

# Changing trend of forest cover in the Pabha reserve forest in the Lakhimpur District of Assam, India

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## ABSTRACT

The change of the forest cover area into other land use and land cover types is known as forest cover depletion. Pabha Reserve Forest of Lakhimpur district has been experienced the same for the last few decades. This study has been conducted on the changing trend of forest cover of the said reserve forest for the years of 1977, 1987, 1997, 2007 and 2017. The Landsat-2 MSS data for 1977, Landsat-5 TM data for 1987, 1997 and 2007 and Landsat-8 OLI data for 2017 have been used to analyze the changing trend and supervised classification and has been used with the help of ERDAS Imagine 2014. Only 8.824 sq km of dense forest area was there in the year of 1977 out of the total geographical area 50 sq km of the Pabha Reserve Forest. That area has become 0 sq km during the year of 1997. The study reveals that the Pabha Reserve Forest has been depleted before the year of 1977. Only anthropogenic activities are responsible for the changing trend of the forest cover.

**Key words:** Reserve forest, Deforestation, Supervised classification, Anthropogenic

## Introduction

Forests are only biotic components that contribute simultaneously food, shelter, and oxygen to all other living organisms along with economic benefits to the human being. Forests are known as "Natural Vegetations" which are found in small to large extent of geographical areas that have been existing since the immemorial and providing opportunity to a large variety of biodiversity. Forests are on the whole complex ecosystems which are composed of trees, shrubs and generally a closed canopy. Forests are the biomes for large varieties of animals, plants, birds, reptiles and insects, etc. along with microorganisms and fungi covering in an around 4 billion hectares area in the Earth's surface. According to the Global Forest Resource Assessment of 2010, this global forest cover occupies 31%

of the total geographical area in the planet Earth.

Nowadays, these forest resources have been threatened by the tremendous pressure of rapid population growth. The recorded forested areas or the protected forested areas have become a very dangerous condition in most of the places in the world. Most of the countries in the tropical region are severely experienced the deforestation problem due to human interference. Deforestation had been defined by FAO 2001:23 and Steven *et al.*, (2015) as "The conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold". Achard *et al.*, (2002) said that the global deforestation rate had been recorded as 13 million hectares per year.

The satellite images with the high spatial, spectral, temporal and radiometric resolution are now emerging spatial data products for land use and

land cover analysis with the help of Geographic Information System. Sajjad *et al.* (2015) said that new techniques like- Remote Sensing and GIS have been growing faster and provides a great opportunity to identify the areas of forest cover depletion. Griffiths *et al.* (2014) said that high resolution of Landsat data with a standard precision terrain correction and less than 70% cloud cover could be considered as the best data product for land use and land cover classifications. Sakthivel *et al.* (2010) assessed the forest cover change in the tropical deciduous forest region of Kalrayan hills of Eastern Ghats of Tamil Nadu using LISS III Satellite data in the years of 1931, 1971 and 2001 with the help of Remote Sensing and GIS tools.

