Data Analysis on Tree Cover Loss in India

Bhavana C.R[1].
[1]PG Scholar,dept.of MCA
Dayanand Sagar College of Engineering
Bangalore,India
bhavanachitraghar80097@gmail.com

Mahendra Kumar [2].
[2] Associate Proffessor,dept.of MCA
Dayanand Sagar College of Engineering
Bangalore,India
mahendra-mcavtu@dayanandasagar.edu

Abstract—**Tree cover loss is a world environmental issue with extensive consequences for environment, climate and human welfare. It covers sustainable environment and conversion of land for various purposes such as agriculture, urbanization and infrastructure etc. An overview of deforestation, including causes, consequences and solutions including the possibility. The reasons for deforestation are multifaceted and vary from place to place. These include agricultural expansion, logging for timber and fuelwood, infrastructure, mining and population growth. These drivers often interact with socio-economic factors, policy frameworks and governance issues, intensifying forest loss. The impacts of deforestation are varied and widespread. Loss of forests leads to biodiversity decline, biodiversity degradation, and habitat loss for countless species of plants and animals. Tree Cover Loss also combines to climate change, as forestland plays an important role in saving carbon and monitoring of the water cycle. Furthermore, deforestation adversely affects local communities and tribal communities that depend on forests for their livelihoods and cultural identities. Addressing deforestation requires a multi-pronged approach including strategic planning, sustainable land management, and community involvement Effective strategies include providing agriculture sustainability, reforestation and deforestation policies, strengthening land rights and environmental legislation. International cooperation and financial mechanisms, can also play a crucial role in incentivizing forest conservation. It poses significant challenges to global sustainability and necessitates urgent action. By understanding the causes, impacts, and potential solutions, we can work towards mitigating deforestation and promoting sustainable forest management practices. It requires collaborative efforts from governments, civil society, and the private sector ,ensuring the preservation of biodiversity, climate regulation, and the well-being of present and future generations.**

Keywords- **Tree cover loss, Tree Cover loss, Forest degradation, India, Biodiversity loss.**

I. INTRODUCTION

India, with its diverse ecosystems and vast forested areas, plays a pivotal role in global biodiversity conservation and climate change mitigation efforts. However, deforestation has emerged a significant challenge, threatening the country's ecological balance and the livelihoods of millions of people who rely on forest resources. Rapid urbanization, agricultural expansion, infrastructure development, and logging activities have all contributed to the accelerated loss of tree cover across the country. In recent years, advances in remote sensing technology and the availability of large-scale datasets have opened new avenues for studying deforestation from a data-driven perspective. Forests and trees play an important role in maintaining ecological balance, biodiversity conservation, climate control and livelihood opportunities. Employing advanced data analysis techniques, such as machine learning algorithms, spatial analysis, and time series analysis, the research reveals insights into the spatial distribution of tree cover loss, temporal trends, and key deforestation drivers, including agricultural expansion, infrastructure development, and logging. findings serve as a basis for future research and policy development, emphasizing the necessity for enhanced monitoring and enforcement, as well as the promotion of sustainable land use practices in India. The study reveals concerning rates of tree cover loss throughout India, with significant variability between various states and ecologies. Scientists have seen a major decline of forest cover in vulnerable regions like the Central Indian Forested Area, the Eastern Himalayas, and the Western Ghats. The approach also emphasises the importance of economic forces, population expansion, and policy influences in promoting deforestation processes. This study leverages a large-scale dataset of tree cover loss across India to analyze trends, patterns, and drivers of deforestation, with the goal of informing the development of targeted strategies for forest conservation and sustainable land use.

II. REVIEW OF LITERATURE

1. "Predictive Modeling of Tree Cover Loss in India Using Machine Learning" (Authors: Kumar, V., Verma, S., & Jain, S.)The study used machine learning algorithms to develop predictive models for tree cover loss in India. The authors combined satellite imagery, climate d   ata, and socioeconomic variables to train the models. The study demonstrated the ability of machine learning to predict future tree cover and highlighted the importance of incorporating dynamic variables into the modeling process.

2. "Spatial Analysis of Urban Tree Cover Loss in Indian Cities" (Authors: Singh, R., Chakraborty, T., & Joshi, P.)
The study focused on the analysis of deforestation in Indian cities. The authors used high-resolution satellite imagery and GIS techniques to assess spatial distribution and causes of urban tree cover loss. The study highlighted the importance of urban green spaces for urban resilience and highlights the need for active planning and management of urban forests.

