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People within Park: forest cover dynamics and management strategies in Dibru-Saikhowa National Park, India

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ABSTRACT

In India, forest conservation goes synergistically with human welfare, as millions of people live within protected areas and relies upon forests products, and many ecologically sensitive forest areas were declared as protected areas. Based on the analysis of multi date remote sensing satellite imagery data, the extent of forest degradation within the Dibru-Saikhowa national park have been quantified. The study revealed that the remote sensing and GIS technology are more suitable tools to map, monitor and manage the forest resources. Statistics derived through forest canopy model (FCD) revealed that most of the changes in forest cover in the park occurred in dense forest, moderately dense forest and non-forest categories during the period 1988–2018. Presence of two forest villages in the core area, viz. Laika and Dadhia, habitat destruction through expansion of agriculture, logging, clearance for settlement, and floods are major threats to the forested area of Dibru-Saikhowa. Restoring the integrity of dwindling forest cover in the park is being an urgent priority for current conservation efforts to halt the ongoing biodiversity crisis.

Key words : *Forest cover change, Forest canopy density, Forest villages, Management strategies.*

Introduction

The formal declaration of protected areas began after independences in India in 1947, but exclusionary approaches to forest conservation have a longer history from colonial period. However over the past four decades, nearly 25 million hectares of land that originally had tree cover has been laid bare for agriculture and other anthropogenic activities (Adhikari *et al.,* 2014). To protect the country's forest cover, India has created six national parks in 1970 to 89 national parks by the end of twentieth century (MOEF, 2002). This approach of conserving forest resources is popularly known as fortress conservation which restricts resource extraction and anthropogenic activities inside the protected areas (Blaike and Muldavin, 2004). Conversely, nearly 65% of protected areas in India are characterized by human settlements and resource extraction. It has caused high deforestation rates inside the protected areas. Understanding forest cover change within the protected areas is very important in developing nations such as India as these areas have a large forest cover, experience dynamic change in human population, land use/cover, and are characterized by socio-political and biological risks not usually found elsewhere. Land use/cover change, coupled with socio-political transformations inside the protected areas, may affect the forested landscape through changes in its effective size, ecological flows into and out of the reserve, and increased exposure to edge effects and human pressures such as agricultures, fires, invasive species and hunting. Thus, the major objectives of the study were 1) to assess temporal pattern of forest cover change in Dibru-Saikhowa national park; 2) to understand the major threats as perceived by the park management; and 3) to understand the management strategies to conserve the biodiversity of the park

Materials and Methods

Study area

Dibru-Saikhowa national park is situated on the South Bank of the river Brahmaputra in the extreme east of Assam. The national park is predominantly spread over two civil districts of Assam, namely Tinsukia and Dibrugarh. There are two Ranges for management of the Dibru-Saikhowa National Park. The eastern part of the Park falls under the Saikhowa Wildlife Range and the western part of the Park falls under Guijan Wildlife Range. The area of the Dibru-Saikhowa biosphere reserve is 765 sq km which is managed on a core-buffer strategy (Mathur, 2012). 340 sq km of the area constitutes the core (Dibru-Saikhowa national park) while the remaining 425 sq km constitutes the buffer. 160 and 180 sq km of the core area are managed by Guijan and Saikhowa Wildlife Ranges respectively. The entire periphery of the biosphere reserve runs for approximately 202 km while that of the core runs for 155 km. The river Lohit and streams of Kundil and Noa-Dihing rivers constitutes the southern boundary and a perpendicular line along the western boundary of the Dibru-Saikhowa National park up to the Dibrugarh-Guijan PWD road constitutes the western boundary.

