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Three Decades of Green: A Comprehensive Analysis of India's Forest Cover Dynamics from 1990 to 2021 Based on World Bank Data

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ABSTRACT

This study basically focuses on an overview of the dynamics of change of forest cover in India using data from the World Bank from 1990 to 2021. This research involves the quantification and analysis of trends in forest cover across different states and classes of forest types, drivers of change, and, finally, assessing the impact of conservation policy. Using World Bank reports, we adopted statistical modeling tools to assess the changes in forest cover, density, and composition. The study integrated other databases on the determinants of socioeconomics, climatic variables, and policy implementations to get an insight into the complex interplay of human activities, environmental conditions, and forest ecosystems. The results bring out a more nuanced picture of changes in forest cover across the country: Presently, some states show significant gains due to successful state policy related to afforestation, capsule restoration programs, and strict protection being followed, while in others, there were persistent pressures of deforestation, linked to urbanization, agricultural expansion, and infrastructure development. Among the various forest types, the denser forests were relatively more resilient to change compared to open and scrub forests, which showed a higher level of vulnerability to anthropogenic and-climate-induced pressures. Policy impact analysis results suggest that while the forest management at community level and the intensity of site-specific conservation interventions yielded effective results, there is also concern regarding qualitative maintenance of forests and biodiversity amidst quantitative increase in forest covers. The value that this research brings is in adding more scope to understanding India's forest dynamics and in offering, through evidence-based recommendations, policy tools for policymakers. Specific strategies and appropriate management must be a priority in regional needs, perspective monitoring, and integrated land-use planning that can ensure sustainability in forest management and conservation in the face of growing environmental challenges.

Key words : *Forest cover, Deforestation, Biodiversity, Afforestation.*

Introduction

This would not only help in maintaining the ecological balance, but also their role as mitigators in climate change through support of biodiversity. In this background, comprehending the dynamics of forest cover is extremely vital for sustainable development and environmental conservation in the context of India, a country whose varied ecosystems are beleaguered with a host of pressures on account of its burgeoning population. Chaturvedi *et al.* (2011) assessed the impact of climate change on Indian forests and predicted that under the different climate scenarios, there may be substantial changes in forest

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types with some loss of biodiversity. Since 1981, the World Bank has played a pivotal role in supplying exhaustive and dependable information on the forest wealth of the country in the form of biannual State of Forest Reports.

The data generated by World Bank has come to form a valuable resource base for research, policy formulation, and conservationists trying to ascertain the health of India's forests and formulate evidence-based strategies for these forests' maintenance and protection. Forest landscapes in the country have witnessed certain changes, which are successive to changes in population growth, urbanization, agricultural expansion, and climate change, over the last few decades. The changes mentioned have far-reaching consequences on biodiversity, ecosystem services, and the means of livelihood available to the communities dependent on forestry. In view of the World Bank dataset, one is able to collate these changes in terms of quantification, trends, and hence the drivers of the dynamics of change in different levels and regions of forests. According to the Forest Survey of India (2021), the total forest and tree cover of India has increased to 80.9 million hectares, which is 24.62% of the geographical area of the country.

The present research is essentially a follow-up from past studies in this area; it fills some of the existing knowledge gaps and, therefore, elucidates a much-needed nuanced view on the subject of forest dynamics in India. We expect that in the future, we shall be able to build upon the World Bank data using other appropriate datasets, including climatic and socio-economic variables, and policy implementations, in order to reveal a comprehensive picture of the potentials of drivers and changing situations for forest cover of the country.

Here are three objectives for research on forest cover in India based on secondary data:

1. To analyze long-term trends in forest cover across different states and regions of India from 1990 to 2020, identifying areas of significant gain or loss.
2. To assess the impact of various land use policies and conservation initiatives on forest cover changes, focusing on protected areas and afforestation programs.
3. To evaluate the relationship between forest cover changes and key environmental factors such as climate variables, population density, and economic development indicators.

These objectives aim to provide a comprehensive understanding of forest cover dynamics in India using available secondary data sources.

Materials and Methods

The study utilizes secondary data sources, primarily from the World Bank reports. Historical forest cover data spanning multiple decades is collected, focusing on total forest area, forest types (e.g., deciduous, evergreen), and state-wise distribution. Data preprocessing involves standardising units, addressing missing values, and ensuring consistency across different reporting periods. Time series are constructed for national and state-level forest cover trends. Statistical analyses are performed using R software to quantify changes in forest cover over time. This includes calculating annual rates of change, identifying significant trend shifts, and comparing trends across different states and forest types. The methodology incorporates data visualization techniques, including time series plots and choropleth maps, to effectively communicate trends and spatial patterns in India's forest cover over time.