3. "Analyzing the Impact of Land Use Change on Tree Cover Loss in India" (Authors: Sharma, R., Singh, S., & Patel, N.)
The paper examines the impact of land cultivation change on deforestation in India. The authors analyze satellite imagery, land cultivation data, and socioeconomic indicators to determine the relationship between land use change and deforestation. The study highlights the importance of sustainable land management practices are developed to accentuate loss of tree cover.

4. "Predictive Modeling of Tree Cover Loss in India Using Machine Learning Approaches" (Authors: Kumar, V., Verma, S., & Jain, S.)

The paper explores the use of machine learning techniques for predictive modeling of tree cover loss in India. The authors use satellite imagery, climate data, and socioeconomic variables to develop models that can predict future tree cover. The study highlights the potential of machine learning to predict and prevent tree cover loss.

5. "Assessment of Drivers and Patterns of Tree Cover Loss in India" (Authors: Gupta, R., Sharma, A., & Singh, S.)

The paper considers the causes and patterns of deforestation in India. Authors analyze satellite imagery, climate data, and socio-economic factors to identify key drivers of deforestation. The study provides insights into the spatial distribution and temporal dynamics of deforestation in various parts of India.

III. OBJECTIVES

This study aims to leverage a comprehensive dataset of tree cover loss in India to achieve the following objectives:

- Identify and analyze the patterns and temporal trends of tree cover loss across various regions in India.
- Investigate the major driving forces behind deforestation and assess their relative contributions to tree cover loss.
- Inform the development of targeted strategies for forest conservation and sustainable land use practices in India.

IV. RESEARCH METHODOLOGY

Data, which can be an important fact in any analysis has been collected through numerous resources, as well as secondary information are employed in this study. The study uses each secondary information. The secondary information was collected from revealed sources like journals & websites.

- Data Collection: Identify and gather relevant datasets on tree cover loss in India. Sources like government reports, research papers, or publicly available datasets (e.g., Global Forest Watch) are used in this study. Ensuring the datasets cover an appropriate time period and spatial extent for your research objectives.
- Data Cleaning: Removing the duplicate records and observations from the dataset. Handling missing values appropriately, depending on the extent and importance of the missing data. Identifying and addressing data inconsistencies, such as discrepancies in units or data formats.
- Data Integration: Multiple datasets are integrated by aligning common fields (e.g., date, location) and creating unique identifiers. Ensuring consistency in the administrative boundaries across datasets.
- Data Transformation: Standardizing or normalizing numerical variables, to bring them to a consistent scale.Considering transforming variables to meet assumptions for statistical analyses.

- Data Visualization: Linegraph ,Bargraph ,Piechart and Donut are uses to visualize the historic data and helps in better understanding of charts with the help of labels and percentage calculations.

Tools: Python
Ide: Jupyter Notebook

V. DATA ANALYSIS & INTERPRETATION
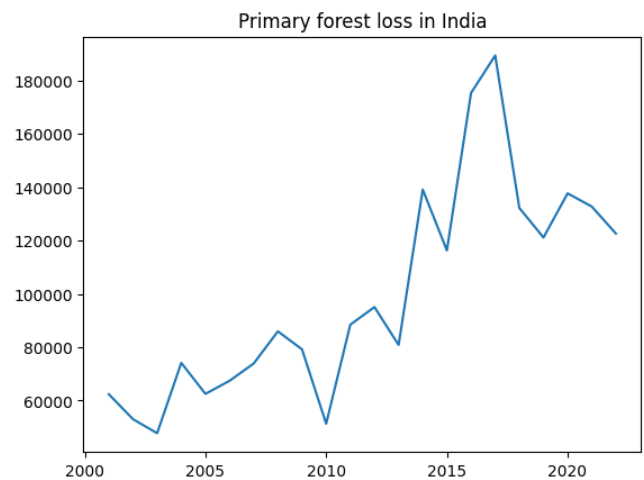
Tree cover loss with respect to year and area:

Fig. 1 Tree cover loss with year and area

Between 2002 and 2022, India lost 393kha of primary temperate forests, accounting for 18% of its total tree cover over the same period Total primary temperate forests declined by 3.9% during this period.
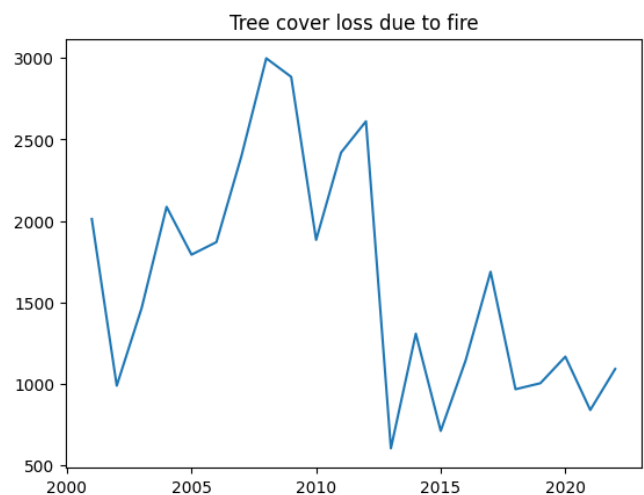
Tree Cover Loss Due To Fire In India:

Fig. 2 Tree cover loss with fire

Between 2001 and 2022, India lost 35.9kha tree cover due to fire, and 2.15Mha in other other total losses. The year with the heaviest tree cover losses due to fire during this period was 2008 with 3.00kha lost to fire—3.5% of the total deforestation for that year.
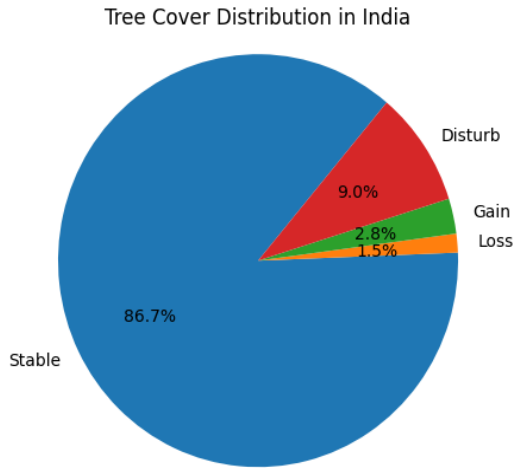
Tree Cover Distribution in India:

Fig. 3 Tree cover Distribution

Between 2000 and 2020, there is a change of 874kha (1.3%) in tree cover in India.

- Stable forest – 59.24 (86.7%)
- Gain - 1.88 (2.8%)
- Loss – 1.01 (1.5%)
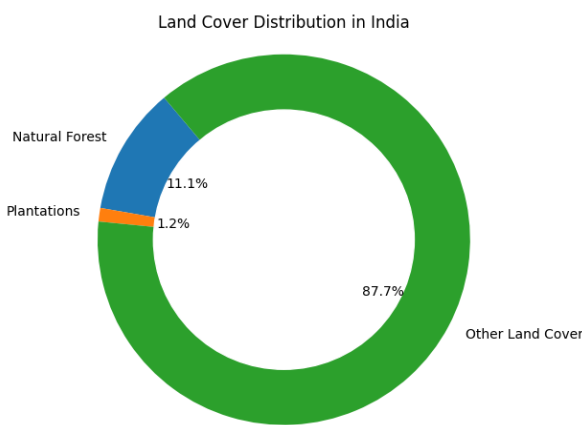- Distrub – 6.17 (9.0%)

Land Cover Distribution In India:

Fig. 4 Land Cover Distribution

As of 2000, 11% of India land cover was >30% tree cover.

- Plantations: 1.2%
- Natural Forest: 11.1%
- Other Land Cover: 87.7%

Top Locations Of Tree Cover Between 2001 And 2022:

The top 5 places in India in 2010 represent 55% of the total tree coverage. Arunachal Pradesh covered the highest tree at 6.11Mha as compared to the average of 957kha.
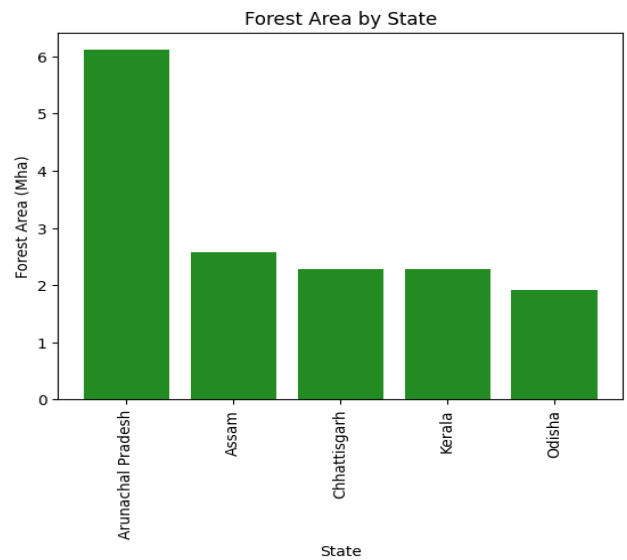

Fig. 5 Top Locations Of Tree Cover

State	Area
Arunachal Pradesh	6.11Mha
Assam	2.57Mha
Chhattisgarh	2.28Mha
Kerala	2.28Mha
Odisha	1.92Mha