The area of the park consists of a single ecological unit which is basically a flood plain of the river Brahmaputra and Siang in the north, Lohit and Dibang to the east, the Anantnala to the south east and the Dangori and Dibru in the south. The entire area is traversed by several rivulets and is completely inundated in the monsoons. The area literally being an island, it can be said that the legal

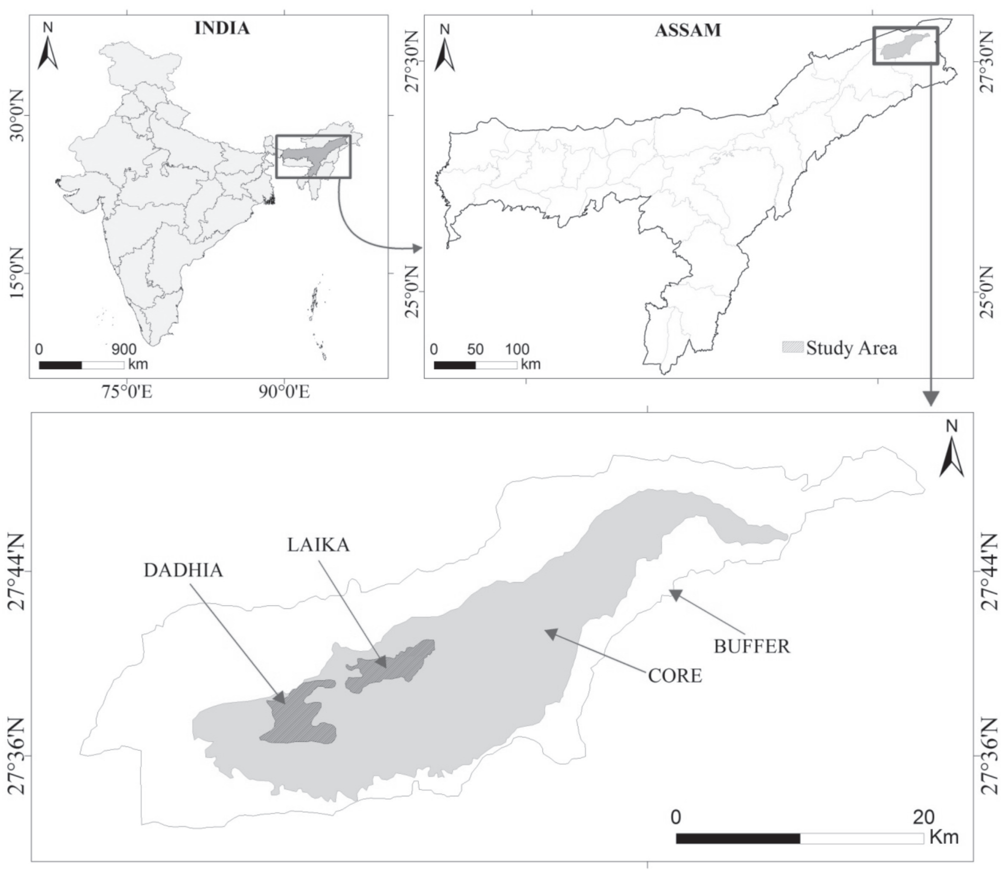

Fig. 1. The location of the Dibru-Saikhowa national park.

boundaries accord with ecological requirements. Save for elephants, and occasionally tigers, which migrate in and out of the core, the area form an isolated fluvial ecosystem subject to vagaries of the monsoon and accompanying floods. The park is very rich in flora, being in the transition zone of two major biodiversity hotspots, i.e. the Indo-Burma global biodiversity hotspot (Myers *et al.,* 2000). The varied habitat types support fauna which is as diverse and adapted to life in terrestrial, aquatic and arboreal ecosystems. The park experiences the monsoon regime of the sub-tropical belt. It enjoys heavy summer rainfall, dry winter, high humidity and relatively low temperature during a year. However, winter rainfall is not uncommon in the area. The annual rainfall is 2,300–3,800 mm and the temperature ranges from 7 °C–35 °C. The core is home to 36 species of mammals, 500 species of birds, 105 species of butterflies, 104 species of fish, 11 species of turtle, 18 lizard species and 23 species of snakes along with 38 species of orchids.

Remote sensed data and analysis

Landsat 5 Thematic mapper and Landsat 8 Operational land imager satellite imagery for the year 1988 and 2018 were selected for forest cover classification of the study area. Selection of the dates for this imagery was based on minimal cloud cover, time of year, and the time frame in which forest change could be monitored. FCD Mapper V2 (ITTO/JOFCA, 2003) was used to examine the temporal forest cover dynamics in the park. The forest canopy density (FCD) model comprises bio-physical phenomenon modelling and analysis utilizing data derived from four (4) indices: Advanced Vegetation Index (AVI), Bare Soil Index (BI), Shadow Index or Scaled Shadow Index (SI, SSI) and Thermal Index (TI) (Rikimaru *et al.,* 2002). It determines FCD by modelling operation and obtaining from these indices. The methodology of the FCD model is illustrated by a flow chart (Figure 2).

