Analysis of Relationship Between Devolution Based on Forest Cover by the Finance Commission and States' Forest Cover

Vishal Aryan

Under the Supervision of Professor Saudamini Das

March 10, 2025

Abstract

The Finance Commission provides for a formula for the horizontal distribution of the total devolved tax revenue among the states. In the formula, the 14th finance commission added a novel component, Forest Cover, with an assigned weight of 7.5%. The intention behind including component was to compensate states through additional revenue for the "fiscal disability" caused due to the opportunities forgone by not clearing forest for other economic uses. Consequently, more forest cover implied more revenues for any particular state. This component would've acted as an incentive for the states to increase their respective forest covers in order to get greater share of the revenues in future.

This paper seeks to inquire into the nature of relationship between devolution based on Forest Cover by the Finance Commission and states' forest cover. The relevance of the paper lies in understanding whether the ecological transfers can nudge states to enhance the forest cover. This understanding can inform policy tailored to generate additional carbon sink to achieve India's Nationally Determined Contributions (NDCs) under the Paris Agreement of United Nations Framework Convention on Climate Change (UNFCCC). The findings indicate that the post-policy effect is positive and significant, suggesting that after 2017 there was a visible increase in the forest cover of the states. [1]

[1]Disclaimer: This paper has been prepared as a part of the probationary training for Indian Economic Services (IES). The content of this paper is based on research and analysis conducted by the author in an academic or professional capacity and is intended for informational purposes only. The views and opinions expressed in this paper are those of the author and do not reflect the official position or policy of the Government of India.

To strengthen the Ecological Fiscal Transfer (EFT) framework, the inclusion of additional ecological indicators such as the ecological value of forest resources, would ensure a more holistic and effective approach to environmental sustainability.

Keywords: Ecological Fiscal Transfer (EFT); Finance Commission; Forest Cover; Ecology; Panel Data; Ordinary Least Square (OLS)

1 Introduction

The 14th Finance Commission (FC) in its multi-element horizontal tax devolution formula included “Forest Cover” as a criterion and assigned it a weight of 7.5 percent. The rationale to include this criterion was to “support states in shouldering the responsibility of managing the environment” (Finance Commission of India, 2015). The devolution formula suggested by 14th FC accounts for both revenue and cost disabilities while also encouraging states to recognize forests as a national asset that should be protected. This devolution of funds due to forest cover has been termed as Ecological Fiscal Transfers.

According to Ring (2008), EFTs refer to the allocation of funds by higher levels of government (e.g., national) to lower levels (e.g., state and local) based on ecological indicators. These EFTs introduced in India have been recognized as the world’s largest intergovernmental fiscal transfer of this kind. The primary objective behind their introduction is to compensate states with large forest cover for the fiscal disability caused by revenue loss which they face due to restrictions on economic activities in those areas. However, beyond mere compensation through this mechanism, a crucial policy question emerges: Do these EFTs act as an incentive for the states to enhance their forest cover to get higher tax devolution in the future?

If these transfers indeed motivate states to expand and conserve forests, the policy has the potential to create a virtuous cycle—wherein states proactively invest in afforestation, conservation efforts, and sustainable forest and ecosystem service management to maximize their future fiscal benefits. This is in consonance with India's broader environmental commitments, particularly its updated Nationally Determined Contributions (NDCs) under the Paris Agreement.

India's updated NDCs target the creation of an additional carbon sink of 2.5 to 3 billion tonnes of CO equivalent through enhanced forest and tree cover by 2030. Achieving this ambitious target requires those policy mechanisms that encourage state governments to actively participate in afforestation efforts. EFTs could play a significant role by indicating to states that they would get compensation for forest management. Hence, through the linkage of fiscal incentives with forest cover, states may be encouraged to adopt policies that promote afforestation, combat deforestation, and implement sustainable forest management and land-use policies.

Furthermore, the positive association of EFTs doesn't become limited to increased carbon sinks. Increased forest cover would enhance biodiversity, improve water security through increased water table, and mitigate the adverse effects of climate change—factors which are critical for India's long-term environmental sustainability. Additionally, by providing a stable financial stream to forest-rich states, EFTs could reduce exploitative economic activities such as illegal logging or unregulated mining. The 15th FC, keeping this in view, not only retained the forest criterion under the head "Forest and ecology" in the devolution formula but also increased its weightage to 10 percent. The idea behind this was the recognition of forests as a global public good that should be preserved for national benefit as well as to meet our international commitments set out in India's NDCs.

