Vegetation coverage change and risk assessment- A case study of Chandubi Lake, Assam

[1]Mamita Kalita, [2]PLN Raju, [3]Nilakshee Devi
[1]Junior Research Fellow, [2]Director, [3]Professor
[1,2]North Eastern Space Applications Centre, Dept. of Space, Govt. of India, Umiam – 793103, Meghalaya, India
[3]Department of Botany, Gauhati University, Guwahati-781014, Assam, India

Abstract: The present study examines on two major issues. Firstly, the study of vegetation loss and secondly to map the wetland loss over 16 years from 2000 to 2016 using Remote sensing, GIS (Geographic Information System) analysis. This study is an attempt to measure Vegetation cover changes and to evaluate Wetland loss. Further, it gives insights for estimating the types of vegetation decline in that time period. The data used in the study include LANDSAT 5 and LANDSAT 8 satellite imagery of three different years 2000, 2008 and 2016. The temporospatial dynamics of surrounding vegetation and wetland areas has been studied using NDVI (Normalized Difference Vegetation Index), MNDWI (Modified Normalized Difference Water Index) and NDBI (Normalized Difference Built Index). In addition, the paper highlights the present and future risk associated with vegetation and wetland loss due to threats from climate change and anthropogenic activities. It has been found that Chandubi beel area have shrunk from 25.89% in 2008 and 20.42% in 2016. The vegetation cover has rapidly decline from 2000 to 2016. In addition the study revealed the aquatic vegetation growth was more in 2008 to 2016 whereas growth was steady from 2000 to 2016. Overall the wetland area has declined from 2000 to 2016 by 14.61 %. The Beel is significantly shrinking from 2000 to 2016 which indicates an urgent need for wetland health restoration as it harbours various endangered and vulnerable species of fishes, amphibians, reptiles, birds, mammals and plant species. The study highlights the need of Remote sensing for risk assessment study for facilitating the ways for its restoration.

IndexTerms **- NDVI, MNDWI, NDBI, LANDSAT, Remote sensing, GIS**

1. INTRODUCTION

Wetland are among the world's most productive environments; cradles of biological diversity that provide the water and productivity upon which countless species of plants and animals depend for survival [1]. The study area Chandubi Lake (beel) is situated within the Loharghat range of Kamrup (Rural) district. A large lake and wetland, created by the devastating earthquake of 1897, the lake is at the base of Garo Hills bordering Assam and Meghalaya. The natural tectonic lake is surrounded by forest and hilly terrain represented by Rajapara and Mayang hill range on its North-West and South-West respectively. Chandubi beel has the distinction of full filling of Ramsar Convention's Ramsar sites (A wetland of International importance) [4]. Change detection study and land use land cover study has been done by many researchers using LANDSAT satellite imagery (1, 2, 3). NDVI, NDWI, NDBI helps in vegetation, water resources and settlements studies respectively [3, 7, 13, 17, 20, and 8]. Such studies help in monitoring wetland change, resource management as well as helps in adopting present and future conservation strategies. The species richness, biodiversity and distributions of plant species are dependent on water level fluctuations [14-16] as well as highly influenced by climate change and anthropogenic activities. Therefore such study will help in land use planning and lake ecological conservation.

1.1. OBJECTIVES

The main objectives of this study are-
1. To study overall vegetation cover change during 2000, 2008 & 2016.
2. To evaluate risk involved in wetland loss in that time period using Remote sensing.

1.2. STUDY AREA

The Lake is located at foothills of Garo hills surrounded by Meghalaya and Assam. Chandubi receives inflow from River Kulsi, a southern tributary of River Brahmaputra (figure 1). Chandubi lake (beel) also known as tectonic or natural lake was formed by devastating earthquake of 1897, during which the forest went down and became the lake. The area geographically located at Latitude 25.8815° N and Longitude

91.4235° E. The climate is moderate and humid (upto 70% relative humidity with most rainfall during monsoon (May-Sept.). The mean minimum summer temperature is 34°C and mean minimum winter temperature is 9°C.

