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Forest Cover Dynamics in South West Bengal, India: A Regional Perspective

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ABSTRACT

Rapid automated detection of forest loss locations is crucial in India, where forests cover 21% of the country and are monitored annually via satellite. Various investigations have been conducted to monitor forest health, but no single source of reporting data is completely reliable. Many forestry agencies and governments are using GIS and Remote Sensing (RS) to monitor changing vegetation patterns. This paper focuses on south West Bengal, specifically six districts: Bankura, Burdwan, Birbhum, Midnapore (East and West), and Puruliya from 2001 to 2007. The study found that forest cover in the districts varied from stable to gradually increasing. The abundance of forest in this area provides adequate shelter for the animals that live there.

Introduction

Forests are extremely important. Forests play a crucial role in our survival, providing us with oxygen and wood. Forests not only provide habitat for animals and human livelihoods, but also protect watersheds, prevent soil erosion, and help mitigate climate change. Forests cover one-third of all land on the planet, and nearly half of all known species live there, accounting for 80% of terrestrial biodiversity. They support 1.6 billion human livelihoods, but humans are responsible for 32 million acres of deforestation each year. Sustainable development and a more environmentally friendly economy can greatly benefit from well-managed forests. There is an urgent need for quick automated detection of forest loss locations because 21% of India's land is covered by forests, and satellite remote monitoring is done every two years. If an effective response to forest loss is to be implemented, this is crucial. Global

climate change has been linked to the conversion of forests. Global mitigation strategies now include forest management.

Review of Literature

Global forest resources were first discovered in 1923, and FAO started tracking changes in forest resources in 1948. Numerous studies have been conducted to monitor the health of forests, but no single source of reporting data is entirely sufficient. The structural characteristics of a stand's trees, such as canopy layering, tree size variation, species richness, and tree spatial arrangement, are the focus of international literature. FAO and the EC Joint Research Center started analyzing Landsat data in 2009 to evaluate change in the use of forest land. The effectiveness of remote sensing as a tool for forest resource monitoring led to about 100 satellites that observe the earth. The NRSA began monitoring forest cover in the 1980s, and after technology was transferred to the Forest Survey of India (FSI), 11 biennial assessments have been completed to date. According to recent reports, there are certain hotspots of deforestation that happen all year long throughout the nation. Recently, NRSC has been studying the spectral and spatial patterns of forest cover in long-term IRS AWiFS data sets. The IRS-1A LISS II data from November 1991 was employed to segregate various forest types and three density classes in the Darjeeling, Jalpaiguri, and Cooch Behar districts of North Bengal, West Bengal, India, using remote sensing techniques. Although Pattnaik et al. conducted some research on joint forest management in south West Bengal, the coverage has never been compared. Recently, Halder conducted a mapping study in the Paschim Medinipur district's Binpur block.

Application of Geospatial Technology in Forest Resource Management:

Mapping forest cover requires the use of GIS and RS technologies. The forestry industry is involved in natural resource management. Geographic Information Systems (GIS) and remote sensing (RS) are currently being used by numerous state and private forestry agencies as well as the government for a variety of purposes, primarily to support forest analysis, assessment, and management. Geospatial data is also used by national forestry organizations. Understanding ground conditions and making strategic decisions both benefit from geographic data with spatial dimensions. For foresters, spatial data is crucial for forest management, conservation, and prevention planning, as well as for the future state of the world's forests. Deforestation is identified using various RS data. Additionally, using GIS maps, various temporal satellite image data can offer statistical analysis of forest cover and information about deforestation. When it comes to representing forests through graphs, maps, and other GIS statistical modeling features, GIS is very helpful. Forest cover data from DEM (Digital Elevation Modeling) is

helpful for GIS analysis. Additionally, it is helpful for examining different aspects of the terrain, the movement of soil and the influence of nutrients from it, and the resulting effects on the distribution of plants, forests, and wildlife productivity.

