Forest Cover Change in Amchang Wildlife Sanctuary, Assam, India

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Abstract: *Assam is one of the most forested states in India. These forests support a large number of important species and endemics and have great significance for global efforts in biodiversity conservation. Therefore the need for assessment and monitoring forest cover change has become essential in managing natural resources and observing environmental changes. In this paper an attempt has been made to detect the landuse/landcover changes before and after institutional change (1989-2011) of Amchang Wildlife Sanctuary, Assam. The study was carried out through Remote Sensing and GIS techniques using SOI toposheets and Landsat imagery of 1989 and 2011. The present study has brought out that the water bodies and moderately dense forests decreased sharply during the 22 years period by 17.64% and 50.35% of hectares. On the other hand the dense forest and open forest area increased by 13.35 % and 2% of hectares. Most of the dense forest and moderately dense forest area has converted to open forest and non-forest area. Non-forest area like settlement area has increased to 49.96% of hectares during the 22 years period.*

Keywords: Land-use/land-cover, change detection, Amchang Wildlife Sanctuary, Assam.

1. Introduction

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LULC change can be generated by either natural or human-induced factors or by a combination of the two (Coppin et al., 2004; Mannion, 2002). The drivers of land cover changes include local and contiguous physical, socioeconomic, and demographic factors, as well as global and regional climatic change. The increase in population and human activities are increasing the demand on the limited land and soil resources for agriculture, forest, pasture, urban and industrial land uses (phukan.et.al 2013). The main objective of this paper is to analyze the land use and land cover changes in Amchang Wildlife Sanctuary, India. Using temporal and multi temporal remote sensing data (LANDSAT TM 1989 and 2011) landuse and land cover changes has been performed. One of the main objectives of this study is to enumerate landuse/landcover changes, specifically the changes in forest area at a suitable level of classification. In order to assess vegetation status supervised classifications were performed for 1989 and 2011 to compute the forest loss. Thereafter the results of the two classifications were compared to identify which segments of forest areas were degraded or otherwise during the period under study.

2. Study Area

Amchang Wildlife Sanctuary is situated on the southern bank of mighty Brahmaputra and lies entirely within the civil district of kamrup and located within the geographical limits of $91^0 55'$E longitude and $26^0 10'$ N latitude. The total area falls within the Survey of India Toposheet No. 78 N/12 (see Fig1). The sanctuary falls under East-Kamrup Forest division of Kamrup district. Of Amchang's 78.64 sq km area, 7.7 sq km are under encroachment, including settlements that had been there prior to its upgradation to a sanctuary in 2004. The sanctuary, comprising Amchang, south Amchang and Khanapara reserve forests, is spread over 7,864 hectares. The sanctuary has 44 species of mammals, including elephants, leopards, wild dogs and bisons. The official said villages, located on the fringes of the sanctuary, would be covered under various eco-development projects. The US Fish and Wildlife Service have also shown interest in the conservation of the rare species found at the sanctuary. They have pledged their support for a project on gibbon conservation (FSI report 2009). But due to several factors including forest fire, resort development, illegal settlement etc, were responsible for significant decreases in vegetation and wildlife.

