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LAND USE CHANGE IN THE PERIPHERIES OF WETLANDS AND ITS IMPACT ON THE WATER BODIES: A COMPARATIVE STUDY IN THE DEEPOR AND URPAD BEELS OF ASSAM, INDIA

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ABSTRACT

Assam, the only plain state amidst six hill states of Northeast India is endowed with as many as 5097 wetlands which size more than 2.25 hectares. Less than that size account 6081. The distribution, shape, size, depth, flora-fauna etc. of the wetlands in Assam are largely depend on the geo-ecological condition of the region and human activities in the peripheral areas.

Keeping aside the rivers and streams the wetlands of the state have been classified into five categories depending on the shape characteristics. These are linear, compact, irregular, discrete (fragmented) and ox-bow wetlands. The shape characteristics speak many things about the origin, distribution and land use condition wetlands and it peripheries.

Here, in this research the land use change in the peripheral areas of two wetlands viz. Urpad Beel and Deepor Beel, both falls almost in same ecological condition have been studies and compared based on satellite data of three different years 1977, 2007 and 2014 using GIS software supplemented by field observation. The impact of urbanization and changing pattern of land use in rural environment has been analyzed aiming at such study to be continued in other wetlands of Assam.

KEYWORDS: Wetland, Peripheral Areas, Land Use, GIS, Urbanization

INTRODUCTION

Assam is primarily a plain state located amidst six hill states of Northeast India. Except the Karbi Anglong and the Dima Hasao districts, all the districts of Assam are plain where occasional hills and hillocks have been seen. The Brahmaputra and the Barak rivers exhibit two distinct river basins which have been dotted with a large number of wetlands. The water table usually remain near the surface or the land covered by shallow water where the wetlands exist [1]. Such situation found almost in all plain districts of Assam. The wetlands of the State along with the rivers are providing suitable habitats of fresh water dolphin, varieties of fishes, many species of turtle etc. These wetlands are also the home of many local and migratory birds. Using remote sensing technology as many as 5097 wetlands have been identified in the state, the sizes of which are more than 2.25 hectares [2]. Smaller to that size are 6081 in number. The total wetland area is estimated to be 7,64, 372 ha i.e. around 9.74 per cent of total geographical area of the state. The rivers and streams account for 84 per cent of the total wetland areas while other water bodies; locally known as ‘beel’, ‘pitoni’, ‘doloni’, ‘jalah’, ‘doba’, ‘hola’, ‘gedeng’ ‘haor’ etc. account the rest.

The origin, present condition and future of these wetlands are largely depending on the geomorphic, climatic and land use condition of the region [3]. Different types of wetlands have been developing under different geomorphic conditions. As many as five different shaped wetlands have been identified in the state viz. linear, compact, irregular, discrete (fragmented) and ox-bow wetlands [4]. Linear wetlands are the abandoned channels or a cut off river courses. Many of them behave like an active river during the monsoon months. During this season such lentic (a system of still water) water bodies becomes lotic (a system of flowing water) ones. The flora, fauna and land use pattern of such wetlands have the similarity with the land use pattern of river banks. Compact type wetlands are normally found in the depressed or naturally low lying areas of the river basins. The length-breadth ratio of such wetlands is usually ranges between 1:1 and 1:3. They are normally shallow and provide agricultural opportunities in their littoral areas. As a result with the increase of population, erstwhile clear water bodies surrounded by rich natural forest now converted into croplands and built up areas. Irregular type of wetlands has irregular shorelines. Such wetlands are usually developed amidst the undulating and hilly areas. These wetlands extend many arms in different directions. Moreover, such wetlands have many feeder channels or inlets which regulate the water regime of such wetlands. Surroundings of such wetlands have rich vegetation. Discrete or fragmented type of wetlands are not a unitary feature rather two or more water bodies connected by one or more perennial channels. Though some portions of such water bodies located distant apart, the active channels keep the water quality and other characteristics almost similar in all the parts connected by the channels. Ox-bow lakes are the wetlands which are commonly found in middle course of many rivers of the state. These are the detached portion of meandered course of the rivers. Surrounding of such wetlands is almost same as the banks of perennial river courses. However, such wetlands in the state have been widely used for fish production and their fringe areas used for agricultural activities.