Study Area

This paper focuses on six districts in south West Bengal: Bankura, Burdwan, Birbhum, Medinipur (East and West), and Puruliya (Figure 1). East and West Medinipur are naturally divided into two sections: the western part of the district is undulating, while the eastern part has alluvial soil. A large portion of this region is flooded, particularly the area bordered to the north by the Silai River and to the south by the Kasai River. The district of Bankura is divided into two separate sections: the deltaic tract of the Ganga River is located in the east, while the western section features isolated hills and undulating uplands. There are numerous excavated tanks in addition to natural lakes or riverine wetlands. The Puruliya district connects the plain of Damodar in West Bengal with the hills of central India and the Chotanagpur plateau. The district has a gently rolling topography with sporadic hard rock hillocks. Geographically the forest area under this Division is lying between latitude: 22°42′35” N - 23°43’18” N; longitude: 85°48’47” E - 86°54’13” E. and covers an area of forest land in an around 62 thousand hectares. There are many degraded areas with the rivers Bhagirathi and Ajay in the lower Damodar valley in Barddhaman, which is a prematurely reclaimed deltaic tract. The surface of a significant portion of the Birbhum district is covered in a series of undulations that generally run from northwest to southeast. There are a number of swamps in Birbhum's northernmost region.

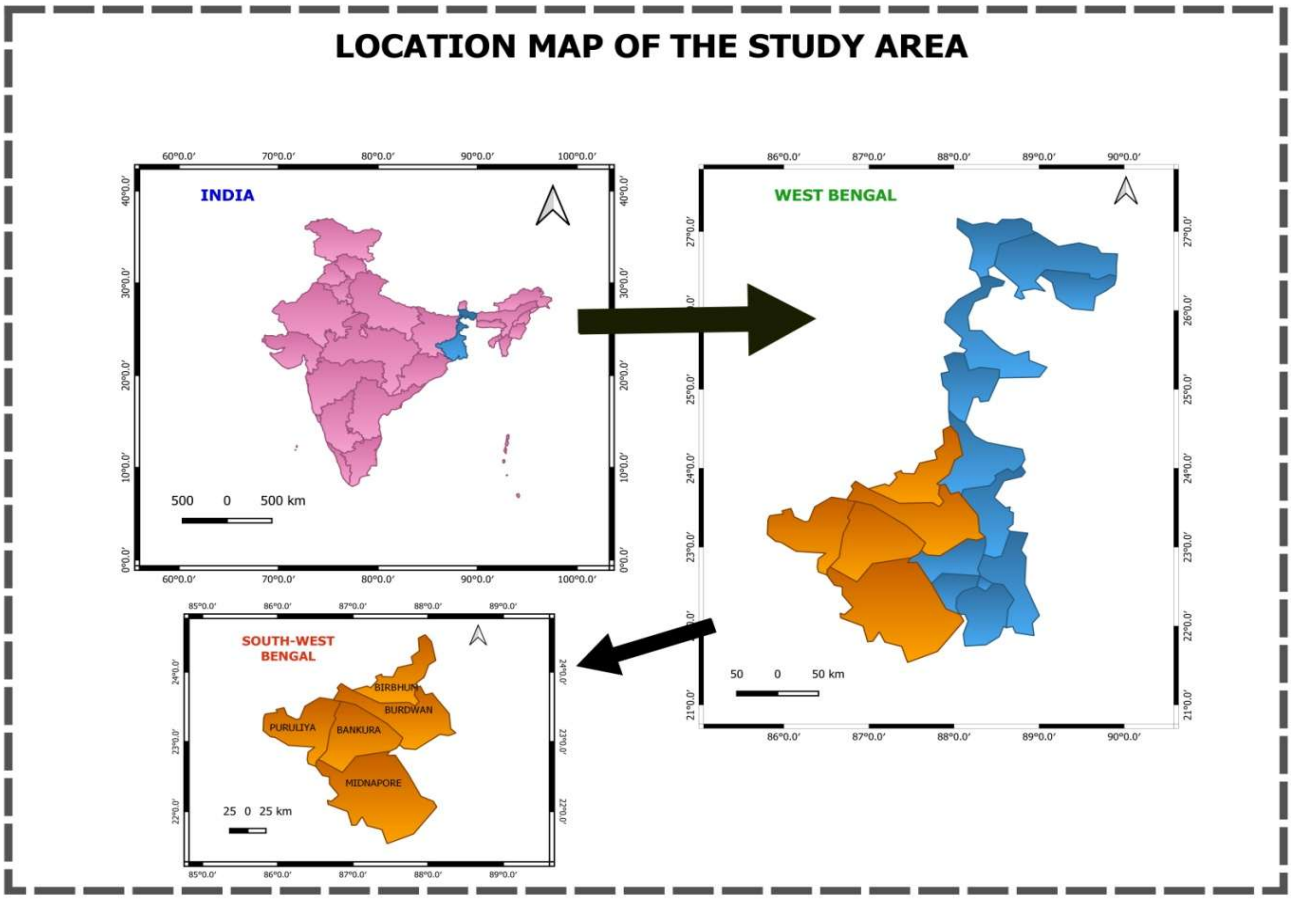

Figure 1: Location map of the study Area

Materials and Methods

The State Forest Report, district official websites (http://www.purulia.nic.in), and interviews with the Divisional Forest Officers of the corresponding districts were the sources of the data. The Survey of India (SOI) provided topographical sheets for the years 2001–2007. In addition to ground-based data, remote sensing offers hints about the state of the world's forests. The method created by RRSC and NRSA in previous studies was used to calculate the state's forest cover. Forest identification is based on the idea that forests are the darkest vegetated pixels during the peak green season. On a 5 km local moving window basis, the Red Band Histogram is used to detect forest peaks. Google Earth and QGIS Map (3.16) were used to process the map before it was exported as jpeg files for display.