Given India's commitment to sustainable development, the relationship of EFTs and forest conservation efforts needs rigorous empirical assessment. If this relationship is proven significant, the framework could be further refined—perhaps by introducing performance-based tiers or incorporating additional ecological indicators—through more targeted devolution for optimising the intended results. In the long run, such an approach would help India meet its NDC targets while ensuring that environmental sustainability is seamlessly integrated into the country's fiscal federalism.

2 Literature Review

The theoretical foundation for incorporating ecological indicators in the intergovernmental fiscal transfers was first established in Kumar and Managi (2009). They demonstrated that due to the positive spatial externalities associated with sustainable resource management at the sub-national level, there is under-provisioning of conservation services due to mismatch between costs and benefits. Therefore, ecological fiscal transfers (EFTs) could incentivize states to undertake sustainable resource management.

Ring (2008) analyzed Brazil's ICMS-E program and demonstrated that EFTs provided due to the programme led to increased protected areas and improved forest conservation efforts. Droste et. al (2017) examined cases of a handful of other countries which had previously introduced EFTs to subnational governments to pay for the protected areas that they maintained under their jurisdiction. They found that in Brazil and Portugal such EFTs incentivized local governments or municipalities to designate additional areas as protected areas.

Busch (2020) remarked that between 2015 (the year when the recommendations of the 14th Finance Commission started getting implemented) and 2019, states' overall budget increased by 42 percent. However, the same increase was not visible in the forest departments' budgets wherein the increase was only 19 percent. This is attributable to the fact that the amount of devolution based on forest cover arrived at according to the scheme of the 14th Finance Commission was not tied and could be used for any purpose by the states.

Dasgupta and Srikanth (2021) emphasized that though this scheme of EFT aims at compensating states for the fiscal disability they face by having more forest cover, the design of the transfer mechanism is also important in achieving the objectives. To align it with the REDD+ (Reducing Emissions from Deforestation and forest Degradation plus) mechanism, they recommend that the fiscal disability approach, which is a weak approach, should be replaced by the Ecological Value Approach. Unlike the former, the latter approach is more robust as it incorporates Ecological Value to incentivize conservation.

However, there seems to be limited empirical evidence available on the direct relationship between forest-based fiscal transfers and forest cover changes in India. Moreover, it was also noted that there is a lack of state-level analysis which incorporates both ecological and economic variables of interest.

3 Research Question

Does tax devolution based on forest cover incentivize states to increase their forest cover?

4 Data Sources

Various sources have been used to construct the dataset in this study. As per the 14th Finance Commission report, the horizontal devolution on account of the component "Forest Cover" (weightage 7.5%) would be provided to the states according to the total area under Very Dense Forest (VDF) and Moderately Dense Forest (MDF) instead of Total Forest area (which includes other than the above two components, Open Forest Area) as given by the Forest Survey of India's Indian State of Forest (2013) report. So, it is expected that to maximize gains from the EFT, states would try to increase the area under VDF and MDF. Hence, in the context of this paper's analysis, forest cover may refer to the sum of the total area under VDF and MDF. Indian State of Forest report comes out biannually. The biannual observation for states in this analysis starts from 2009 and goes up to 2021.

The study uses RBI's Handbook of Statistics on Indian States for per capita gross state domestic product (PCGSDP) at constant prices for the same year range and for arriving at the percentage share of the industrial sector in the GSDP of the states.

Population Density, defined as the number of persons per square kilometre, is an important demographic variable in the analysis. Data for this indicator has been sourced from the Ministry of Statistics and Program Implementation. Annual Rainfall (in millimetres) data has been extracted from Rainfall Statistics of India Report published by India Meteorological Department (IMD), Ministry of Earth Sciences. This dataset provides comprehensive insights into regional variations in precipitation across different states.

The study also utilises the total annual devolution and annual devolution on account of forest cover for each state, which have been calculated based on the 14th Finance Commission report by the author.

5 Methodology

The Union government started devolving funds to the state governments under 14th Finance Commission's recommendation starting from 2015-16. In the case of forests, it's reasonable to expect that any measurable impact on forest cover would materialize with a time lag. The object of the analysis would be to see whether from 2017 onwards there will be a positive change in the forest cover across the states after the implementation of this devolution mechanism.