Many of the wetlands in Assam are degenerated in course of time mainly due to (i) inorganic bottom deposits (ii) organic bottom deposits (iii) blockade of feeder channels (iv) unscientific construction of engineering structures (v) encroachment and cultivation in marginal areas (vi) release of industrial and urban wastes (vii) unscientific fishing methods and gears used for fish catching and (viii) poor governance [5]. It is important to note that with the degeneration of the wetlands, surrounding areas are also losing its productivity to a great extent. In many cases the people who were dependent on the wetland resources particularly on fish are now surviving on forest and other resources in the wetland surroundings. As a result the overall natural environment of the wetlands deteriorated significantly [6]. With the change of land use in the wetland surroundings the inorganic bottom deposit in the wetlands increased manifold. Use of chemical fertilizers and insecticides in the agricultural areas in wetland peripheries altered the natural quality of soil and water of the wetlands and thereby cause decrease of fish production. In most of the wetlands fish business is no longer profitable at present for which fish dependent people now look for alternative livelihood sources. The changes in their livelihood have clear impact on the forest cover of the wetland peripheries. People living in the villages and suburban areas are increasingly using the forest resources. Trees have been cut for fuel wood and for timber. After removal of the forest cover the wetland peripheries have been used for both food and cash crop production. This way forest cover has been reducing in the wetland peripheries and thereby accelerating top soil erosion and consequent siltation in the bottom of the wetlands.

In the midst of the protected forest areas where human interference is not there or very less, tall trees have been seen very close to the shore areas of the wetlands. The wetlands in such areas are full of fishes and other aquatic plants and animals. But the picture of the wetland peripheries near the urban areas or close to the industrial units is different.

Most parts of the peripheral areas of such wetlands are used mainly as built up area, cropland, and municipal and industrial waste dumping area [7].

Here, in this study an attempt has been made to compare two wetlands viz. the Deepor Beel and the Urpad Beel in respect of land use pattern and its changing scenario in the peripheral areas since 1977 to 2014. The Deepor Beel is one which is located in the city area of Guwahati and the other one is Urpad Beel surrounded by rural environment. The changes caused due to urban and industrial activities in Deepor Beel and rural activities in the Urpad Beel have been taken into account in the study to understand the key factors of their degradation and the methods to be adopted for their conservation and restoration. For proper comparison, both the wetlands have been identified which are located almost in same latitude, similar aerial extent and fall in same climatic regime.

OBJECTIVE

The main objectives of the present work are-

- To highlight the wetland scenario of Assam, their status and changes caused in recent past
- To study the pattern of the wetlands and their characteristics
- To analyze the impact of land use change in and around the wetlands based on primary investigation, and
- To pin point the causes of degradation and find out the conservation and development strategy of the wetlands.

METHODOLOGY

The study has been done based mainly on the primary information. The data related to the general wetland environment of the state have been collected from secondary sources. But the data presented for the comparison of the land use change in the peripheral areas of the Deepor and Urpad Beels have been done collected from primary sources. The methodology for depicting the land use/land cover (LULC) change was based on the comparison between the satellite imageries taken on different dates. For preliminary processing of the satellite imageries, the Survey of India topographical sheets (No- 78 N/12, and 78 J/8) of scale 1: 50000 have been used. From the available imageries, for the years 1977 LANDSAT MSS, for 2007 IRS 1C LISS III and for 2014 IRS 1C LISS III for both the wetlands have been used for change detection. The satellite imageries brought from NRSC was first rectified or geometrically corrected using GCPs and GPS points. The scene was geo-referenced to latitude-longitude coordinate system using Polyconic Projection system and Polynomial Equation. Enhancement of satellite imagery has been done using histogram equalization technique. It is very essential for improving the image contrast which allows the best possible separation of land cover classes by tuning the contrast. A field visit has made before the interpretation and some information regarding ground truth has been collected and on the basis of that, the LULC maps have been prepared. As many as 50 GPS points were collected for ground truthing and verification. GPS points have given the location (latitude and longitude). Digital processing for classification was found relatively difficult for mapping due to merging of tone of different classes. Therefore the visual interpretation technique was adopted. The LULC maps have been generated for the years 1977, 2007 and 2014. The mapping exercise was carried out first on the dataset of year 2007. Same vector layer was overlaid upon the dataset of 1999 and polygons were modified wherever changes were found. The whole process has done with the help of ArcGIS.