Five FCD classes were categorised according to FCD percentage obtained for each pixel of forested land. These classes were dense forest (FCD >70%), moderately dense forest (FCD 41-70%), open forest (FCD 11-40%), scrublands (FCD 1-10%) and non-forest (FCD 0%). To validate the FCD estimation by FCD Mapper for 2018 data, the canopy cover was measured on the ground using a convex spherical densiometer (Forestry Suppliers Inc., Jackson, MS,

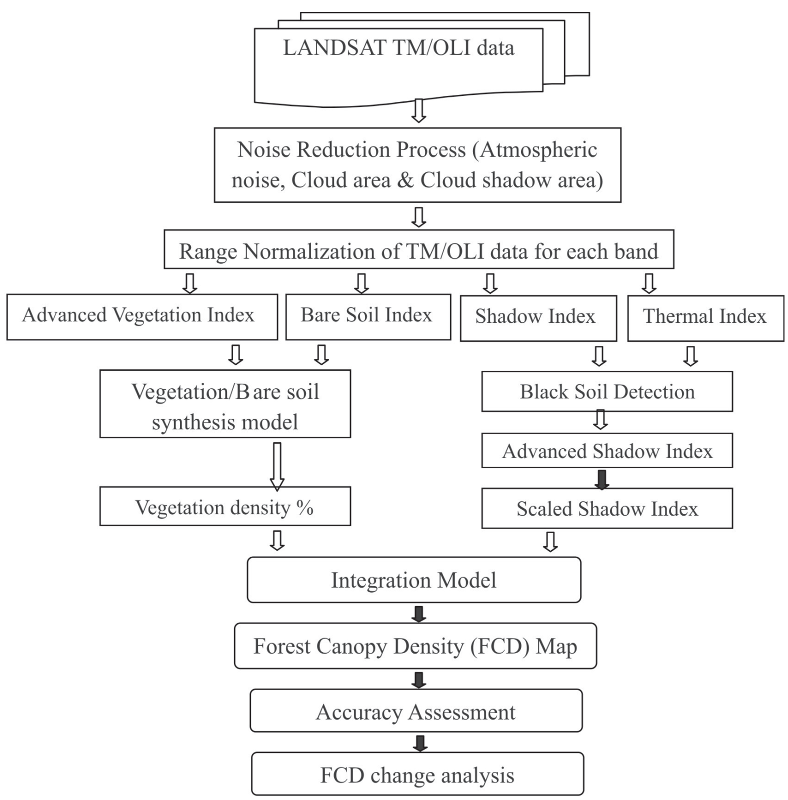

Fig. 2. Flow chart showing the steps followed in determining forest canopy density.

USA) during November and December 2018 to coincide with the time of year that the image was acquired to minimize possible errors. The sample plots (n = 127) were selected using stratified random sampling. The size of the sample plot applied was (10 × 10 m) with a minimum 500 m interval to sample each canopy density class in the study area. In each plot, canopy density was measured at five survey points (four corners and the centre of each plot) and average reading was calculated to get percentage of forest canopy density.

Results and Discussion

Extent of forest covers change

Accuracy is estimated from the error matrix over the training class, in terms of percentage of number of correctly classified category against the total number of classes, viz., dense forest, moderately dense forest, open forest, scrublands and non-forest. The error matrix of measured and estimated classes of forest cover indicated the accuracy of the FCD Mapper in classifying forest cover, that is 114 of 127 observations were correctly classified with an overall accuracy of 87.47% and a kappa coefficient of 0.89. Overall analysis of FCD indicates that most of the forest in the study area has canopy density of 41-70% (moderately dense forest) in all the study years. Temporal variations of forest cover are apparent from the forest cover maps of 1988 and 2018 where dense and moderately dense forest decreased substantially over year. On the other hand, non-forest, open forest scrubland classes accrued significantly during the period 1988-2018. These categories were mostly the result of degradation of dense and moderately dense forest coupled with the regeneration of secondary forest in degraded forest lands.