The study employs descriptive analytics to summarize and interpret key patterns in the data. Graphical representations such as histograms, and maps are utilized to illustrate the data. The advantage of this approach is that it helps in dealing with potential outliers and understanding underlying distributions, and preliminary relationships among variables, which complement the regression analysis.

In addition to above-mentioned descriptive analytics, a pre-post analysis using Ordinary Least Square (OLS) panel regression would be employed in this study. The frequency of the observations in the panel dataset is biannual. The dependent variable is the percentage change in forest cover of each state. The independent variable is Forest Cover as a percentage of the total geographical area of each state. A dummy variable for pre-post analysis has been used which takes the value 0 before the year 2017 and 1 otherwise. A dummy variable has been introduced which takes value 1 if the Forest Cover as a percentage of the total geographical area is greater than 30 percent but less than or equal to 50 percent and 0 otherwise. Similarly, another dummy variable has been employed which takes the value 1 if the Forest Cover as a percentage of the total geographical area is greater than 50 percent and 0 otherwise. This has been done to check whether there is any significant additional change in dependent variable for the states having large forest cover, mainly those having Forest Cover as a percentage of the total geographical area to be greater than 30 percent.

The analysis controls for per capita GSDP, Annual Rainfall and Industrial Sector's share in GSDP and population density to account for potential biases that may arise due to any variable being omitted. Per capita GSDP has been included as a proxy for overall economic development, which may influence environmental policies and forest conservation efforts. Annual rainfall is controlled for, as variations in precipitation levels can impact forest growth. The industrial sector's share in GSDP indicates the degree of industrialization, which could put pressure on forest cover through resource extraction and land-use changes for industrial purposes. Population density is considered to capture demographic pressures on forest areas and resources because higher population concentrations may lead to increased deforestation due to more pressure on forests caused by increased demand for habitats, especially in rapidly developing industrial centres. By incorporating these controls, the study tries to isolate the effect of the key explanatory variables on forest cover dynamics more accurately.