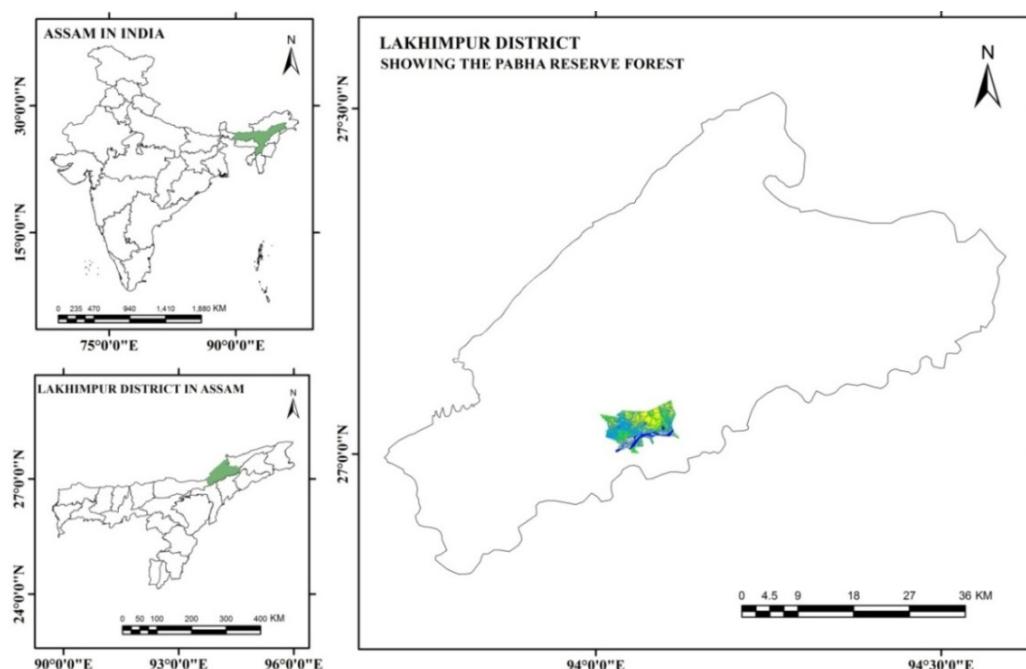
### Study Area

The Pabha Reserve Forest is located in the central part of the district and 15 km far towards the southern side from the NH-15 and Nowboicha town. The geographical extension of the reserve forest is  $27^{\circ}00'40.42''N$  -  $27^{\circ}04'38.54''N$  and  $94^{\circ}00'22.16''E$  -  $94^{\circ}07'14.19''E$ . The reserve forest was recognized by the government in the year of 1941. A part of the reserve forest has been controlled by North Lakhimpur Range Office and the rest of the part has been controlled by Harmutty Range Office. Khabalu is the only Forest Beat Office to look after the re-

serve Forest. The total geographical area of Pabha Reserve Forest was 4933.87 hectares during the time of recognition and the present geographical area is 4625.87 hectares. The 308-hectare area of the reserve forest was de-reserved by the government and forest department in the year of 1964 for settlement. Out of the total geographical area, the 1605.87-hectare area is under North Lakhimpur Range Office and the 3020-hectare area is under Harmutty Range Office.

### Sources of Data

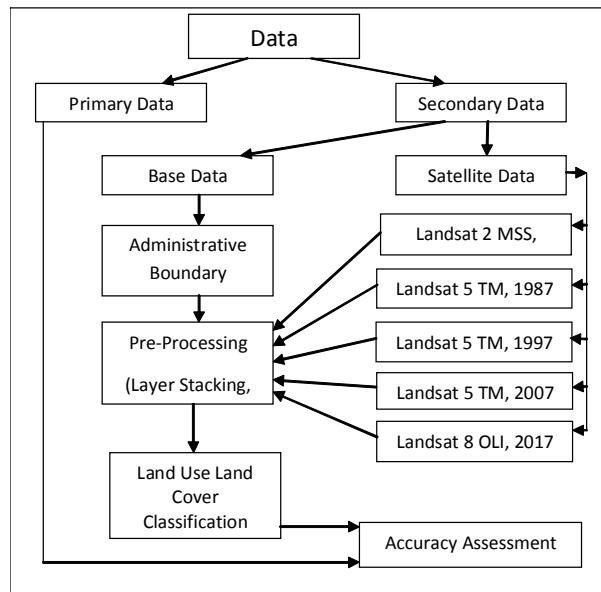
The study has been conducted based on secondary data and primary observation. The administrative map of Lakhimpur district has been downloaded from Diva GIS and the study area map of the reserve forest has been collected from the Divisional Forest Office of Lakhimpur district. The satellite data for the years of 1977, 1987, 1997, 2007 and 2017 have been downloaded from USGS Earth Explorer and ground truth points for accuracy assessment have been collected directly from the field visit with the help of GPS. The Landsat-2 MSS for the year of 1977, Landsat-5 TM for the years of 1987, 1997 and 2007 and Landsat-8 OLI for the year of 2017 have been downloaded for the forest cover change analysis.



**Fig. 1.** Location Map of Pabha Reserve Forest in the Lakhimpur District

## Methodology

To analyze the forest cover change of the Pabha Reserve forest, the Supervised Classification method has been applied with the help of ERDAS Imagine 2014 and finalized in ArcGIS 10.3. The preprocessing techniques such as layer stacking, mosaic and subset have also processed before supervised classification. The process of forest cover change analysis has been given in the following flow chart.



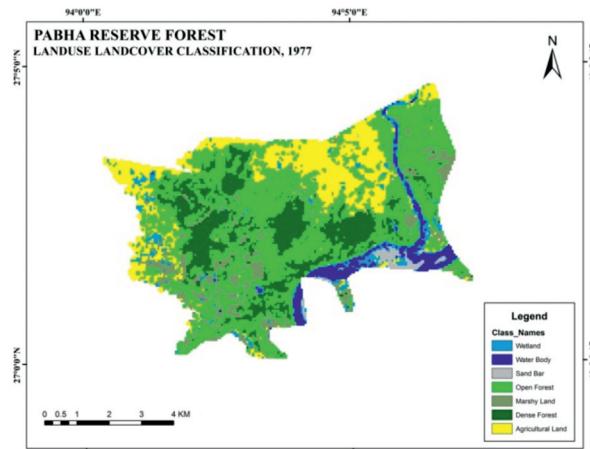
**Fig. 2.** Flow-Chart for the Data Analysis