Results and Discussion

Our assessment will focus on the major indicators in terms of total forest cover, change in open, moderately dense, and very dense forest density, and that in the contribution of tree cover outside forests. Furthermore, we will look at the diversity of factors that are likely to lead to these changes: afforestation initiatives, deforestation patterns, land-use modifications, among others. The present study therefore increases the perspective within which one can understand the dynamics of India's forest cover. In their study, Kimothi and Dasgupta, back in 2011, contextualised the role that community participation played in forest management, explaining how, at the initiative of various initiatives under Joint Forest Management, the increase in forest cover has come to be witnessed in a number of states. Knowledge from this study can guide future forest management strategies and form the baseline for efforts to achieve both national and international environmental—socioeconomic goals.

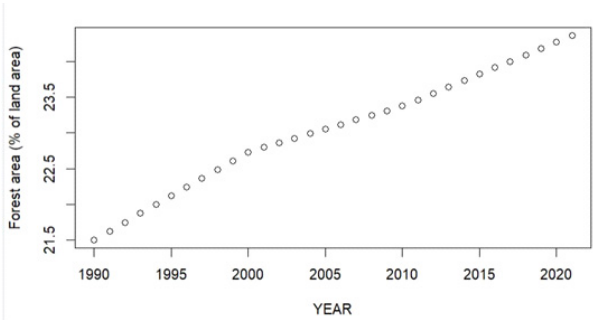
Forest Cover in India

Sl No.	YEAR	Forest area in India (% of land area)
1	1990	21.50484833

2	1991	21.627713
3	1992	21.75057766
4	1993	21.87344233
5	1994	21.996307
6	1995	22.11917166
7	1996	22.24203633
8	1997	22.364901
9	1998	22.48776567
10	1999	22.61063033
11	2000	22.733495
12	2001	22.7975676
13	2002	22.86164019
14	2003	22.92571279
15	2004	22.98978538
16	2005	23.05385798
17	2006	23.11793057
18	2007	23.18200317
19	2008	23.24607576
20	2009	23.31014836
21	2010	23.37422095
22	2011	23.46382169
23	2012	23.55342242
24	2013	23.64302315
25	2014	23.73262388
26	2015	23.82222461
27	2016	23.91182535
28	2017	24.00142608
29	2018	24.09102681
30	2019	24.18062754
31	2020	24.27022827
32	2021	24.35982901

Source: WORLD BANK Report

The table below gives information on the forest cover of India for the period 1990-2021 and for a span of 31 years in terms of percent of land area. In fact, the data taken from the reports of World Bank clearly indicate the trend of the increasing forest cover for all these three decades. In 1990, around 21.5% of the land of India had forest cover. Since then, there was a gradual but steady increase in forest coverage. By 2000, the growth in forest cover was to about 22.7%. The forest cover continued to grow on this positive path, touching 23% by 2005 and crossed 24% in 2018. The latest data, 2021, indicates forest covers 24.36% of India's total landmass, a massive improvement from the 1990 baseline. Such a consistently rising trend over three decades would indicate effective afforestation and forest conservation policies in India. With this augmentation, albeit at a slow acceleration, the intensive development towards further expansion of green cover in the country coupled with its contribution to biodiversity conservation, mitigation of climate change, or maintenance of the ecological balance would be very important. Meiyappan et al. (2017) indicated that forest cover change in India is spatially heterogeneous, mostly showing remarkable improvement in some areas, while other regions experienced continued deforestation. However, this is data on excessive forest cover and does not address the quality and type of forests, which are also key factors for the state of health of forest ecosystems.



Source: R Software

The figure below plots the trend in forest cover in India over the period 1990 to 2021, and it clearly illustrates the changes in the percentage of land area over the three decades. The x-axis is the years over the period, while the y-axis values are percent values of forest area as a share of total land area, which is slightly over 21.5% to 24%. In the timeline given, one can observe that the small circular data points rise consistently over the entire period. In 1990, the forest cover reveals at approximately 21.5% of the Indian land mass. Continuing along the timeline, one may notice that there is a steady increase in the forest coverage. The growth seems to be very even, without sharp spikes or drops, and that would suggest a prolonged effort in afforestation and forest conservation over the years. It was somewhere in the mid 1990s, when the forest cover had increased to around 22%, and thereafter it was gradually increasing at the onset of the millennium.