6 Results

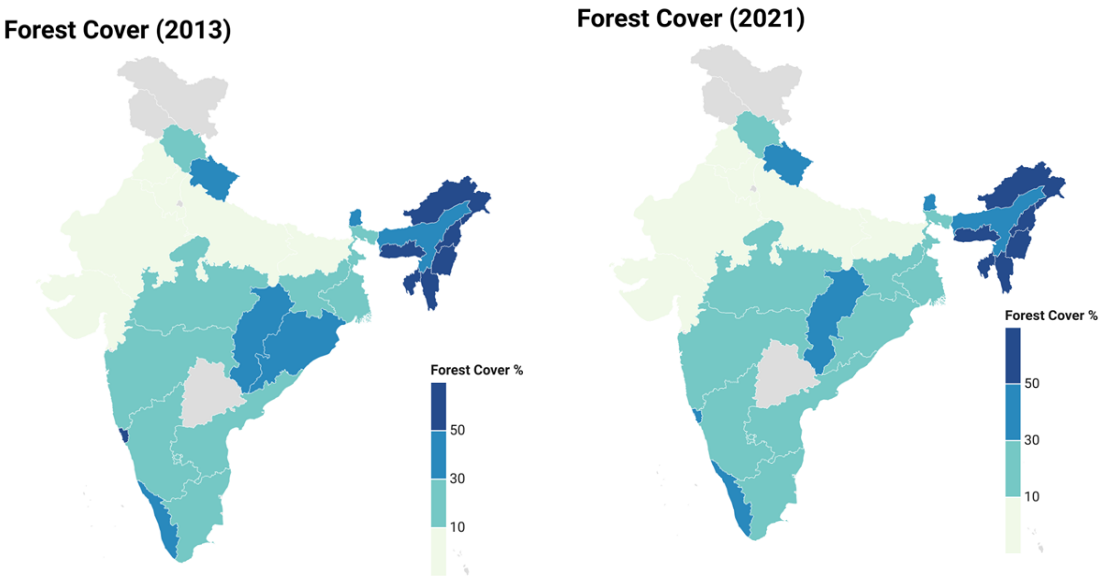


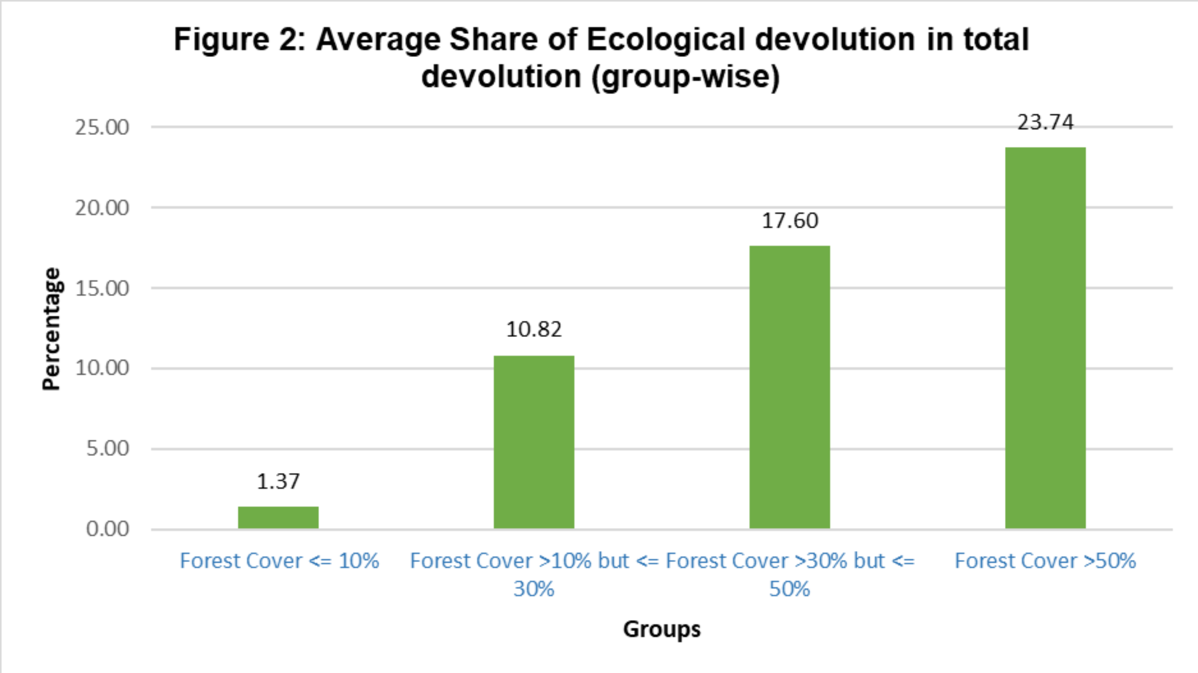
Figure 1: Forest Cover as a percentage of total geographical area (State-Wise).

Figure 1 presents the state-wise forest cover as a percentage of total geographical area for the years 2013 and 2021. In both years, the north-eastern states—Meghalaya, Arunachal Pradesh, Tripura, Mizoram, Manipur, and Nagaland—maintained a forest cover exceeding 50 percent of their geographical area.

Most central Indian states, such as Madhya Pradesh and Maharashtra, along with southern states like Tamil Nadu and Andhra Pradesh, had forest cover ranging between 10 percent and 30 percent. Meanwhile, northern states, particularly those in the Gangetic plains—Rajasthan, Haryana, Uttar Pradesh, and Bihar—had forest cover below 10 percent.

The figure also highlights state-level mobility across forest cover categories over time. For instance, between 2013 and 2021, Goa transitioned from the greater than 50 percent forest cover category to the 30–50 percent category, while Odisha shifted from 30–50 percent forest cover to the 10–30 percent category.

Using the 14th Finance Commission Report, 15th Finance Commission Report, India State of the Forest Report, and the Union Annual Finan-



cial Statement documents, the author first calculated the EFT and total devolution for each state and then EFT as a share of total devolution. Thereafter, states were categorized into 4 groups based on the forest cover as a percentage of total geographical area i.e., first group consisting of states with forest cover less than or equal to 10 percent, second group consisting of states having forest cover greater than 10 percent but less than or equal to 30 percent, third group consisting of those states having forest cover greater than 30 percent but less than or equal to 50 percent and fourth group consisting of states having forest cover greater than 50 percent.

After that, group average was calculated. It is observed that the share of ecological devolution in total devolution increases successively as forest cover increases and states with higher forest cover receive, on an average, a greater percentage of their devolution through ecological criteria set by the Finance Commission.

While the first group received only 1.37 percent of total devolution as EFT, the fourth group received almost a quarter of their devolution as EFT (Figure 2). This confirms that states with substantial forest resources benefit the most from performance-based transfers linked to forest cover. Therefore, states with high forest cover could be the ones that remain incentivised to enhance forest afforestation and conservation efforts. States with moderate forest cover (10-30%) might have room to increase their forest cover to benefit more from EFT.