## Results and Discussion

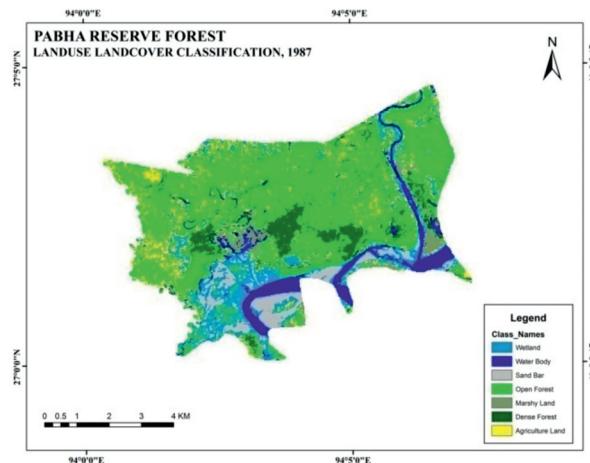
An overview of the changing trend of forest cover of the Pabha Reserve forest in the Lakhimpur district has been shown in Fig. 3, 4, 5, 6 and 7 for the years of 1977, 1987, 1997, 2007 and 2017. Seven different land use and land cover classes such as dense forest, open forest, marshy land, wetland, waterbody, sand bar, and agricultural land have been used to know the clear picture of the forest cover change in the Pabha Reserve Forest.

The classified images give a clear picture of the decadal forest cover change of 1977, 1987, 1997, 2007 and 2017. The base year 1977 has been chosen after the consultation with the local dwellers. They told that the forest had been declined from 1980 by human interferences. But the study reveals that the forest had been reduced before the base year 1977.

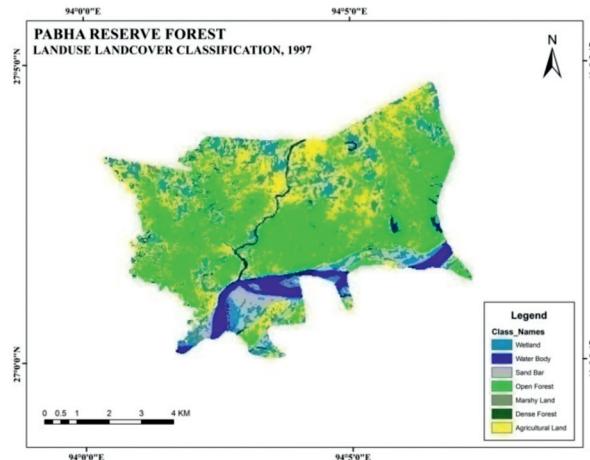
The attribute table of land use and land cover classification of Pabha Reserve Forest and the line



**Fig. 3.** Classified Image of 1977



**Fig. 4.** Classified Image of 1987



**Fig. 5.** Classified Image of 1997

graph give a clear picture of forest cover change from the year of 1977 to 2017. The dense forest and open forest areas were 8.824 and 21.031 sq km dur-

ing the year 1977 respectively. These areas show that the percentage of the area under dense forest and open forest in the Pabha Reserve Forest were 16.98% and 40.47% and the total forest area was 57.45% only. Hence, the reserve forest had been de-