Results and Discussion

Table 1: District-wise Area under Forests by Legal Status in West Bengal (2007)

Districts	Geographical Area (sq. km.)	Recorded Forest Area (sq. km.)	% of Recorded Forest Area

Darjeeling	3,149	1,204	38.23%
Jalpaiguri	6,227	1,790	28.75%
Cooch Behar	3,387	57	1.68%
Bankura	6,882	1,482	21.53%
Medinipur (E & W).	14,081	1,709 12	14%
Burdwan	7,024	277	3.94%
Purulia	6,259	876	14.00%
Birbhum	4,545	159	3.50%
Hooghly	3,149	3	0.10%
Nadia	3,927	12	0.30%
Mushidabad	5,324	8	0.15%
Malda	3,733	20	0.54%
Uttar Dinajpur	3,140	10	0.32%
Dakshin Dinajpur	2,219	8	0.36%
Kolkata -	104	-	0.00%
Howrah -	1,467	-	0.00%
24-Parganas (S)	10,159	4,221	41.54%
24-Parganas (N)	3,997	43	1.08%
Total	88,752	11,879	13.38%

The area of forests worldwide is steadily declining, although certain areas or forest types are seeing increases. The demand for agriculture is the main cause of the ongoing conversion of forests in the tropics. Approximately 27% of the state's land is covered by vegetation. West Bengal has 11,879 square kilometers of recorded forest land, of which 7,054 square kilometers are Reserved Forest, 3,772 square kilometers are Protected Forest, and 1,053 square kilometers are Unclassed State Forest. This amounts to 13.38% of the state's total land area. Based on

satellite imagery obtained from NRSA, the GIS determined that 15.52% of the geographical area is covered by forests, including those established outside of the designated forest area [14]. The Purulia Forest Division's forest is classified as a Northern Tropical Dry Deciduous Forest (5B/C 1c) (http://www.purulia.nic.in). Among the chosen study sites, undivided Medinipur district has the largest geographical area (14,081 sq km) (Table 1), followed by Bankura (6,882 sq km) and Birbhum (4,545 sq km).

This pattern is also seen in recorded forest areas, with West Midnapore having 170 sq km of forest area, Bankura having about 148 sq km, and Birbhum having the least amount of forest, at 159 sq km (Table 2). Figure 1 shows that Burdwan and Birbhum have increased forest cover in recent years (see Figures 2 and 3), while Purulia has experienced some deforestation. The remaining districts have relatively consistent forest coverage.