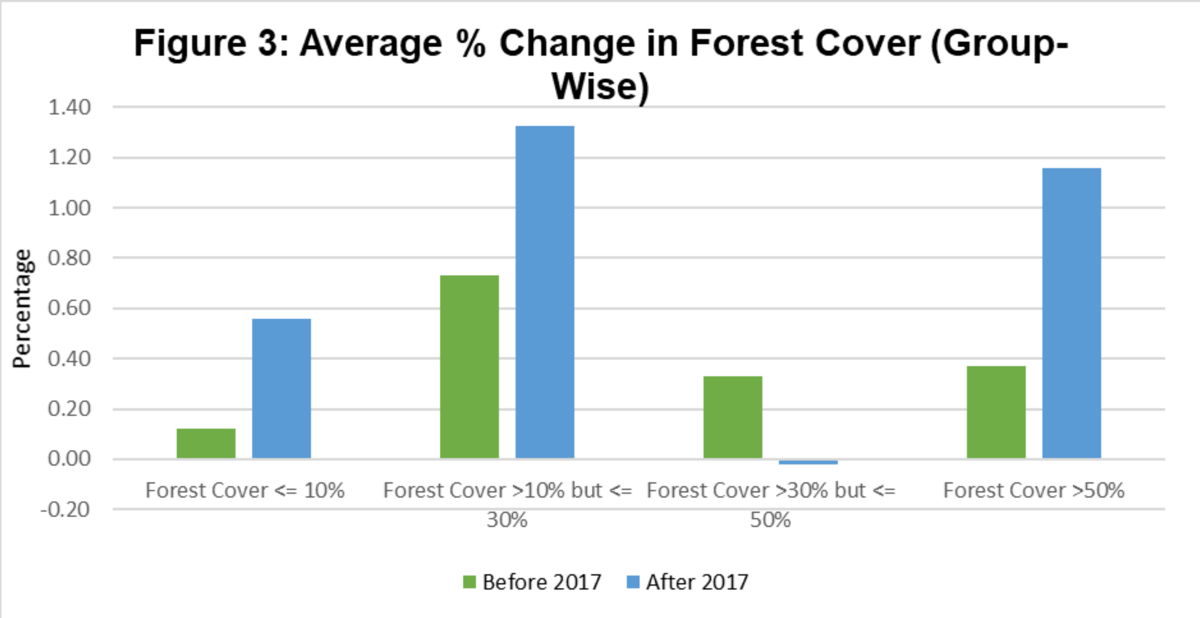


Figure 3 highlights the average percentage change in forest cover before (pre-2017) and after (post-2017) for the above defined four group of states. The green bars represent pre-2017 data, while the blue bars represent post-2017 data. The post-2017 period shows a significant increase in forest cover for those states which had very high forest cover (>50%) and moderate forest cover (10-30%). However, there was mixed impacts across different forest cover groups. States with forest cover between 30-50% show minimal change post-2017. The largest percent increase in forest cover post-2017 is observed in states with forest cover between 10-30% which saw at least 1.3 percent increase annually on average. The post-2017 jump in forest cover for high forest cover states (>50%) and moderate forest cover states (10-30%) and low forest cover states may indicate the potential effectiveness of EFTs.

6.1 Model Specification

$$
\begin{aligned}
\text{Change in Forest Cover}_{it} = \beta_0 &+ \beta_1 \text{Forest Cover}_{it} + \beta_2 \text{PCGSDP}_{it} + \beta_3 \text{Industrial Share}_{it} \\
&+ \beta_4 \text{Annual Rainfall}_{it} + \beta_5 \text{Population Density}_{it} + \beta_6 \text{Fcover\_30\_50}_{it} \\
&+ \beta_7 \text{Fcover\_50}_{it} + \beta_8 \text{Post}_{it} + \alpha_i + \lambda_t + \epsilon_{it}
\end{aligned} \tag{1}
$$

where,

- i = cross-sectional unit (state)
- t = time period (biannual data)
- β_0 = Constant Term
- $\beta_1, \beta_2, \ldots, \beta_8$ = Coefficients of variables
- α_i = State fixed effects (to control for time-invariant heterogeneity)
- λ_t = Time fixed effects
- ϵ_{it} = Error Term

The model as specified in equation (1) keeps Change in Forest Cover as the dependent variable, with Forest Cover as a percentage of total geographical area (ForestCover) as the key independent variable of interest. To control for potential confounding factors, the model includes Industrial Share, Annual Rainfall, Population Density, and Per Capita GSDP (PCGSDP) as control variables. Additionally, dummy variables—Fcover30_50 and Fcover_50—have been used to account for differences across states with varying levels of forest cover. A pre-post policy dummy variable (Post) is also included to check whether there is any significant change in forest cover post 2017.