Major threats to the national park

Two enclave forest villages, viz. Laika and Dadhia are located in the northern and western side of the national park under Guijan Wildlife Range. Though their original allotted area was 373 ha, they are now occupying more area, gradually encroaching upon land as their families are increasing. An analysis using satellite imagery and GPS trackmaker software has revealed that Dadhia village currently occupies an area of 1571 ha (originally 135 ha) while Laika occupies 1138 ha (originally 238 ha). These villages are completely dependent on forest. The villagers of the two enclave villages are mainly of Mising community (Schedule Tribe). They have their own traditional identities and culture. With their burgeoning population and inward movement

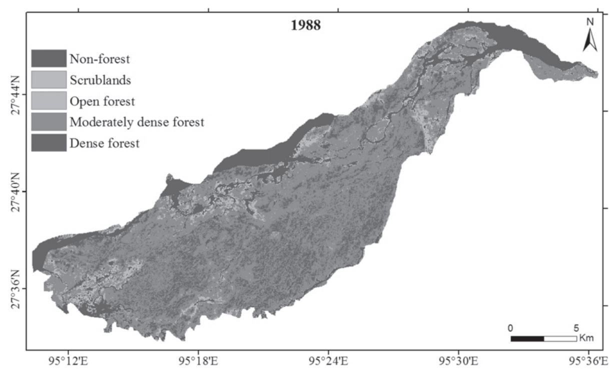

Fig. 3. Forest cover map for the year 1988.

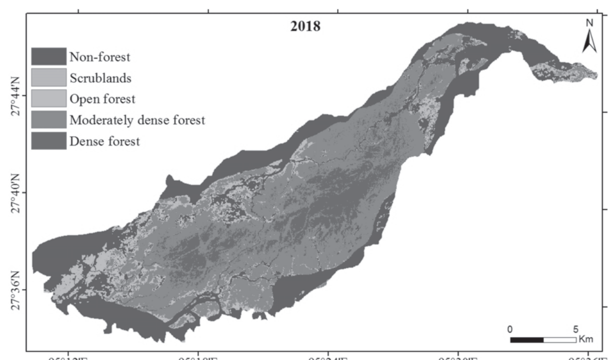

Fig. 4. Forest cover map for the year 2018.

Table 1. The extents of forest cover change in Dibru-Saikhowa national park.

Forest types	Area (ha)		% change	ha/year^{-1}
	1988	2018		
Dense forest	6,515.05	4,026.22	-38.20	-82.96
Moderately dense forest	19,322.09	14,436.74	-25.28	-162.85
Open forest	2,329.43	3,376.86	44.96	34.91
Scrubland	163.09	440.28	169.96	9.24
Non-forest	5,662.6	11,712.16	106.83	201.65
Total	33,992.26	33,992.26		

due to erosive river forces all around, they are gradually eating up the core area. More and more land is being cleared for agriculture and establishment of *khutis* (cattle farm) to earn a livelihood. With people adopting an attitude of looking beyond their bona fides use and indulging in such business practices, it is becoming increasingly difficult for park management to clear newly encroached areas. While the notification declaring the area as a sanctuary permitted members of Laika and Dadhia to enjoy their rights, the National park notification is silent on this aspect and has left park management in a dilemma. Being traditional fishermen and hunter-gatherers, the presence of Laika and Dadhia is exerting probably, the most detrimental effect on Dibru-Saikhowa National park. It is hard to achieve adequate protection with these two villages in the core area.

Taking advantage of the dismal manpower scenario in the park, *khutis* (cattle farm) keep cropping up on a regular basis. The presence of Erasuti village in Guijan range and Ajukha village in Saikhowa range is another source of livestock entering the park. The villages claim to be on non cadastral land but imagery data has shown that both lie within the national park boundary. If not nipped in the bud, a situation similar to Laika and Dadhia is foreseeable in the not so distant future. While removing the cattle camps is not a painstaking task, capturing the entire livestock and their subsequent disposal is an issue of concern. No dedicated funds are received for such an exercise and neither is any area or space available for putting the cattle. Annual floods with periodic high-level flooding, and erosion by water channels are major natural threats to the area. Erosion by the Brahmaputra and Lohit rivers has already taken away large chunk of forest land of the park.