Forest resources in Burdwan, Midnapore, and Bankura districts primarily rely on lateritic and red soils, with some alluvial soil present. Forest resources in these districts have been inventoried at regular intervals, such as 1981-82 and 1991-92, to assess their current status and estimate the distribution, composition, density, growing stock, and growth of forest crops.

These districts' recorded forest area totals 4503 square kilometers, accounting for approximately 11.60% of the total geographic area. The total forest cover in these districts is estimated to be around 2400 square kilometers. The lower estimate may be due to the scattered nature of the forests and the crop composition, which consists mostly of coppice forests and young plantations that are difficult to detect in satellite images due to sensor resolution limitations. North Bengal has a forest cover of 26.2%, with an overall accuracy of more than 85% in identifying forest classes using various estimation methods. According to India's National Forest Policy, 33% of the country's land area should be covered by forests, but this figure is currently only 23.38%.

Table 2: District-wise Area (in thousand hectares) of Forests in South West Bengal (2001-2007)

District	2001	2003	2004	2005	2006	2007
Burdwan	28.78	22.51	22.24	22.26	22.27	70.24
Birbhum	16.03	16.03	15.85	15.85	15.85	45.45
Bankura	148.35	148.35	147.29	147.69	148.93	148.2
Midnapore East	1.22	1.22	0.9	0.9	0.9	0.9
Midnapore West	169.61	169.61	180.72	169.69	171.93	170
Purulia	87.6	87.6	87.17	75.05	75.05	62.59

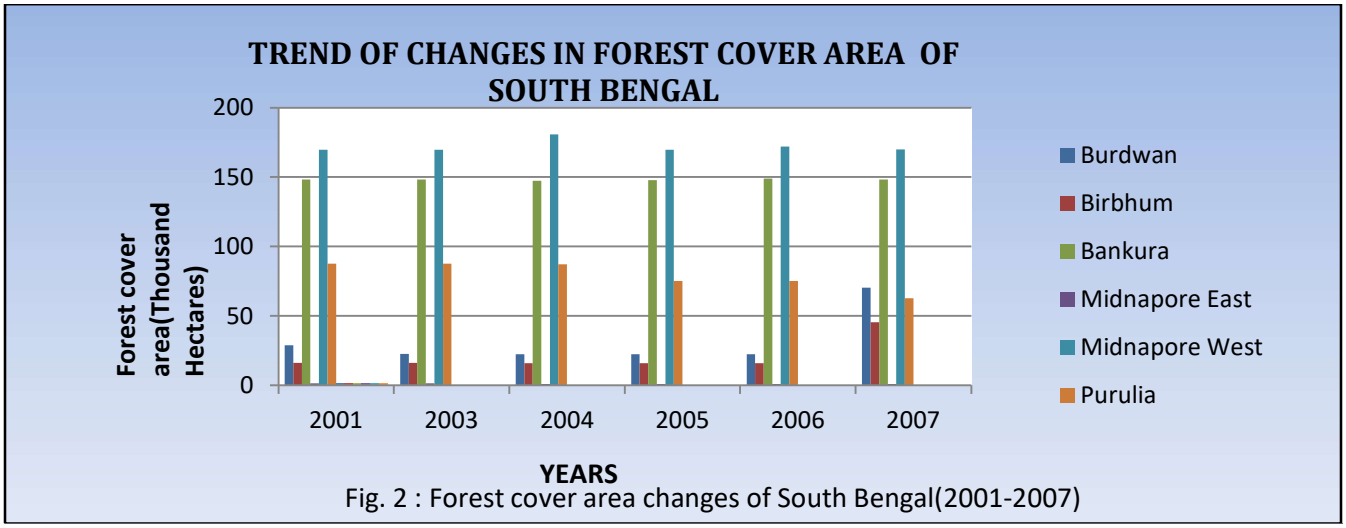

Fig. 2 : Forest cover area changes of South Bengal(2001-2007)