3. Methodology

In this study, Landsat Thematic Mapper and Enhanced Thematic Mapper Plus imageries were used to estimate the amount of above-ground landuse and landcover by means of supervised classification of the study area in Erdas Imagine 8.5 software. The imageries were with the spectral range from 0.45 μm to 2.35 μm, and the bands used were 1, 2, 3, 4, 5 and 7; excluding band 6 which is a thermal band. This software consists of accuracy assessment tool. The land use land cover map should be in raster format to run this tool. By applying random points in accuracy assessment window we got accuracy report which contains overall classification accuracy. Accuracy assessment verification using standard measures such as user accuracy, producer. Accuracy and Kappa accuracy were performed to assess the correctness of the classifications. Accuracy assessments showed encouraging results ranging from an overall accuracy of 83.75% for 2011 respectively and Kappa accuracy of 0.7418 (2011). Ground checking is also done by collecting GPS points to make the validation of result gained for different land use characteristics.
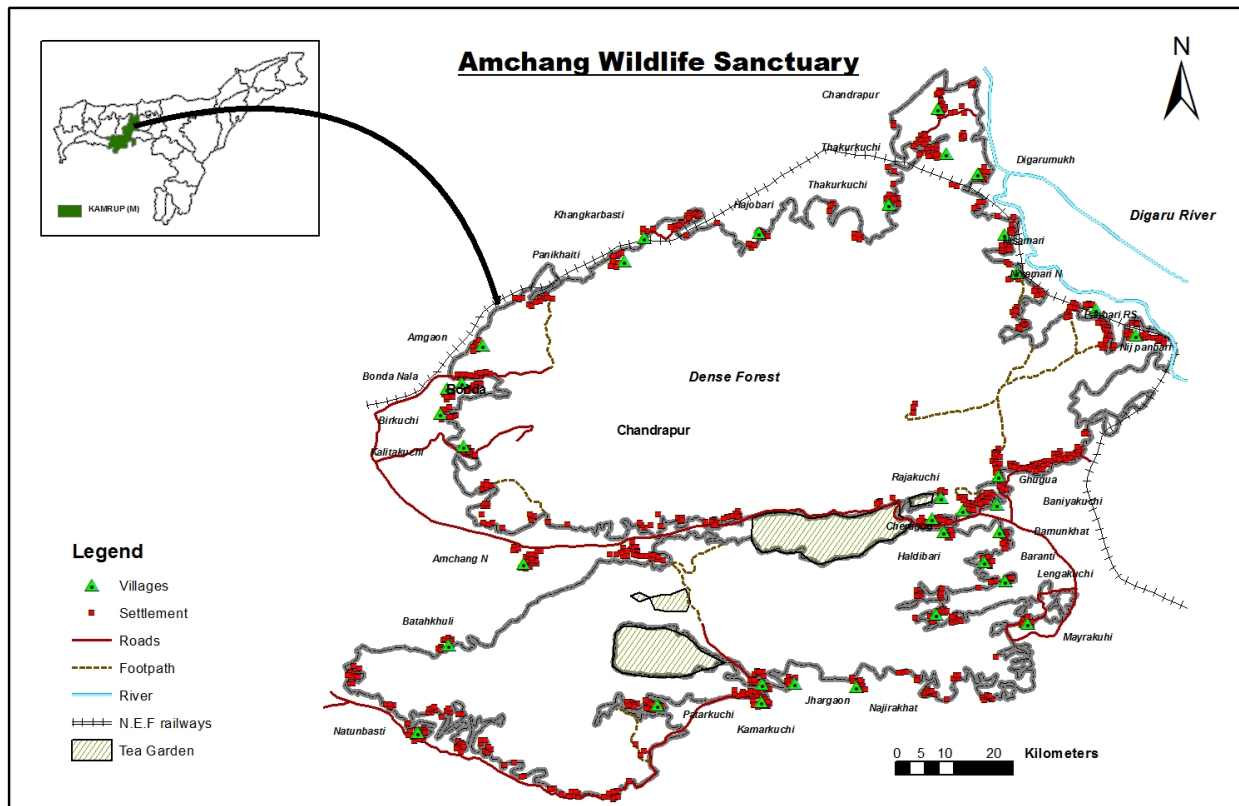

Figure 1: Location Map Of Amchang Wildlife Sanctuary [Source: Topographical map, Survey of India No. 78/12 and 78/16].

I. **TABLE 1:** DETAILS OF THE SATELLITE IMAGERIES USED IN THE STUDY

Data Type	Resolution (m)	Row-Path/ Grid	Acquisition period / Downloaded
Landsat TM	30	42/136	1st February 1989
Landsat TM	30	42/137	31st April 2011

There are several methods of image processing applied for landuse/landcover change studies, but among them, there is an inclination for the supervised classification method.. Landsat images pertaining to two periods i.e. 1989 and 2011 were used to assess the changes in the forest cover Erdas Imagine 9.1 and Arc GIS 9.3 software (ESRI Inc., Redlands, CA, USA) were used to carry out the image processing,

database creation and spatial analysis. All images were georeferenced to Survey of India maps and to each other and then all scenes were radiometrically corrected using dark pixel subtraction method. The study is not covered by a single scene of Landsat, so a mosaic operation was done to get a single image from two scenes for each year and the histogram matching was done to correct the radiometric differences prevailing in mosaics. After acquiring a mosaic, all the scenes were arranged according to the study area using the digitized boundary of the study area.

The study area i.e Amchang Wildlife Sanctuary was classified into five classes. As the study is concerned more with the changes in the Sanctuary areas, all the area outside the Sanctuary except rivers and sands were grouped as non-forest area. The other classes are open forest (includes mainly moist deciduous forest), dense forest (contains mainly sub-tropical evergreen and tropical semi-evergreen forest), degraded forest (includes also moist deciduous forest), water bodies and settlement.The resulting landuse/landcover maps were analyzed and attribute values were compared to detect the vegetation changes.

The created signatures were evaluated for separability and contingency and then an accuracy assessment was done for each classified image with the help of 400 randomly generated points throughout the classified image using 'equalized random' distribution parameters. For each class, a total of 80 random points were collected as reference points.

The classified maps were converted into shape files to carry out the geoprocessing in ArcGIS software. The intersect operation was done to generate the combined single map of 1989 and 2011 with all the attributes. Areas were calculated and by comparing the attribute values for each year the changes were detected as accordingly.