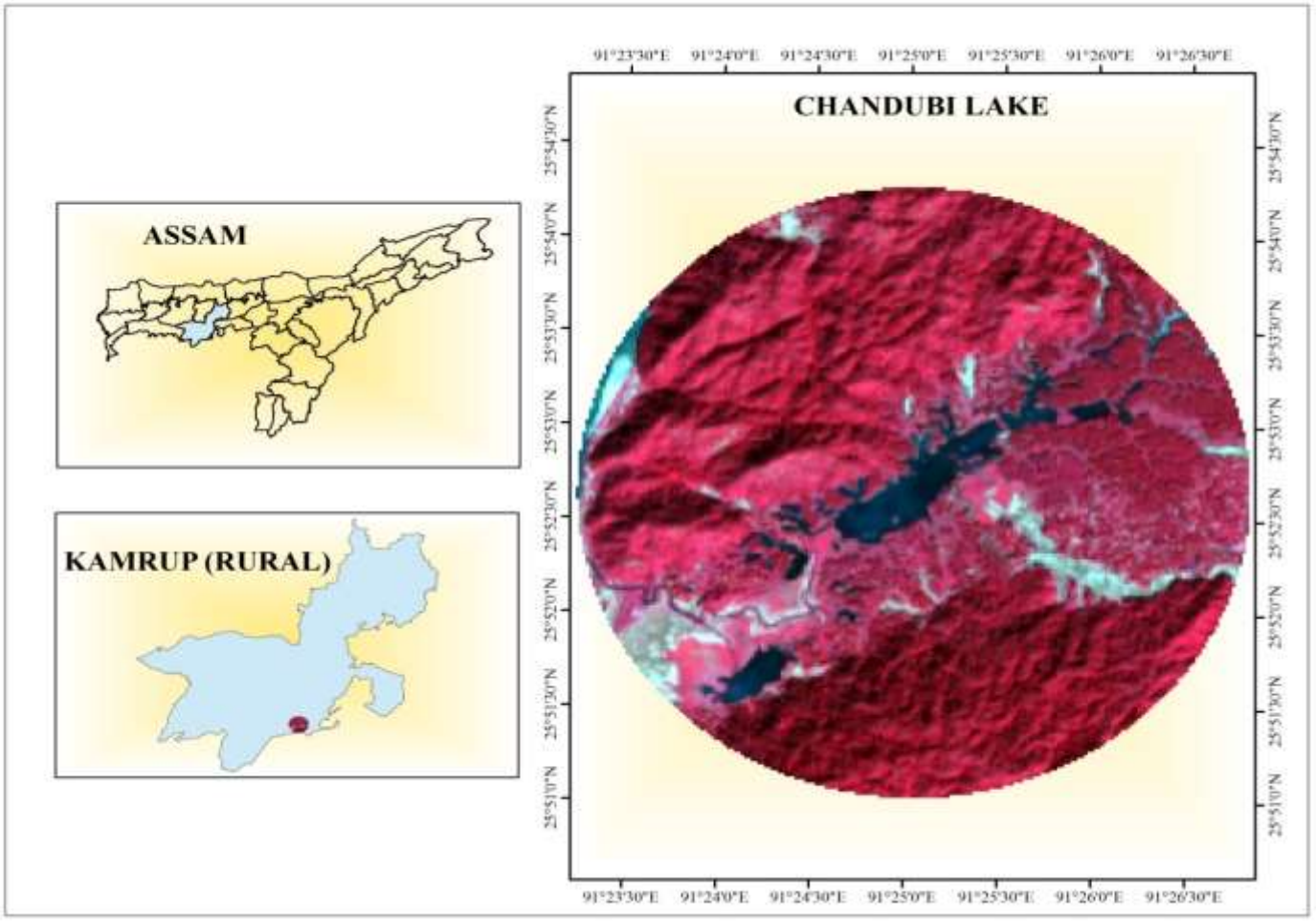

Figure 1. Location of Study Area (Deepor beel, Assam)

