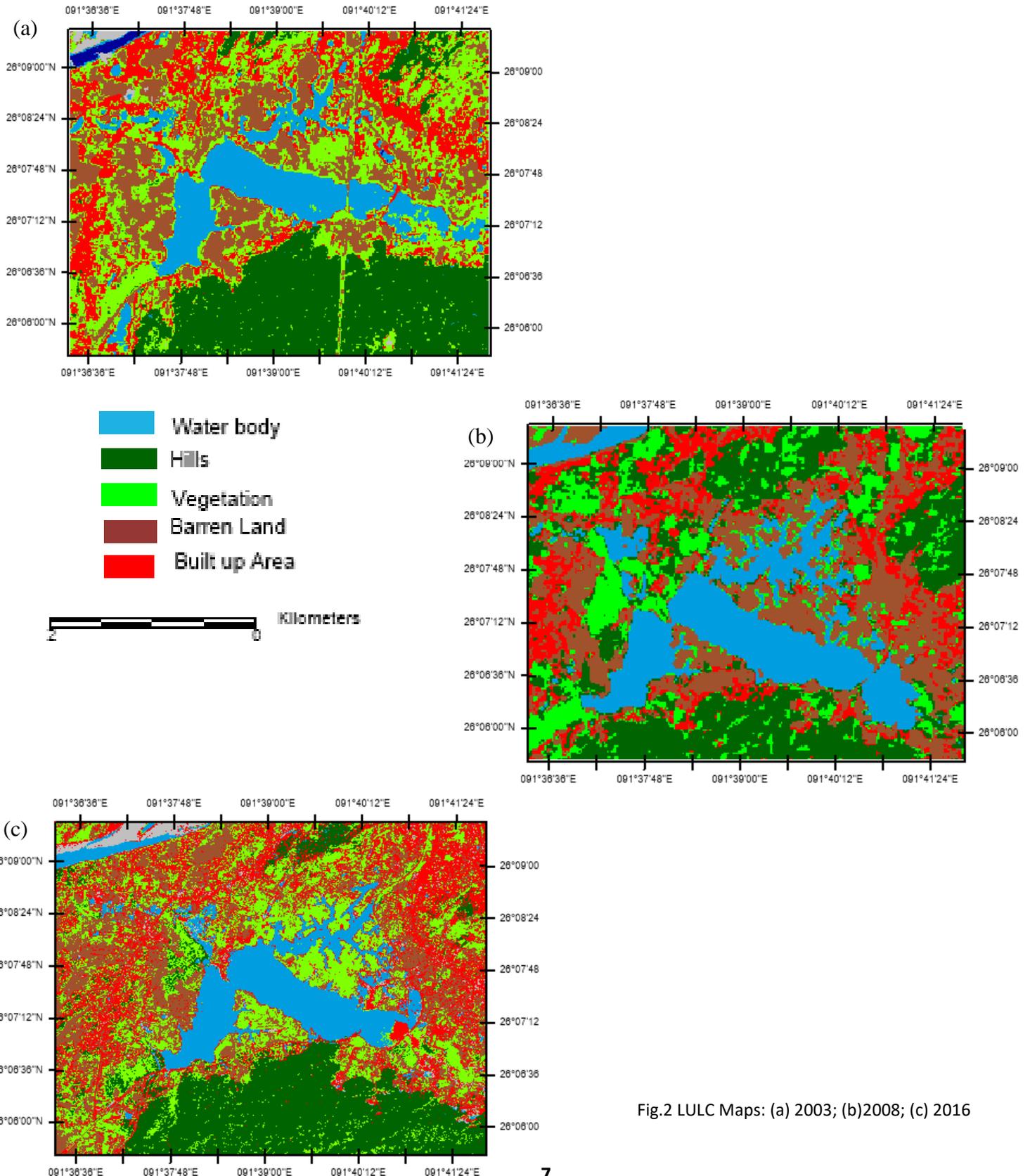
(a)