4. Results

The analysis and comparisons were performed on the basis of the classification results of two different year (1989 and 2011). The landcover types of Amchang Wildlife Sanctuary as estimated in 1989 have been depicted in figure 3. More emphasis was given to the forest cover types within the Wildlife Sanctuary areas and all the non-forest areas including settlement, tea garden, non-agricultural land etc. were grouped as a single class. The result indicate that in 1989, the moderately dense forest category includes moist deciduous forest occupy maximum area of the sanctuary followed by dense forest which includes sub-tropical evergreen and semi-evergreen forest. The open forest category also includes moist deciduous forest which is the highly affected forest in the study area. Another important category is the settlement which is one of important factor causing deforestation in the study area. During the period 1989 the human settlement was less in comparison to 2011 which has been increasing tremendously.

II. **TABLE 1:** LULC CHANGE IN AMCHANG WILDLIFE SANCTUARY. AREAS ARE IN HECTARES AND NEGATIVE SIGNS DENOTE A DECREASE

| Landuse Category	Landuse(1989) in hectare	Landuse(1989) in %	Landuse(2011) in hectare	Landuse(2011) in %	Landuse/landcover change (in %) 1989-2011
Dense Forest	1428.37	18.16	1619.13	20.58914039	13.35
Moderately dense Forest	2530.18	32.17	1256.1	15.97278739	-50.35
Open forest	1165.3	14.81	1187.7	15.10300102	2
Water Bodies	456.1	5.79	375.62	4.776449644	-17.64
Settlement	2284.05	29.04	3425.2	43.55544252	49.96
Total	7864	100	7864	100	
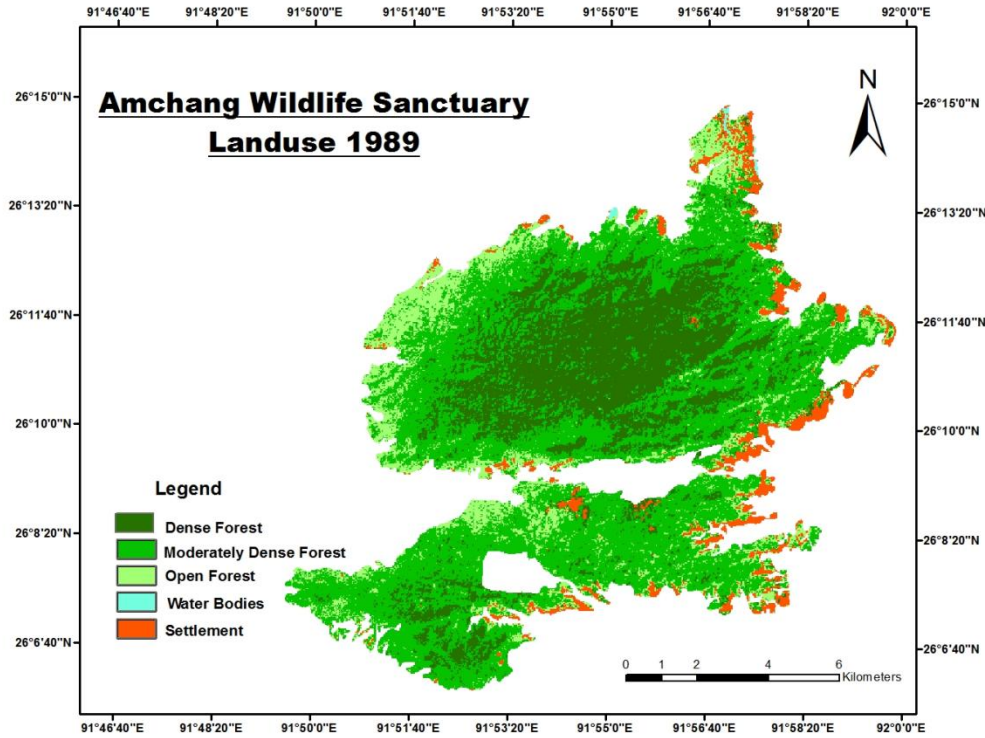
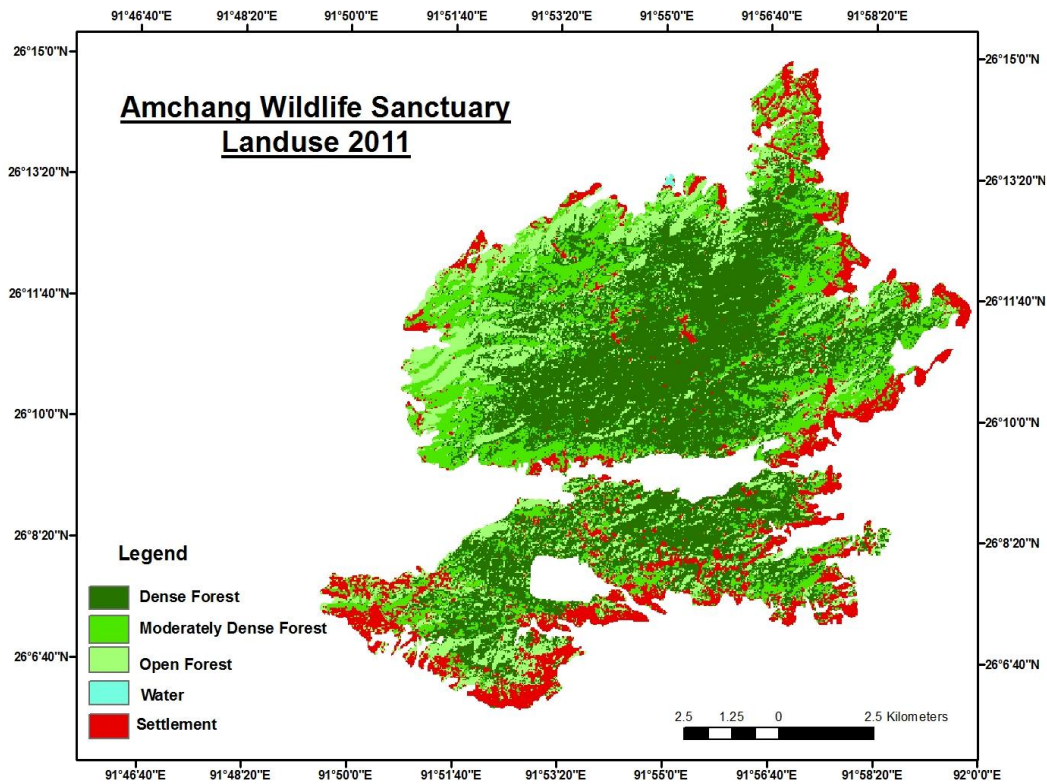**Figure 2**: Landuse/landcover map of Amchang wildlife Sanctuary 1989.