As points in the data show, by the time of switching into the new millennium, forest cover was continuing to move up. By 2010, the land under forest cover had risen to about 23%, a good sign of surpassing the 20% land area of green cover in the country. The trend continued positively, with forest cover moving up in the 2010s towards 24% by 2021. As it has been for the last 32 years and more, this curve is of significance in the face of happenings in India—rapid urbanization, population growth that seems to be out of hand, and of course, economic

development. That is if the graph already shows that insurmountable pressure did not return overall good efforts at maintaining and expanding forest cover. In addition, it must be noted that the trend of increase is positive but looks to be in a very gradual rate of increase. This may speak of the long-lasting nature of how forest growth is, and the expandability challenge that any country like India faces when it comes to increasing the forest cover. Reddy *et al.* (2016) have pointed out that despite overall gains, many states in Northeast India have suffered major losses of forest cover between 2001-2016 due to shifting cultivation and infrastructure development.

Conclusion

The complex and nuanced picture of the country's forest dynamics from 1990 to 2021 is brought out by this analysis, based on data from the World Bank. In other words, it took three decades. Although it is a significant achievement in the direction of the conservation of forests, large parts of India are still posing challenges to maintain and improve forest cover, considering the pressures of a growing population, urbanization, and climate change impacts. Although forest cover has been observed to depict a pretty modest increase during this period, the forested and tree area has increased from about 21.5% to 24.6% of the country's geographical area between 1990 and 2021. While the improvement is not too shabby, there is yet more room for the coverage to fulfill the national target of achieving 33% forest cover. This gain, however, masks huge regional variations and qualitative forest composition changes. Several states have experienced considerable decline in forest cover, mainly in the Northeast states due to shifting cultivation, infrastructure development, and natural calamities. This task has been more or less achieved through successful afforestation programs, improved working of forest management, agroforestry, and social forestry. On the other hand, states of Punjab, Gujarat, and Rajasthan have made commendable strides through focused greening. On the other hand, it has also been the time of change in the forest quality: there is an increase in the open forest categories and simultaneously, a worrying decrease in the regions with dense forest covers. This change will always question the ecological health and capacity of the forests to increase regions and also for the support of biodiversity. The data is based on the WORLD BANK and leans on the growing importance of trees outside forests, in urban areas, where it has resulted in the gross green cover being built up drastically. This perception echoes many of the thoughts that are current and stresses a more integrated approach to forest management that does not simply lay emphasis on the quantitative targets but on the quality and ecological functionality of forest ecosystems. To the extent that India will be able to balance its developmental aspirations with the need for conservation of the environment, lessons drawn from this three-decade study will be seminal in shaping future forest policies. Such policies should address regional disparities in forest cover by enriching extra protection of existing forests, adding quality in afforestation, and integrating forest conservation with broader goals of sustainable development that, consequently, guarantee the good long-term health of India's forest ecosystems together with their vital contributions of climate management and protection of biodiversity useful for community livelihoods in the long term.

References

Chaturvedi, R.K., Gopalakrishnan, R., Jayaraman, M., Bala, G., Joshi, N.V., Sukumar, R. and Ravindranath, N. H. 2011. Impact of climate change on Indian forests: A dynamic vegetation modeling approach. *Mitigation and Adaptation Strategies for Global Change.* 16(2): 119-142.

Forest Survey of India, 2021. India State of Forest Report 2021. Ministry of Environment, Forest and Climate Change, Government of India.

Joshi, A.K., Pant, P., Kumar, P., Giriraj, A. and Joshi, P.K. 2011. National forest policy in India: Critique of targets and implementation. *Small-Sscale Forestry.* 10(1): 83-96.

Kimothi, M.M. and Dasgupta, A. 2011. Geospatial technology in forest management. *Current Science*. 102(10): 1394-1395.

Meiyappan, P., Roy, P.S., Sharma, Y., Ramachandran, R.M., Joshi, P.K., DeFries, R.S. and Jain, A.K. 2017. Dynamics and determinants of land change in India: Integrating satellite data with village socioeconomics. *Regional Environmental Change.* 17(3): 753-766.

Reddy, C.S., Jha, C.S., Dadhwal, V.K., Hari Krishna, P., Vazeed Pasha, S., Satish, K.V. and Diwakar, P.G. 2016. Quantification and monitoring of deforestation in India over eight decades (1930-2013). *Biodiversity and Conservation.* 25(1): 93-116.

Roy, P.S., Roy, A., Joshi, P.K., Kale, M.P., Srivastava, V.K., Srivastava, S.K. and Kushwaha, S.P.S. 2015. Development of decadal (1985–1995–2005) land use and land cover database for India. *Remote Sensing*. 7(3): 2401-2430.