Table 1: Regression Results

Dependent Variable: Change in Forest Cover	
Forest Cover	0.116
	(0.096)
Industrial Share	0.221***
	(0.082)
Annual Rainfall	0.001
	(0.001)
Population Density	-0.028**
	(0.011)
PCGSDP	-0.00001
	(0.00001)
Fcover_30_50	2.269
	(3.644)
Fcover_50	2.015
	(4.398)
Post	2.057**
	(0.857)
Constant	-1.432
	(6.358)
Observations	189
Controls	Yes

Note: Standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

There is a positive but statistically insignificant relationship between Forest Cover (Coefficient=0.116) and Change in Forest Cover (Table 1). Further, a 1-unit increase in industrial sector share in SGDP is associated with a 0.221 unit increase in the change in forest cover, indicating that industrial growth is positively correlated with change in forest cover. With $p < 0.01$, it is highly significant. Higher population density exhibits a significant negative relationship with changes in forest cover (Coefficient: -0.028). The post dummy shows a positive relationship with percentage change in forest cover (Coefficient: 2.057). Economic growth (measured by PCGSDP) does not show a significant direct relationship on forest cover changes (Coefficient: -0.00001). No statistically significant relationship was observed between annual rainfall and change in forest cover (Coefficient: 0.001).

States with forest cover between 30-50% (fcover30_50 as dummy) show a positive but insignificant relationship with percentage change in forest cover (Coefficient: 2.269). States with more than 50% forest cover (fcover_50 as dummy) also shows positive but insignificant relationship with percentage change in forest cover (Coefficient: 2.015).

As a robustness check, hausman test was performed to determine the appropriate model specification and it was found that fixed effects model was better than the random effects model and accordingly, fixed effects model has been retained in the analysis. Moreover, Wooldridge test for serial autocorrelation was also conducted and the results indicated that there was no serial autocorrelation in the model.

7 Discussion

The positive but statistically insignificant relationship between Forest Cover and Change in Forest Cover suggests that higher initial forest cover which means higher tax devolution is not necessarily associated with a significant change in forest cover over time. Industrial Share's strong positive and significant association with forest cover changes (p ¡ 0.01) may have been because of compensatory afforestation policies. Acts such as the Compensatory Afforestation Fund Act, 2016 (CAMPA) in India mandate industries to plant trees in exchange for forest land which got diverted for industrial use. Many industries are required to take necessary mitigation efforts such as reforestation and biodiversity conservation to comply with environmental impact assessments (EIA) and sustainability certification by the Indian Standards Organisation (e.g., ISO 14001).

The Post-policy dummy's coefficient being positive and significant suggests statistically significant increase in forest cover changes after the policy intervention indicating that policies may have had a meaningful effect on forest conservation or afforestation. The policy may have raised awareness among state governments about the importance of maintaining or increasing forest cover and associated financial implications, leading to more proactive conservation efforts.

The negative relationship between population density with changes in forest cover indicate towards the understanding that increased human presence and land use changes may reduce forest cover over time. Densely populated regions like fast growing urban centres often experience that the forests and green spaces are cleared to accommodate housing, infrastructural development, commercial centres, and industrial zones.

States with high forest cover (30-50% and above 50%) do not exhibit significant differences in forest cover changes as coefficients are not statistically significant. This suggests that, despite having substantial forest cover, these states have not experienced significantly higher forest cover changes compared to states with lower forest cover. One plausible explanation for this may be the Saturation Effect which, in effect, means that states that already have a high proportion of forest cover may have limited scope for further afforestation. Unlike the states with lower forest cover, where afforestation efforts can significantly increase forest area, highly forested states may see only marginal changes over time. This may especially be true if natural topography of states with high forest cover puts a limit on large-scale tree planting or natural forest expansion.