Water body
Hills
Vegetation
Barren Land
Built up Area
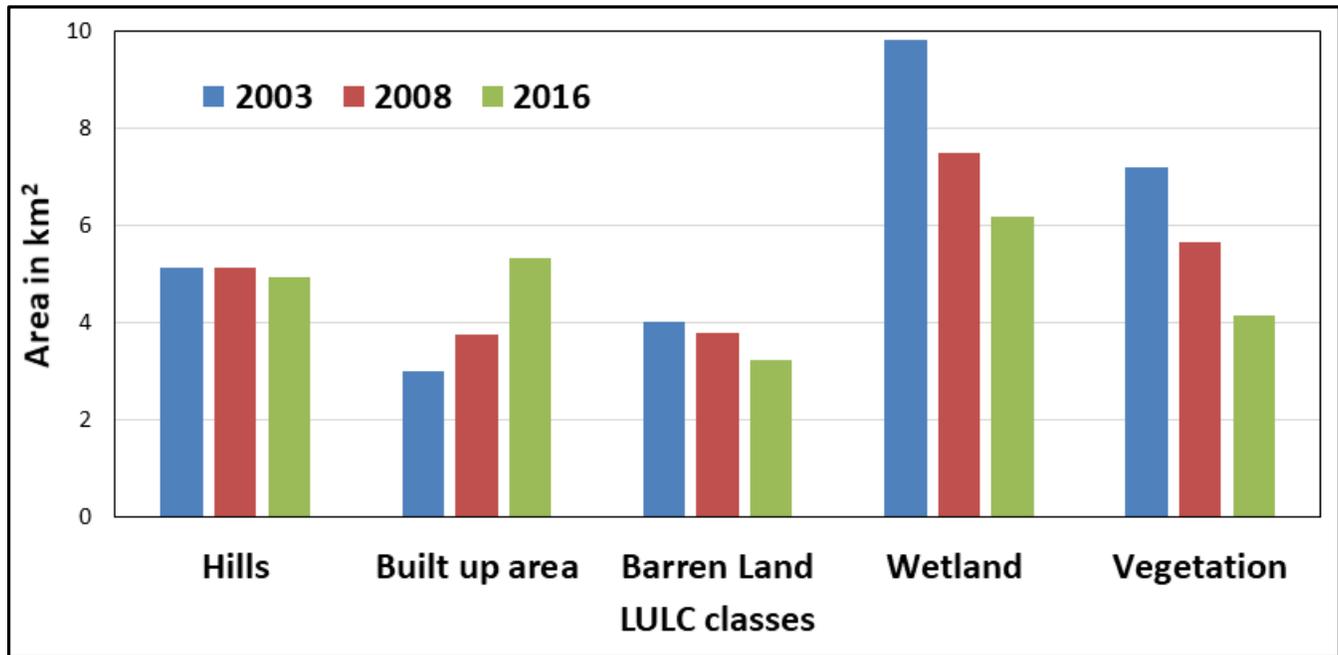
(b)

(c)

Fig.2 LULC Maps: (a) 2003; (b)2008; (c) 2016

Fig.3- Graphical representation of various LULC area statistics in different observation years

Conclusion

In the rugged and data-scarce region like Deepor Beel, which was hardly examined despite their enormous ecological and economic importance, the present study attempts to monitor the LULC change over the years. It also investigated the impact of rapid urbanization in nearby Guwahati city over the biodiversity and water quality of Deepor Beel. Continuous decline in the areal coverage of vegetation cover and wetland at the cost of urban encroachment at an alarming rate is really matter of concern. The deterioration of water quality due to sewage water is also affecting the aquatic life. Hunting and killing or trapping of birds and other mammals found in the wetland have negatively affected the entire ecosystem. Looking into such scenario, proper conservation and management measures are utmost important to protect and preserve the wetland. Immediate steps need to be taken to abolish or relocate the dumping site which is the supreme reason in contaminating the wetland water.

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