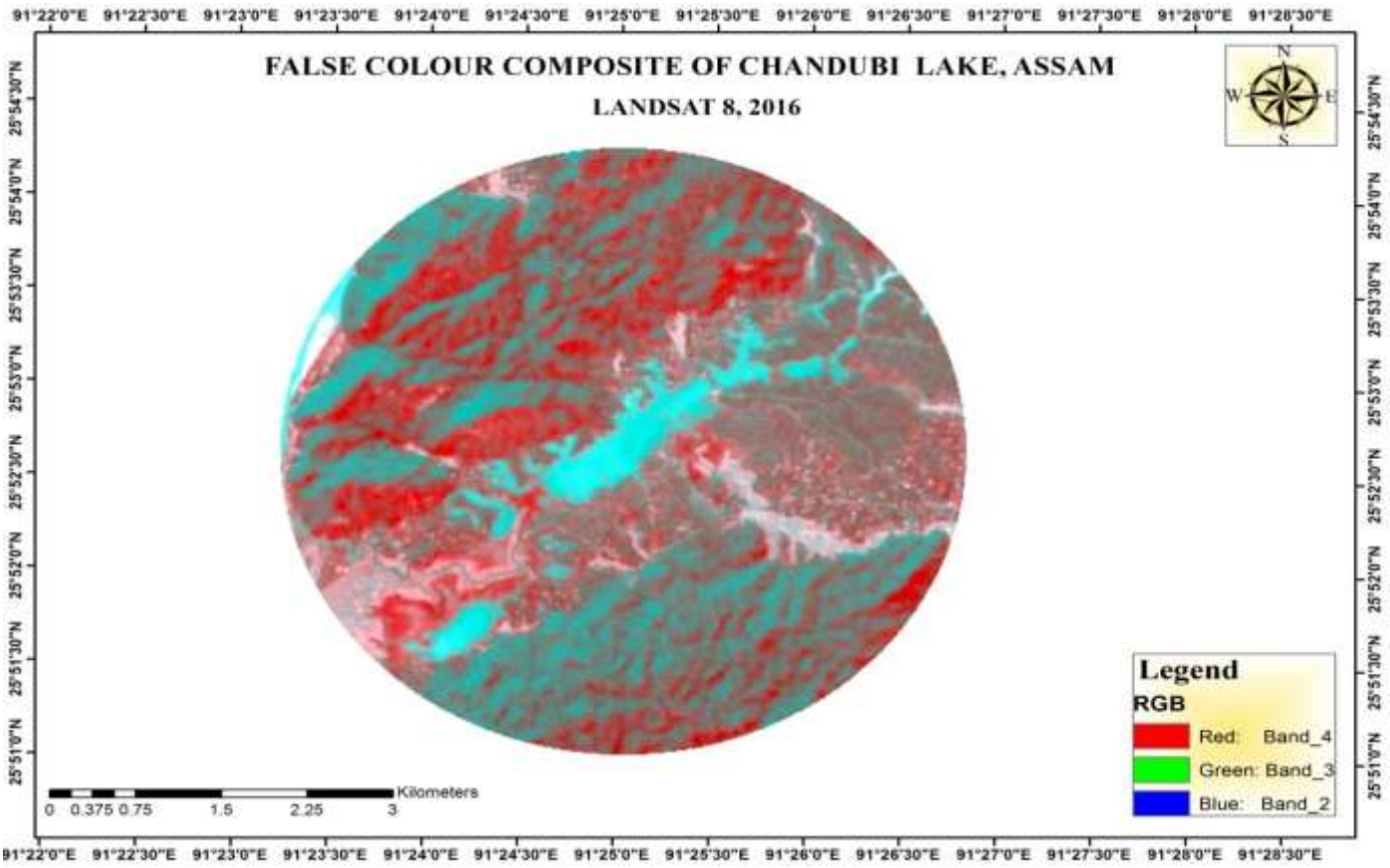

Figure 2. FCC Image of Study Area

3. RESEARCH METHODOLOGY

The study is carried out using LANDSAT 5 (2000, 2008) and LANDSAT 8(2016) December satellite imagery (Path/Row: 137/42) collected from United States Geological Survey (USGS). The study area has been subsided with an buffer area of radius 3km. The LANDSAT imagery has been converted into Pan-sharpened raster dataset to enhance the resolution by 15m. The digital image processing has been carried out using ArcGIS and ArcGIS Pro software.

Table 3.1: Landsat 5 and Landsat 8 data specifications

Projection- WGS_1984_UTM_zone_46N					
Satellite	Year	Path/Row	Resolution		Source
			Original	Pan sharpened	
Landsat5TM	2000	137/42	30m	15m	USGS
Landsat 80LI/TIRS	2008	137/42	30m	15m	USGS
Landsat 80LI/TIRS	2016	137/42	30m	15m	USGS

Delineation of Beel and Change Analysis- The method used is most well known index for vegetation study using remotes sensing data is Normalized difference vegetation index (NDVI) (Tucker,1979). Theoretically the NDVI value ranges from -1 to +1. An NDVI value that is negative or close to zero indicates no vegetation whereas a high value or value close to 1 indicates high concentration of green vegetation [6, 7]. Normalized difference water index (NDWI) is a commonly used index to detect and delineate water-like features and high soil moisture areas (McFeeters, 1996). The formula for calculating (NDWI). The NDWI values range from -1 to +1. An NDWI value that is negative or close to zero means no water whereas an NDWI value close to 1 indicates the highest wetness [6,7]. The Normalized difference built index (NDBI) is used to extract built-up features and have indices from -1 to +1, where negative or values near to zero indicates less built-up and values close to 1 indicates more built-up features[7,8]. Using these indices the vegetation cover change as well as wetland loss over 16 years have been extracted.

Table 3.2: Analysis formulae used in the study

NDVI= $\frac{NIR-RED}{NIR+RED}$ NDVI values ranges from -1 to +1. Values (negative or close to zero) indicate no vegetation & (high value or value close to 1) indicates high concentration of green vegetation.
NDWI= $\frac{GREEN-NIR}{GREEN+NIR}$ NDWI values ranges from -1 to +1. Values (negative or close to zero) indicate no water & (values close to 1) indicates high wetness.
NDBI= $\frac{NIR-SWIR}{NIR+SWIR}$ NDBI values ranges from -1 to +1. Values (negative or close to zero) indicate no or less settlements & (values close to 1) indicate settlements.