GEO-ECOLOGICAL SETUP OF DEEPOR AND URPAD BEELS

The two wetlands studied here are (i) Deepor Beel and (ii) Urpad Beel. Both the wetlands located almost in same latitudes. Climatic and other natural environmental conditions are almost same (Table-1). The similar geomorphic and climatic conditions support same type of vegetation cover in both the wetlands. But the Deepor beel is located very close to the congested urban areas of Guwahati city while the Urpad Beel located away from direct urban influences. Deepor Beel, the lone Ramsar site in Assam, is one of the most important riverine wetlands situated at the southern fringe of the mighty river Brahmaputra. The core area of the wetland occupies about 4000 hectares. The wetland is situated at 53 m above sea level. The wetland is bounded by Bharalu river basin in the east, Kalmoni river basin in the west, Jalukbari wetland areas in the north and Rani-Garbhanga reserved forests in the south. Major part of the wetland consists of black clay soil except on the western part which is composed of light yellowish lateritic soil. Near banks and in shallow water the soil often consists of detritus of decomposed leaves of aquatic plants and garbage of Guwahati city washed down by the storm water. The wetland is the home of about 122 species of birds and 50 species of fish in addition to other bio-resources [8].

The Urpad Beel is surrounded by the NH-37 in the south, west and north. The villages viz. Agia, Kalapani, Shyamnagar, Genedera and Garukutia are located between the NH-37 and the beel proper. The eastern side of the beel is surrounded by agricultural land of villages like Maijunga, Garaimari, Kuruabhasa etc. The Urpad Beel is connected with an adjacent wetland the Patakata Beel located in the eastern side by a small channel. The river Jinari flows by the south eastern side of Urpad beel. Another river called Jinjiram, which originates from the Urpad Beel flows westward to meet the mighty Brahmaputra River. The entire area including the Beel is characterized by an almost flat terrain with mild north-east and south-east to east slope [9].

Table 1: Environmental Condition of Deepor and Urpad Beel Areas

	Deepor Beel	Urpad Beel
Location	$26^0$03’26’’N-$26^0$09’26’’N $90^0$36’39’’E-$90^0$41’25’’E	$26^0$05’05’’N-$26^0$06’45’’N $90^0$34’08’’E-$90^0$37’45’’E
Climate	Moderate during winter and Hot during summer	Moderate during winter and Hot during summer
Temperature	Max. 36^0 in July Min. 7^0 in January	Max. 33^0 in July Min. 7^0 in January
Rainfall (Annual Average)	1662 mm	1614 mm
Relative Humidity	70-85%	70-82%

RESULTS AND DISCUSSIONS

The 2km buffer of both Deepor and Urpad Beels covers almost equal area 64.68 sq km and 67.8 sq km respectively. In both cases, the water spread areas, forest cover, fallow and barren lands, built up area from 1977 to 2014 show significant changes (Figures. 1, 2, 3, 4, 5 & Figure 6). The Table -2 shows the comparative data of LULC of the peripheral areas of both the wetlands and also water spread areas, which gives a clear picture how due to urbanization accelerated the changes in the Deepor Beel compared to the Urpad Beel. In spite of attaining Ramsar site status by the Deepor Beel and also efforts made by the concerned authorities to save the wetlands, more encroachment and faster degradation of the wetland environment observed being it located in urban area. The total water spread area in the buffer has been reduced in Urpad Beel mainly for natural causes rather than human interference. On the other hand wetland proper reduced in Deepor Beel occurred mainly due to encroachment which has been partly compensated by de-siltation

(Photo 1&2).