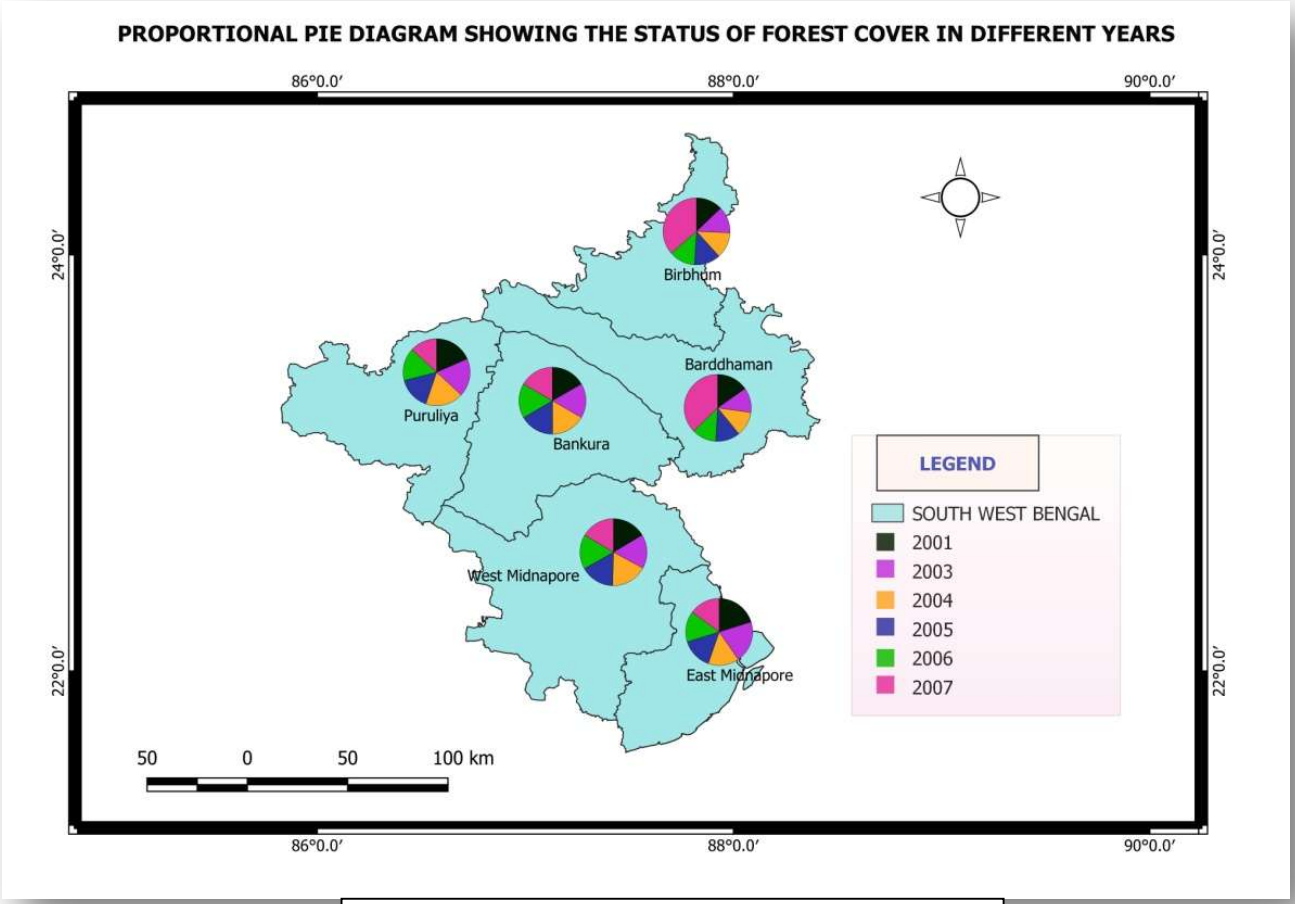

Fig. 3: Status of Forest Cover in different years

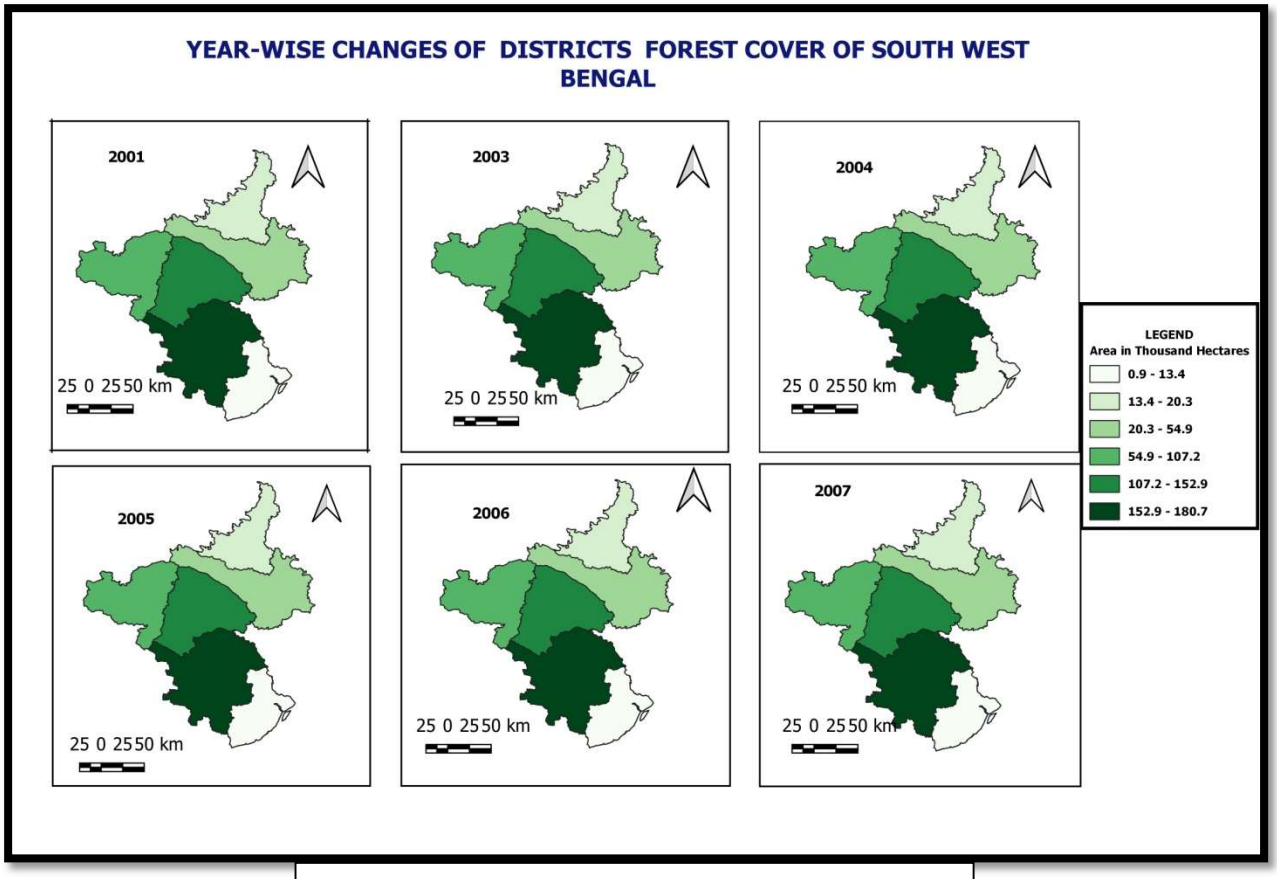

Fig. 4: Year wise changes of District Forest Cover

Conclusion

Data analysis from 2001-2007 on forest cover in south West Bengal shows that Medinipur (E & W) has remained unchanged, while Burdwan and Birbhum have increased and Purulia has decreased slightly. The study suggests that differential change could be caused by both natural and anthropogenic activities, including hill erosion, illegal forest cutting, altered cultivation patterns, and forest fires. The abundance of forest in this area provides adequate shelter for the animals that live there. Short-term studies in this area may not provide enough information to analyze degradation patterns in detail. To effectively monitor, manage, and conserve forests in this state belt, it is necessary to investigate various influencing factors.

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