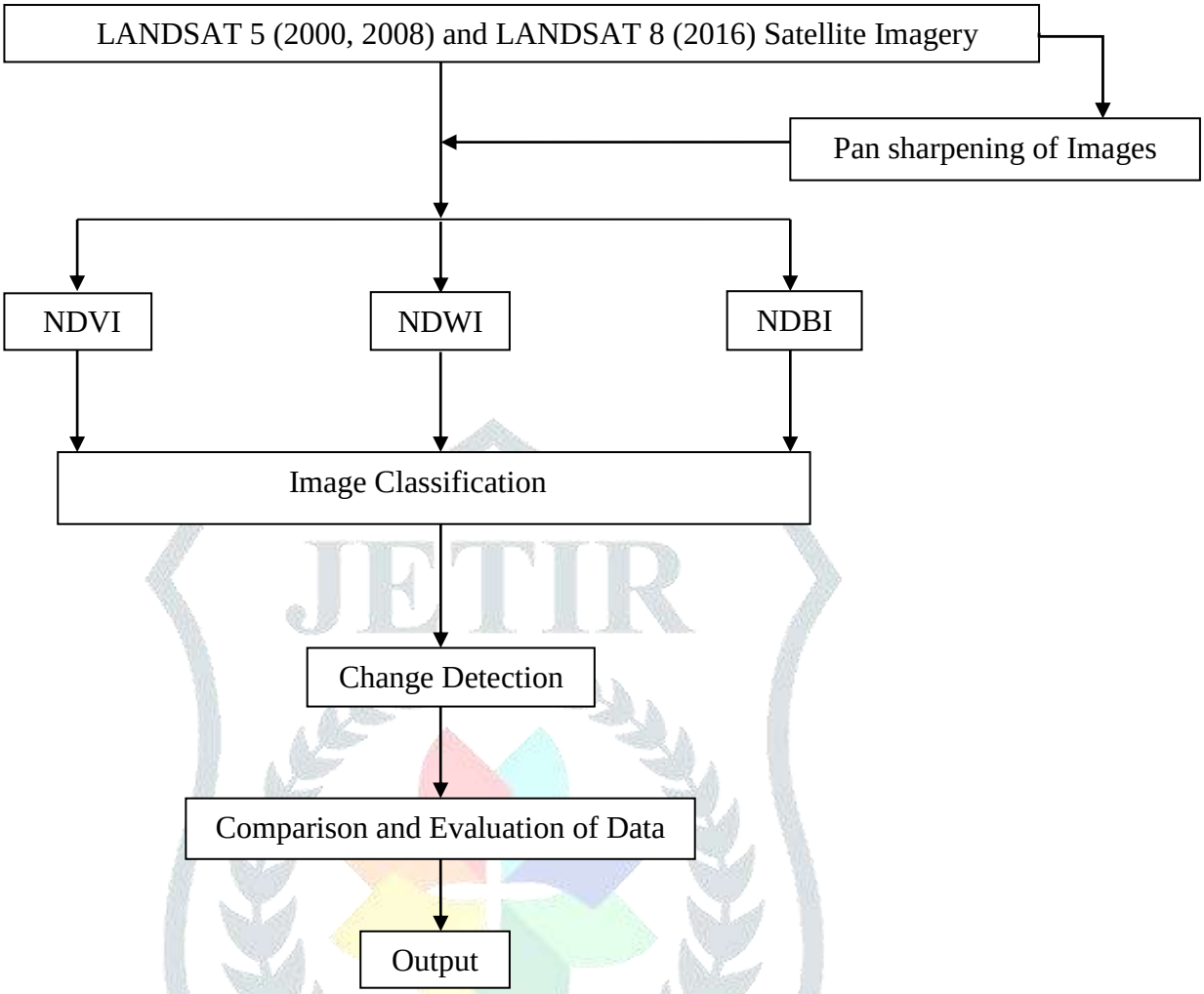

Figure 3. Methodological procedure as adopted in the study

4. RESULTS AND DISCUSSION

The study through NDVI & NDWI concluded that the beel has undergone major vegetation cover changes and wetland loss over 16years (2000 to 2016). The area was having 40.75% Thin and Thick forest vegetation in 2000, 23.84% in 2008 which reduces drastically by 5.67% in 2016. It has been found through NDWI that the total area of water bodies within study area has reduced by 79.57% from 2000 to 2016. NDBI reveals more built-up increase from 12.69% to 50.40% in 16 years. The results have been tabulate in (Table.3). Also it assessed the risks involved with biodiversity loss as the wetland harbours and (*Haliaeetus leucoryphus)* Pallas's Fish-Eagle & (*Leptoptilos javanicus)* are the threatened species found in this lake. Further the adjoining tropical moist deciduous forests is home of Mountain BambooPartridge (*Bambusicola fytchii),* Blue-throated Barbet (*Megalaima asiatica),* White-cheeked Hill Partridge (*Arborophila atrogularis)*, Blyth's Kingfisher (*Alcedo hercules),*White-throated Bulbul (*Criniger flaveolus)*, Grey Peacock Pheasant (*Polyplectron bicalcaratum).*