Figure 3: Landuse/landcover map of Amchang wildlife Sanctuary 2011.

The Moderately dense forest landuse category (LUC) registered maximum losses during the 22 years period, losing an area of 1274.08 hectares (-50.35%). Dense forest and open forest category increase an area of 190.76 hectares (11.35%) and 22.4 hectares (2%). On the other hand non-forest area like water bodies lost an area of 80.48 hectares (-17.64%). Most of the dense forest and moderately dense forest LUC area has converted to open forest and non-forest area. Non-forest area like settlement area has increased upto 1141.15 hectare (49.96%) during the 22 years period.

Fig. 4 shows thrashing and expanding of the landuse/ landcover class and it clearly indicates that except for the non-forest area all of them are decreasing and so there are losses of forest cover. There is some increase of dense forest category in 2011; it is due to the afforestation programme under taken by the institution and settlers. But the open forest area was occupied by the settlers who also started their agricultural activities. Some of the water bodies were disappeared in the year 2011. The area which was degraded in 1989 was occupied by settlers in 2011. Due to faster growing population near the forest area as well as in the fringe villages naturally available forest resources in a sustainable manner are becoming inadequate for their basic livelihood. Many rural people are engaged in farming and cattle rearing in the forest areas causing irreparable damage to forests. The erstwhile protectors of forests are slowly turning into the bane of forests and its wildlife.

5. Conclusion

Researchers envisage that the Southeast Asia has the highest rates of forest loss and degradation (Achard et.al, 2002). LULC variables describing the variety and structure of landscapes may be used as alternative to assess the diversity of certain types of habitat dependent species (Moser et al., 2002), and the increasing disintegration in Amchang WLS could have caused a decline of such species. In this context the finding of a recent study are relevant encroachment and illegal tree-felling have turned into a heavy threat for the eastern part of Amchang WLS, with almost one-tenth of its area officially stated to be under human settlement, and no government intervention in sight. What is more worrying is that the existing settlements are encouraging more encroachment, with the forest authorities themselves admitting that the steps taken to contain encroachment are "inadequate" to meet the situation. The failure of the Forest Department and the State Government to effect the final demarcation of the sanctuary's boundaries is aggravating matters. There were about more than 200 households settled in the area. The rapid encroachment of forest land in the Amchang Wildlife Sanctuary which is going on unchallenged by the local authorities is threatening to lay bare the wooded hills. If conservation is to thrive in the Sanctuary and its buffer areas, ways and means of controlling the problem of encroachment must be rapidly sought before further habitat loss and degradation arise. The government should devise schemes to avert this process and save the dwindling forest area and its flora and fauna. The rural people have extraordinary understanding of forest flora and fauna which can be productively utilized. They should be employed by the government in the expansion and protection of forests and its wildlife till their descendants get educated and diversify into industrial and service sectors.

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