Top Locations Of Deforesation Between 2001 And 2022:

In India, these regions are responsible for all tree cover loss between 2001 and 2022. Assam has the the the highest tree cover loss of 306kha compared to an average of 62.5kha.
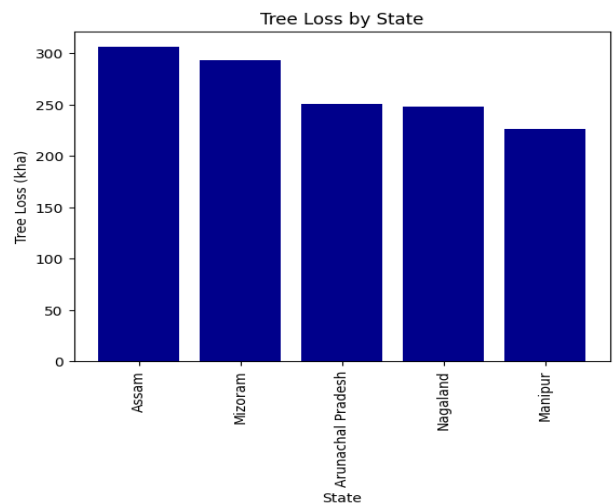

Fig. 6 Top Locations Of Deforesation

State	Area
Assam	306kha
Mizoram	293kha
Arunachal Pradesh	251kha
Nagaland	248kha
Manipur	226kha

VI. CONCLUSION

In conclusion, analyzing tree cover loss data in understanding extent, causes, impacts from deforestation and degradation Timeline used remote sensing data, satellite imagery, machine learning techniques and socioeconomic indicators, researchers were able to gain valuable insights. The reviewed research highlights the importance of applying data and analysis to mapping and tree cover loss at multiple scales, from region to region. They emphasize the importance of accurate and up-to-date data to identify deforestation hotspots, monitor changes over time, and evaluate the effectiveness of intervention programs. In addition, the literature emphasizes the importance of integrating data analyzes of socio-economic factors and land-use changes to better understand the drivers of tree cover degradation in India. This interdisciplinary approach allows researchers to identify root causes and prioritize conservation efforts accordingly. Overall, data analysis on tree cover loss in India is critical for evidence-based decision-making, policy formulation and conservation efforts. By leveraging the power of advanced data and analytical techniques, comprehensive strategies can be developed to reduce deforestation, promote sustainable land management practices and create India's serving forests value cover protection.

VII. FUTURE SCOPE

The future scope of data analysis of tree cover loss in India involves several potential areas of exploration and application. Here are some key areas to consider:

- Prediction and Early Warning Systems: Data analysis can be used to develop predictive models and early warning systems for tree cover loss in India. By analyzing historical data, satellite imagery, climate data, and other relevant factors.
- Impact Assessment of Policy Interventions: Data analysis can be utilized to evaluate the effectiveness of policy interventions aimed at addressing tree cover loss. By analyzing the data before and after the implementation of specific policies or interventions, it is possible to assess their impact on tree cover and identify the most effective approaches. This can inform future policymaking and help design more efficient strategies for tree cover conservation.

- Integration with Climate Change Mitigation Efforts: Tree cover loss contributes to climate change by reducing carbon sequestration and exacerbating greenhouse gas emissions. Data analysis can facilitate the integration of tree cover conservation efforts with climate change mitigation strategies. By quantifying the carbon storage potential of forests and analyzing the impact of tree cover loss on regional and national carbon budgets, policymakers can make informed decisions to combat climate change effectively.

REFERENCES

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Global Forest Watch provides data and tools for monitoring forests globally, including tree cover loss in India. The platform allows users to explore interactive maps, analyze trends, and download data.

[2] Forest Survey of India (http://fsi.nic.in/)
The Forest Survey of India (FSI) is an organization under the Ministry of Environment, Forest, and Climate Change, Government of India. FSI conducts regular assessments of the country's forest resources and publishes reports, such as the India State of Forest Report (ISFR), which provides comprehensive information on forest cover, tree cover, and forest cover loss.

[3] World Resources Institute (https://www.wri.org/)
The World Resources Institute (WRI) is a global research organization that focuses on sustainable development. WRI produces research, data, and tools related to forest cover loss and natural resource management, including country profiles for India.

[4] The Food and Agriculture Organization of the United Nations (FAO) - Global Forest Resources Assessment (http://www.fao.org/forest-resources-assessment/en/)
FAO's Global Forest Resources Assessment (FRA) provides comprehensive data on forest resources, including tree cover loss, for countries like India. The FRA reports are published every five years and provide insights into the status and trends of the world's forest resources.

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