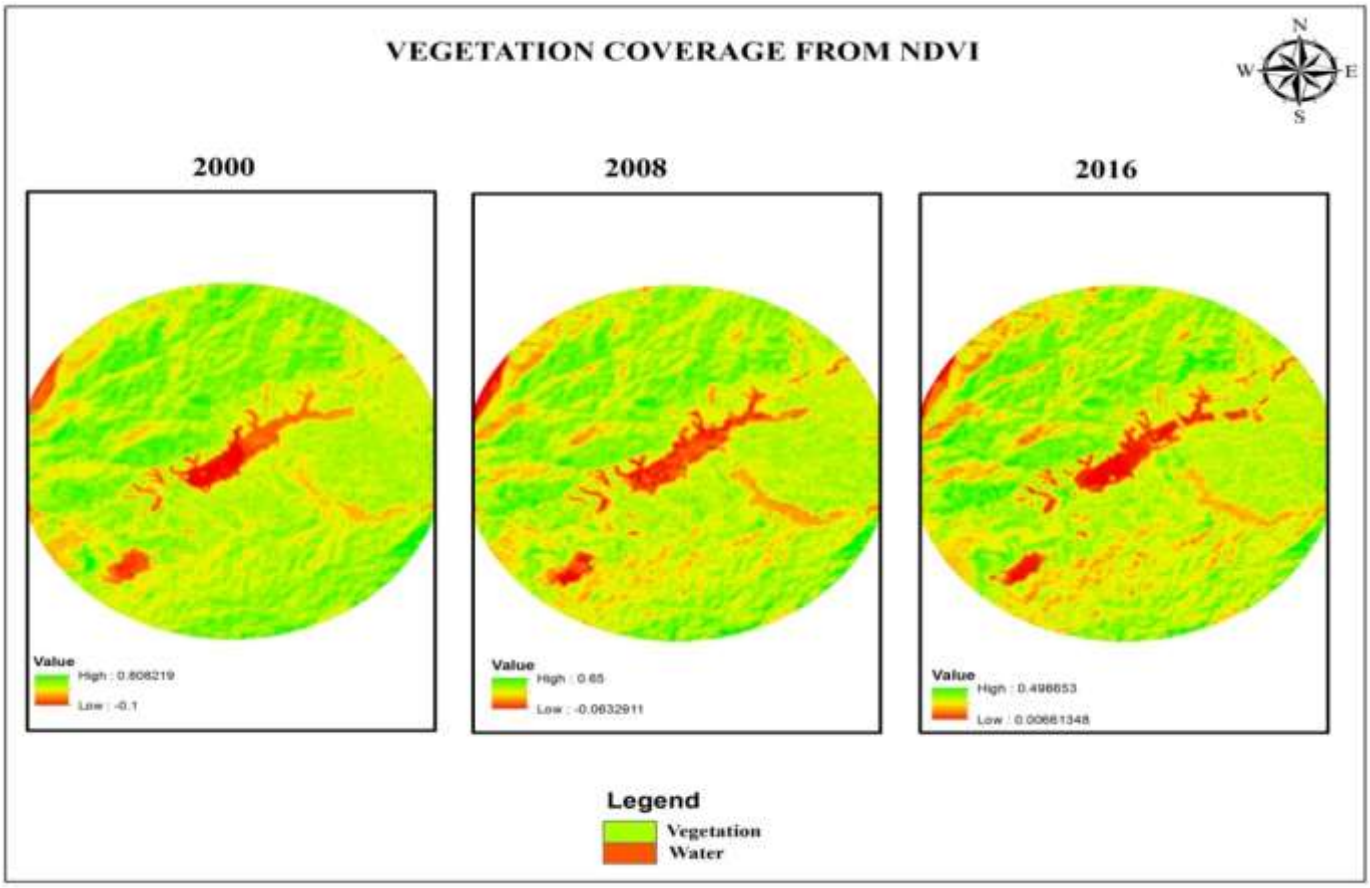

Figure 4. Normalized Difference vegetation Index map of study area (2000, 2008 and 2016)