8 Limitations

There are concerns related to the endogeneity issues in this analysis. One of the key endogeneity concerns in the analysis is reverse causality, where forest cover may itself influence economic factors like per capita Gross State Domestic Product (via eco-tourism for instance) and Industrial Share, leading to simultaneity bias in the regression results. This issue may arise because the assumed direction of causality—where economic factors influence changes in forest cover—may not fully capture the two-way relationship between these variables.

Omitted Variable Bias is another concern as other unobserved factors (e.g., enforcement of environmental laws) may influence both forest cover and its change. Differences in state policies, enforcement of environmental laws, or local governance can affect forest cover but may not be fully captured by fixed effects.

9 Conclusion and Policy Recommendations

The finding in the analysis that the post-policy effect is positive and significant suggests that devolution-based incentives, such as Ecological Fiscal Transfers (EFTs), may have played a role in encouraging states to enhance their forest conservation efforts. This implies that states respond positively to financial incentives linked to forest cover, reinforcing the idea that fiscal decentralization can be an effective tool for environmental governance. The high forest cover states face opportunity costs as they forego income and revenue from alternative land uses such as industrial expansion. These EFTs may help these states offset these economic trade-offs which makes conservation a more viable option which aligns with India's NDCs of the Paris Agreement. Therefore, these EFTs should continue.

The negative relationship which was observed between population density and change in forest cover in the analysis highlights the significant pressure that human settlements exert on natural ecosystems. As population density increases, concurrently urban expansion, infrastructure development, and deforestation intensify, leading to depletion of forested areas. Usually, rapid urbanisation occurs without proper sustainable planning leading to unregulated encroachment on forested land. To mitigate this impact, the government should come up with stricter land use regulations in high-density regions as it is essential to balance developmental needs with environmental conservation.

The Ecological Fiscal Transfers (EFT) mechanism may serve as a crucial policy tool to incentivize forest conservation and sustainable environmental management by linking fiscal allocations to ecological performance. While the current EFT framework primarily considers forest cover, it should be further strengthened and made more comprehensive by incorporating other ecological indicators and measures like the ecological value of the current forest resources. Expanding the range of ecological criteria would ensure a holistic approach to environmental sustainability which would encourage states to adopt broader conservation and climate resilience measures. This would not only encourage states to focus on the quantity but the quality of the forest resources also.

References

1. Busch, J., Kapur, A., & Mukherjee, A. (2020). Did India's ecological fiscal transfers incentivize state governments to increase their forestry budgets? *Environmental Research Communications*, 2 (2020) 031006.

2. Dasgupta, P., & Srikanth, K. (2021). Achieving the climate goal with intergovernmental transfers to the forestry sector: Insights from the Indian experience. *Springer Nature.*

3. Droste, N., Lima, G. R., May, P. H., & Ring, I. (2017). Municipal responses to ecological fiscal transfers in Brazil: A microeconometric panel data approach. *Environmental Policy and Governance*, 27(4), 378–393.

4. Government of India (2009). *India state of forest report.* New Delhi, India.

5. Government of India (2011). *India state of forest report.* New Delhi, India.

6. Government of India (2013). *India state of forest report.* New Delhi, India.

7. Government of India (2014). *Report of the Fourteenth Finance Commission.* New Delhi, India.

8. Government of India (2015). *India state of forest report.* New Delhi, India.

9. Government of India (2017). *India state of forest report.* New Delhi, India.

10. Government of India (2019). *India state of forest report.* New Delhi, India.

11. Government of India (2021). *India state of forest report.* New Delhi, India.

12. Government of India (2020). *Report of the Fifteenth Finance Commission*. New Delhi, India.

13. Kumar, S., & Managi, S. (2009). Compensation for environmental services and intergovernmental fiscal transfers: The case of India. *Ecological Economics*, 68(12), 3052–3059.

14. Reserve Bank of India. (2013). *Handbook of Statistics on Indian States 2013*. Reserve Bank of India.

15. Reserve Bank of India. (2015). *Handbook of Statistics on Indian States 2015*. Reserve Bank of India.

16. Reserve Bank of India. (2017). *Handbook of Statistics on Indian States 2017*. Reserve Bank of India.

17. Reserve Bank of India. (2019). *Handbook of Statistics on Indian States 2019*. Reserve Bank of India.

18. Reserve Bank of India. (2021). *Handbook of Statistics on Indian States 2021*. Reserve Bank of India.

19. Ring, I. (2008). Integrating local ecological services into intergovernmental fiscal transfers: The case of the ecological ICMS in Brazil. *Land Use Policy*, 25(4), 485-497.