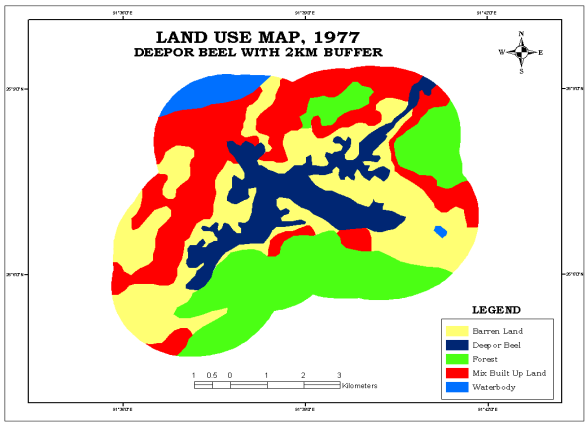

Figure 1: Land Use of 2 km Buffer Area of Deepor Beel, 1977

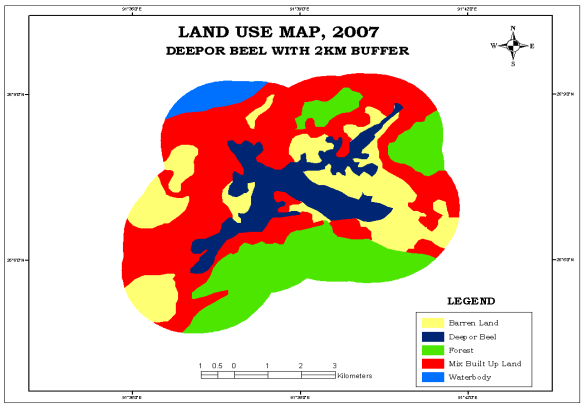

Figure 2: Land Use of 2 km Buffer Area of Deepor Beel, 2007

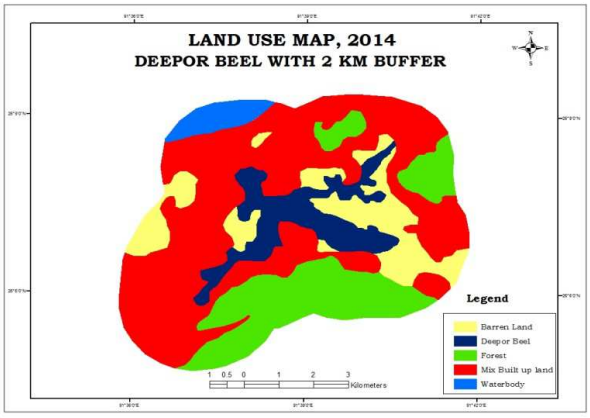

Figure 3: Land Use of 2 km Buffer Area of Deepor Beel, 2014

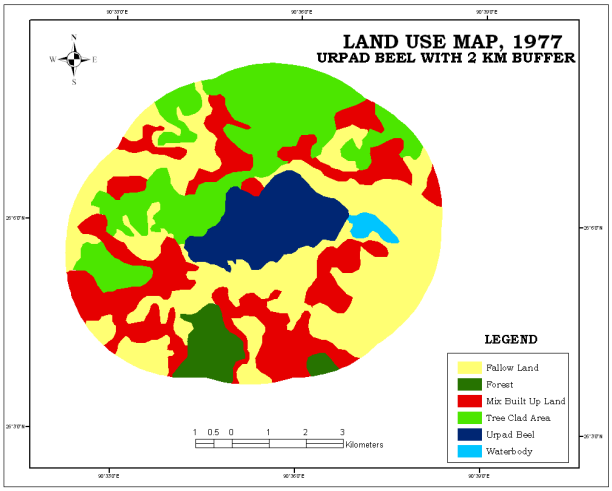

Figure 4: Land Use of 2 km Buffer Area of Urpad Beel, 1977

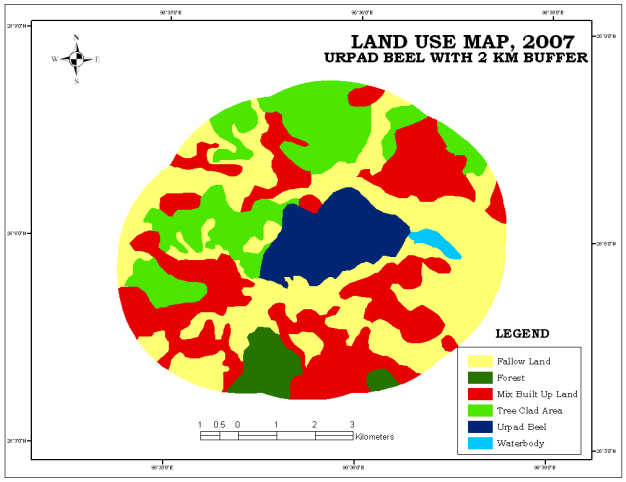

Figure 5: Land Use of 2 km Buffer Area of Urpad Beel, 2007

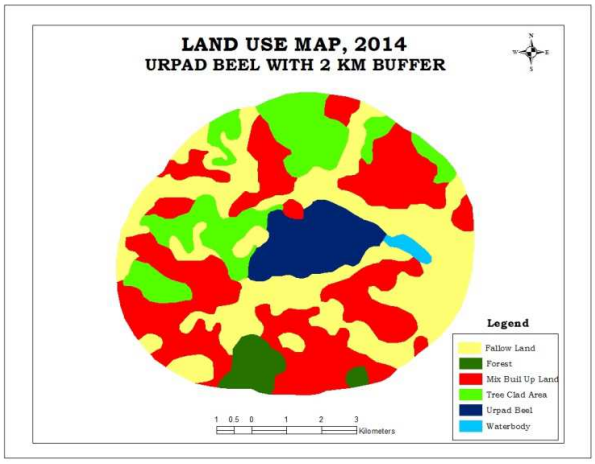

Figure 6: Land Use of 2 km Buffer Area of Urpad Beel, 2014

Table 2: Land Use and Land Cover (LULC) Change of Deepor and Urpad Beel Areas (1977-2014)

Deepor Beel (Area in Sq km)				Urpad Beel (Area in Sq km)			
Land Use Category	**1977**	**2007**	**2014**	**Land Use Category**	**1977**	**2007**	**2014**
Water body	1.98	1.9	1.9	**Water body**	0.6	0.48	0.4
Forest	16.8	14.8	13.8	**Forest**	2.8	2.6	2.4
Barren Land	19.2	12.8	9.2	**Tree clad area**	15.6	12.9	10.1
Fallow land	-	-	-	**Fallow land**	25.0	24.7	24.21
Mixed built up land	17.3	26.4	31.9	**Mixed built up land**	17.1	20.82	24.7
Beel proper	9.3	8.78	7.8	**Beel proper**	6.7	6.3	5.7
Total	64.58	64.68	64.6		67.8	67.8	67.51

Photo 1

Photo-2

The forest covers in Deepor Beel buffer area reduced by 3 sq km during this period. The neighbouring barren land around the Deepor Beel was reduced by 10 sq km. But the built up area increased by 14.6 sq km. On the other hand the built up area around Urpad beel increased only by 7.6 sq km during the same period. It clearly indicates the urban effect on reduction of wetland area. The most dangerous effect on land use change in Deepor beel is the increase of built up area particularly the increase of industrial units in recent