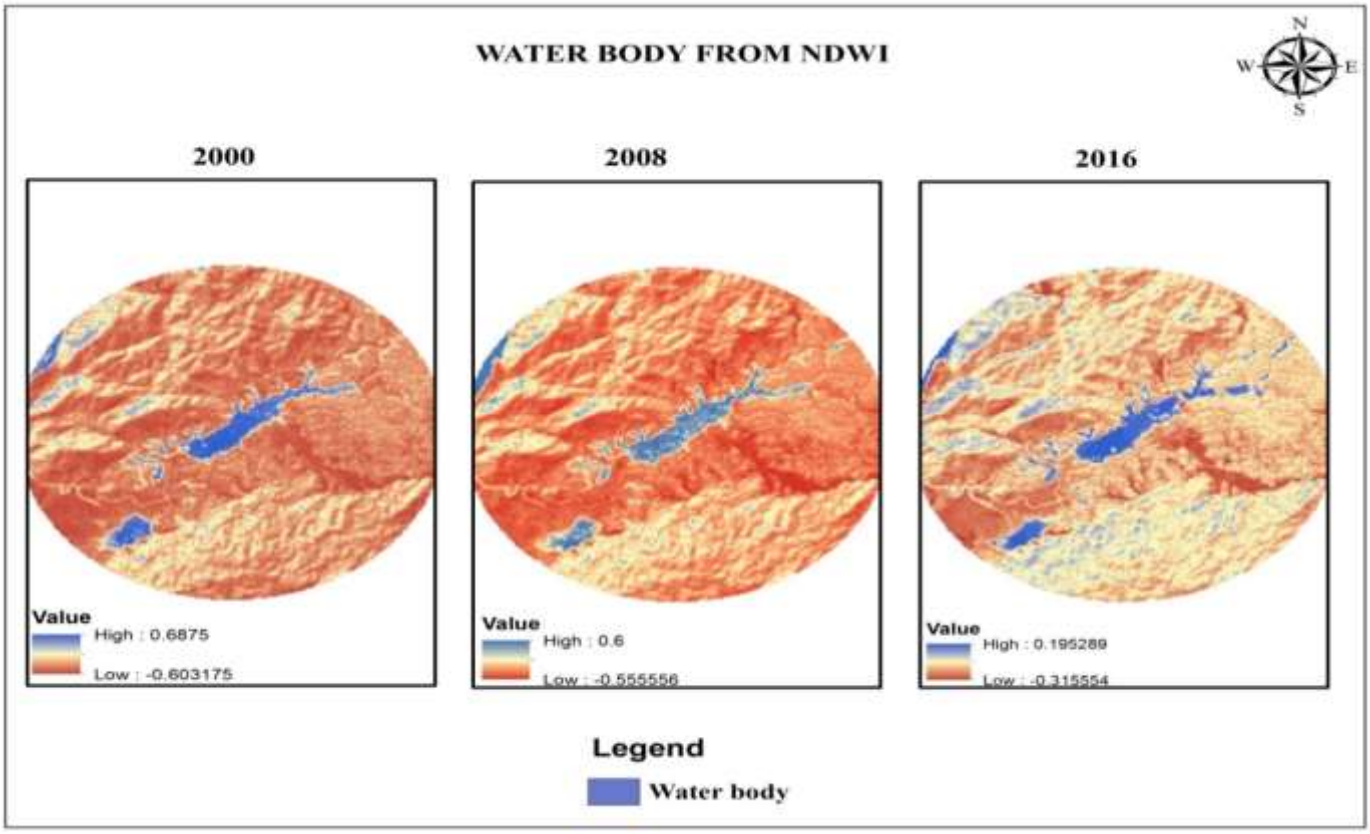

Figure 5. Normalized Difference Water Index map of study area (2000, 2008 and 2016)