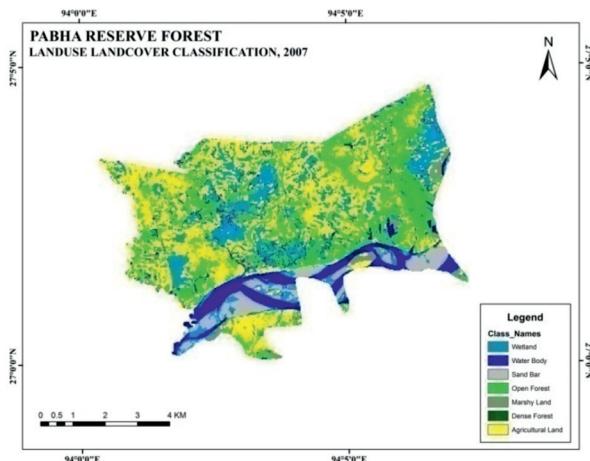


Fig. 6. Classified Image of 2007

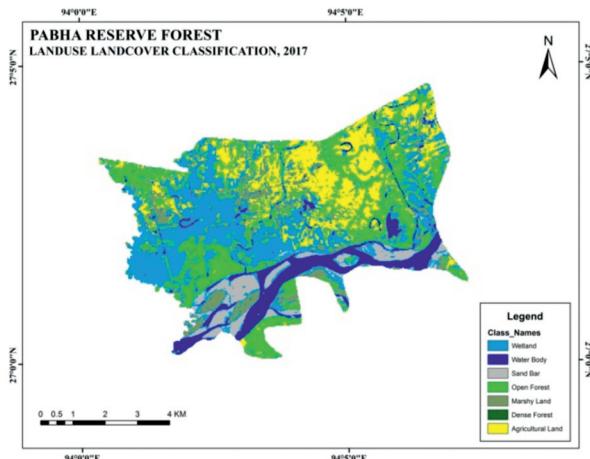


Fig. 7. Classified Image of 2017

#### Land Use and Land Cover Classes of Pabha Reserve Forest (1977-2017)

SL No.	Class Name	Area in sq km				
		1977	1987	1997	2007	2017
1	Wetland	2.218	6.098	6.612	9.581	15.381
2	Marshy Land	8.129	3.944	4.605	7.400	9.872
3	Open Forest	21.031	26.785	20.928	10.779	10.598
4	Dense Forest	8.824	3.623	0.013	0.000	0.000
5	Sand Bar	0.677	2.693	2.161	2.326	2.708
6	Water Body	2.027	3.490	3.287	4.738	4.279
7	Agricultural Land	9.061	4.028	13.055	15.836	7.822
	Total Area	51.966	50.660	50.660	50.660	50.660
	Total Forest Area	29.855	30.407	20.940	10.779	10.598

Source: Attribute Table Extracted from Classified Images

pleted before the base year 1977. The dense forest cover became 0 sq km during the year 1997 and the open forest had also been declined in every decade after 1987. The classified images of 1997, 2007 and 2017 reveals that the maximum areas of the reserve forest occupied by agricultural land, open forest, and wetland. But, the ground truth implies that these land use and land covers are nothing but the agricultural lands only. As the satellite data have been downloaded for December and January, winter crop was being started during these months and the cultivated land covered with shallow water and crops. In the southern part of the reserve, the forest had been eroded by river Subansiri started during the year of 1987.

To prove the existence of agricultural activities during the years of 2007 and 2017 in the reserve for-

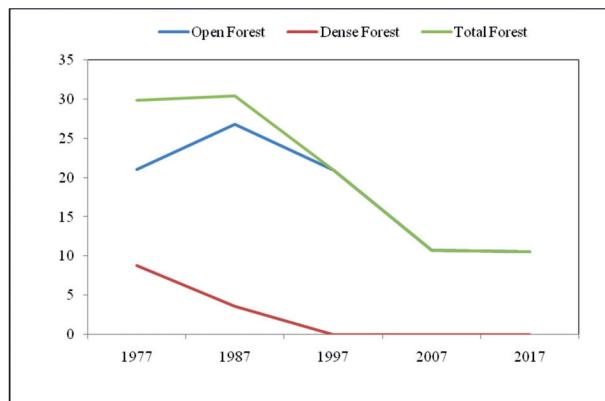


Fig. 8. Changing Trend of Forest Covers of Pabha Reserve Forest from 1977 to 2017

est area, two images from Google Earth have been attached here. The settlements are so much scattered, therefore, it is difficult to identify in the images.



Fig. 9. Google Image of 2007



Fig. 10. Google Image of 2017

### Accuracy Assessment

The following two formulae have been used to assess the level of accurateness of the classified images.

$$1. \text{Overall Accuracy} = \frac{\text{Total Number of Correctly Classified Pixels (Diagonally)}}{\text{Total Number of Reference Pixels}} \times 100$$

$$2. \text{Kappa Coefficient (T)} = \frac{(TS \times TCS) - S (\text{Column Total} \times \text{Row Total})}{TS - S (\text{Column Total} \times \text{Row Total})}$$

Based on these above two formulae the Overall Accuracy of the year 1977, 1987, 1997, 2007 and 2017 have been found 83.33%, 74.07%, 75.86%, 79.31%, and 70.97% respectively and the Kappa Coefficient of the same years have been found 0.797, 0.695, 0.710, 0.745 and 0.632 respectively.

### Conclusion

The study has been conducted to know the present status and changing trend of forest cover in the Pabha Reserve Forest of Lakhimpur district of

Assam. The base year 1977 has been chosen for the forest cover change analysis based on the interaction conducted with the local dwellers. The study reveals that the forest cover had been reduced before the base year 1977.

The reserve forest has been declined only because of the human interferences since the decade started in the 1970s. Only some open forest areas have been observed during the year of 1997. Agricultural activities and human habitats have been observed in the classified images of 2007 and 2017 as well as during the field visit.

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