years. The increasing industries have not only accelerating the siltation rate and causeing deterioration of water quality but also adversely affecting the rich flora and fauna diversity of the region. The forests on the Rani-Garbhanga hills have not been affected much by urban activities mainly because the territory falls under Reserved Forests. In both cases the rate of changes almost in all categories found to more during the period from 2007 to 2014 rather than 1977 to 2007. The variations occurred not because of time span difference rather caused due to changes in human activities.

CONCLUSIONS

From the above study, it could be concluded that both the Deepor beel and Urpad beel with its surrounding areas have undergone lot of changes since 1977 to 2014. More changes have been observed in the peripheral areas rather than the wetlands proper. Decrease of water spread area in both the cases due to siltation partly by natural processes and partly due to human induced factors. Tremendous increase in built up areas in and around Deepor beel caused due to its location near the congested urban and industrial areas. For the similar reasons the forest cover has been depleting and agricultural lands which are presently remain barren also decreasing significantly. On the other hand good quality forests are there near the Deepor beel as because such forest areas fall under Reserved Forests. Again Urpad Beel and its surroundings exhibit a better picture probably for non interference of urban activities. Therefore, it could be concluded that more care and restrictions are required to protect natural vegetation cover along with enforcement of law in and around the wetlands, which are located near the urban areas.

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