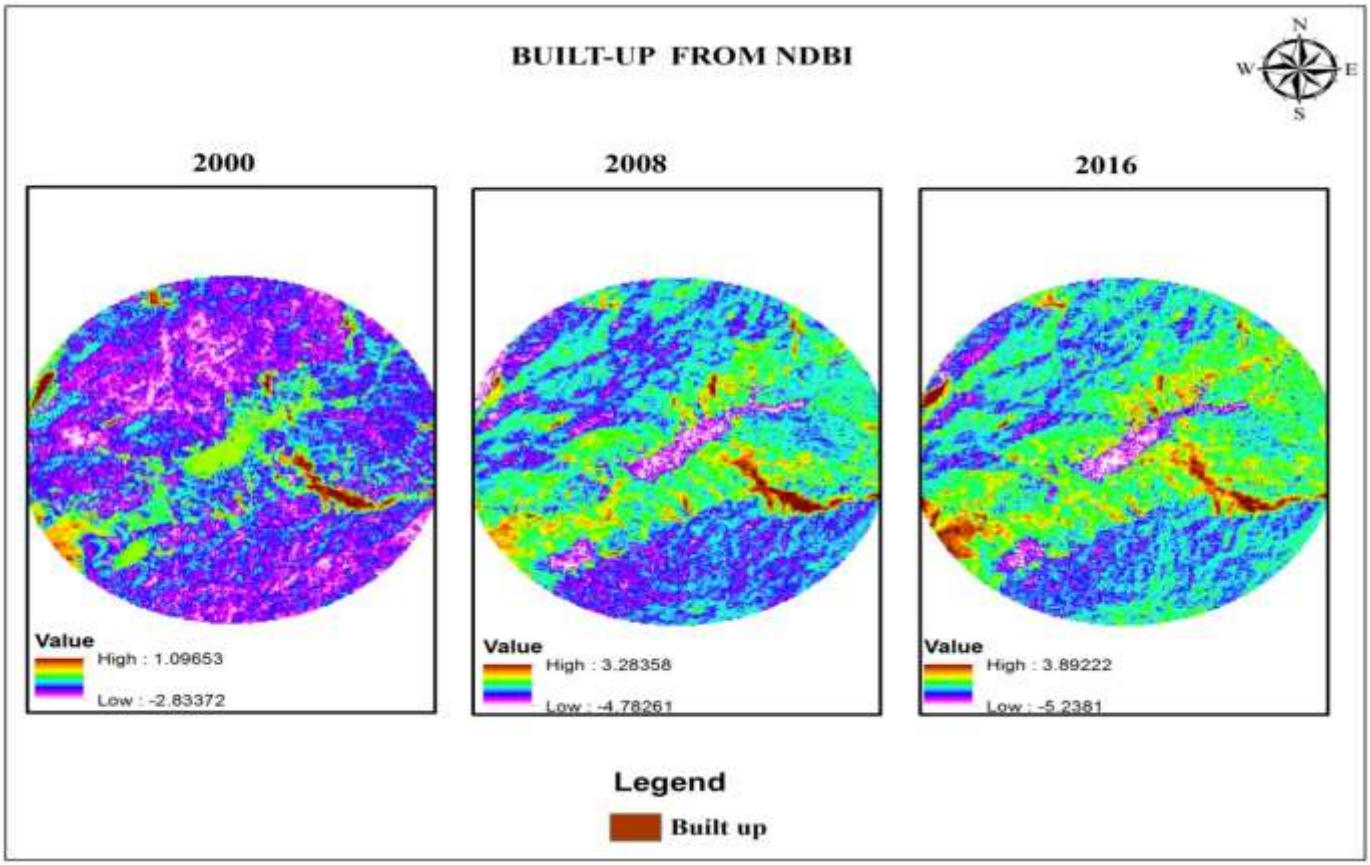

Figure 6. Normalized Difference Built up Index map of study area (2000, 2008 and 2016)

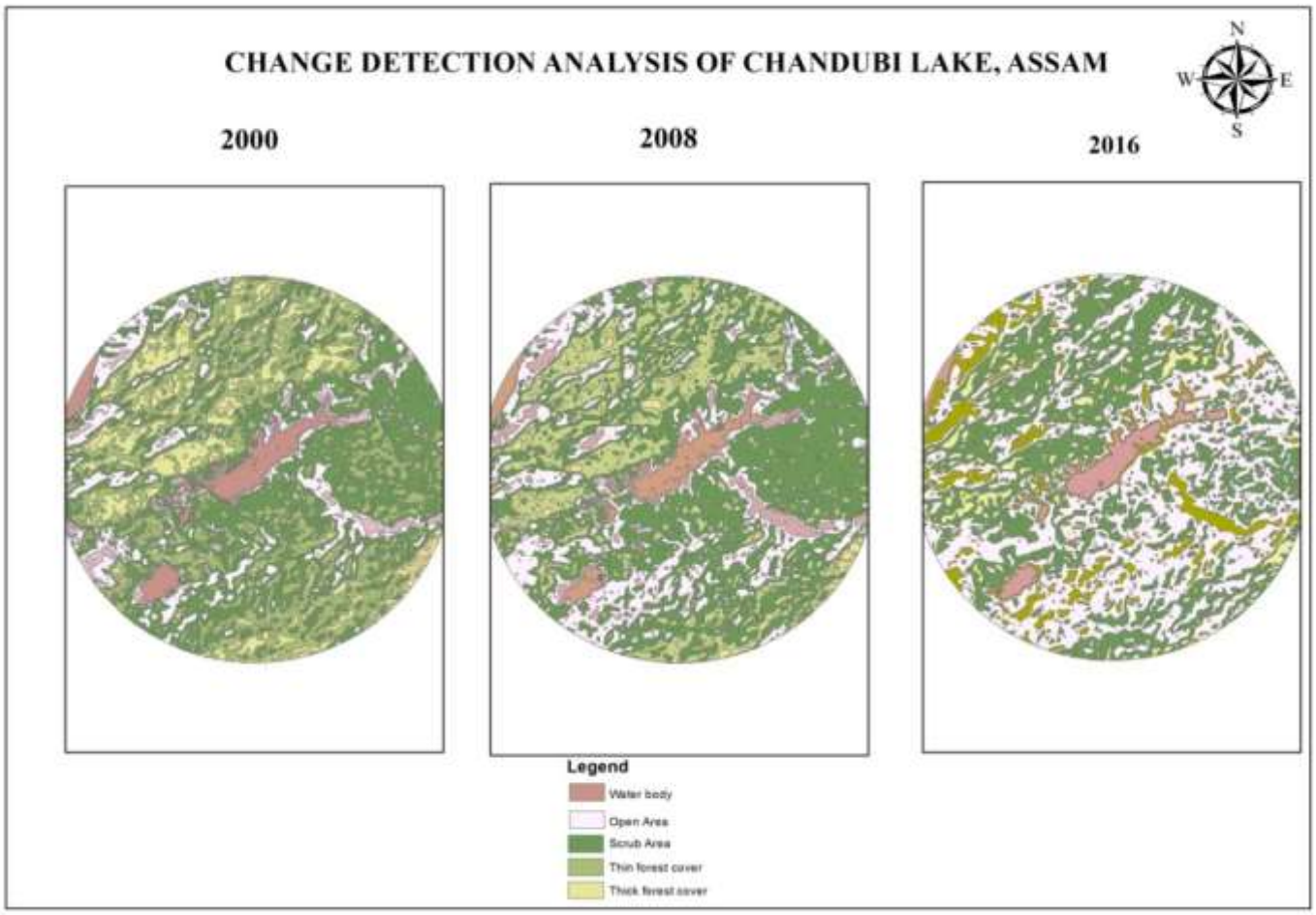

Figure 7. Normalized Difference vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Normalized Difference Built up Index (NDBI) based change detection of study area (2000, 2008 and 2016)