Management strategies

To ensure the persistence of existing forest covers and wildlife through enhanced protection and habitat management, the national park is divided into the four sub zones viz. Grassland zone, Woodland zone, Tourism zone and Rehabilitation zone. Grassland zone: Almost 22% of the core area is grassland which has not been maintained scientifically over the years due to lack of staff and erratic supply of funds. This habitat forms the requirement of many species including birds such as the Black Breasted Parrotbill which is range restricted to Dibru-Saikhowa. Grasslands also form the base trophic level in the carnivore food chain for which it is essential to maintain them annually. This zone is covered by nearly 50 sq km of the area. However, interventions are restricted based on availability of funds and prevailing human resource scenario. Woodland zone: 35% of the core area approximating 85 sq km has been subject to erosion, siltation and illicit felling over a period of time. This has created gaps in several areas which need to be put under artificial regeneration and aided natural regeneration. It was

Table 2. Schedule of management strategies of Dibru-Saikhowa national park.

Activity	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Construction and civil works	■	■	■						■	■	■	■
Highland construction	■	■	■									
De siltation	■	■	■									■
Grassland Burning	■	■										
Creation of grass exclosures				■	■							
Removal of obnoxious species			■	■								
Maintenance/Clearance of patrolling paths									■	■		
Protection Activity	■	■	■	■	■	■	■	■	■	■	■	■
Research/ Monitoring/Training	■	■	■	■	■	■	■	■	■	■	■	■
Eco Development	■	■	■	■	■	■	■	■	■	■	■	■

proposed to address this issue through this zone. Tourism zone: This zone will be created to streamline and regulate tourism in the core area which is currently being undertaken on the whims and fancies of local eco tourist operators. Rehabilitation zone: This zone will be created in the 2700 ha occupied by Laika and Dadhia, but is subject to achieve subsequent to rehabilitation only.

Protection will be accorded top most priority in management of Dibru-Saikhowa national park. There are threats from poachers, *khuti*, fishermen and floods. All four issues need individual attention. To safeguard wild animals against the floods, highlands will be needed based on topographical features as well as from the security point of view as and when required. There is immense potential for ecotourism to flourish in the park. Owing to the incessant rains experienced in the park area beginning April onwards, there is a very narrow time window available to carry out most works. Schedule of operations is presented below based on the activities identified in the management plan of the park (Table 2).

Conclusion

This research set out to quantify and understand the forest cover change and management strategies within the Dibru-Saikhowa national park from 1988 to 2018 by determining the spatio-temporal dynamics of the landscape. The use of remote-sensing and GIS techniques allowed for assess temporal pattern of forest cover change using an innovative combination of continuous and thematic approaches to the analysis. The field observations and informal interviews with the local respondents supported the results by giving information on forest cover change, management strategies and major drivers behind the forest change dynamics. On the other hand, forest canopy density is one of the most useful parameters to consider in the planning and implementation of afforestation and reforestation of logged over areas. Forest cover is of great interest to a variety of scientific and land management applications, many of which require not only information on forest types, but also tree canopy density.

References

Adhikari, S., Southworth, J. and Nagendra, H. 2014. Understanding forest loss and recovery: a spatiotemporal analysis of land change in and around Bannerghatta National Park, India. *Journal of Land Use Science*. 10(4) : 402–424.

Blaike, P. and Muldavin, J. 2004. The politics of environmental policy with a Himalayan example. Asia Pacific. 74: 1–8.

ITTO/JOFCA. 2003. FCD-Mapper Ver. 2 User Guide. International Tropical Timber Organisation and Japan Overseas Forestry Consultants Association. Yokohama, Japan.

Mathur, V. C. 2012. Management plan: Dibru Saikhowa Biosphere Reserve 2011-12 to 2015-16, Tinsukia Wildlife Division.

MOEF. 2002. National wildlife action plan (2002.2016). New Delhi: Ministry of Environment and Forests, Government of India.

Myers, N., Mittermeier, R., Mittermeier, C., da Fonseca, G. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature*. 403: 853–858.

Rikimaru, A., Roy, P. S. and Miyatake, S. 2002. Tropical forest cover density mapping. *Tropical Ecology*. 43(1): 39–47.