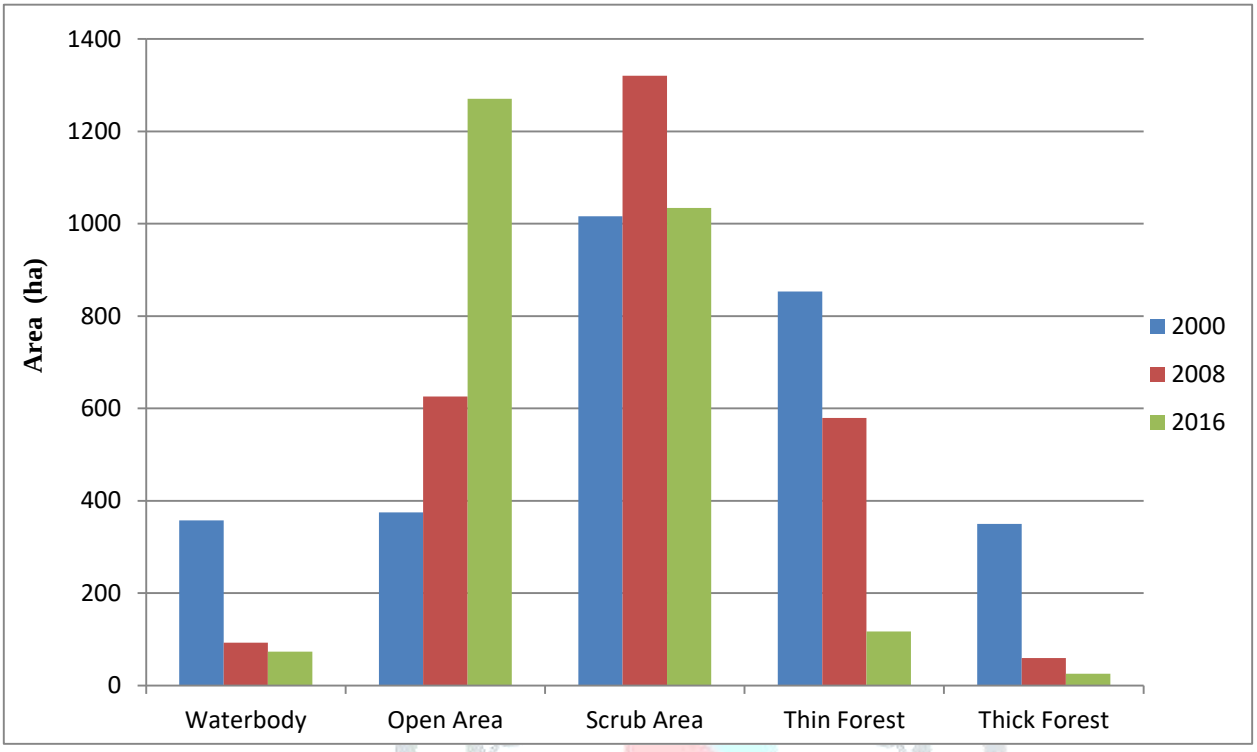

Figure 8. Area of different classes in hectares (ha)

Table 4.1: Area statistics of Study area during 2000, 2008 and 2016

Category	2000		2008		2016	
	Area(ha)	Area (%)	Area(ha)	Area (%)	Area(ha)	Area (%)
Water Body	357.82	12.12004	92.65	3.460369	73.09	2.899603
Open Area	374.82	12.69586	625.88	23.37589	1270.61	50.40723
Scrub Area	1016.48	34.43011	1320.59	49.32249	1034.11	41.02488
Thin forest cover	853.25	28.9012	579.07	21.62759	117.19	4.649124
Thick forest Cover	349.93	11.85279	59.27	2.213665	25.69	1.019165
TOTAL	2952.3	100	2677.46	100	2520.69	100

5. CONCLUSION-

Earlier researches reveals Tropical forest degradation [9] and almost 90% decline in Piscean fauna, which is a major threat to the ecological stability. Also, NDBI revealed increasing human settlements which posing a great threat to wetland and its nearby areas due to illegal encroachment and logger syndicate. The beel is habitat of critically endangered fish species *Nandhani* & ornamental fish *Phutkiputhi.* Chandubi wetland also provides a healthy ecosystem to gangetic dolphins species(*Platanista gangetica*) coming from River Kulsi via channel of 2.5 kms. Locals allege that Gangetic Crocodiles (*Gravialis gangeticus*) used to be seen till 1960, but now they have vanished from the ecosystem. The remote sensing study has provided accurate results of wetland loss and further gives the reasons of major biodiversity loss from this area.

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