Harnessing the Power of India's Forests for Climate Change Mitigation

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ABSTRACT Forests help mitigate the impacts of climate change, provide economic benefits for the country, and meet specific facets of India's sustainable development goals. It is essential, therefore, to revisit India's forest governance and evaluate the country's efforts at forest restoration and conservation. This brief examines the current state of India's forests, explores the effectiveness of forest restoration and conservation measures, and recommends a roadmap for the regeneration of India's forest cover.

INTRODUCTION

India's first comprehensive climate analysis report, 'Assessment of Climate Change over the Indian region',[1] highlights the role of forests as effective mechanisms to mitigate climate change impacts,[2] provide economic benefits for the country, and meet several of India's sustainable development goals. It is essential, therefore, to revisit India's forest governance and evaluate efforts at forest restoration and conservation.[3] Over the past two decades, India has witnessed an ever-increasing rate of deforestation and unsustainable exploitation of forest resources, leading to overall degradation at an alarming rate.[4]

At the UN Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP, 2015), India, under the Bonn Challenge[a] committed to the goal of restoring 13 million hectares (mha) of degraded and deforested land by 2020 and an additional 8 mha by 2030.[5] Moreover, in its pledge to reduce the emission intensity of its GDP by 33-35 percent by 2030 (from 2005 levels) through mitigation efforts across various sectors, India envisions to create an additional carbon sink of 2.5-3.0 billion tonnes (Bt) of CO_2eq through additional forest and tree cover by 2030.[6]

The Indian government is pursuing afforestation and reforestation through policies and programmes such as the National Mission on Green India,[7] the National Afforestation Programme, compensatory afforestation, and plantation drives across States. In the Union Budget 2020-21, the overall allocation for the Union Ministry of Environment, Forest and Climate Change[8] (MoEFCC) has increased to ₹ 31000 million for 2020-21 from ₹ 2,6579.4 million in the revised estimate of 2019-20,[9] a significant portion of which is expected to be channelled to the integrated development of forest ecology. Furthermore, in October 2019, the MoEFCC transferred ₹ 47,436 crore under the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) to 27 States for their afforestation efforts.[10]

India is now ranked 3rd in the world for annual net gain in terms of forest area.[11] The biennial India State of Forest Report-2019 released by the Union Ministry for Environment, Forest and Climate Change reports that India has achieved an increase of 24.56 percent in its total forest and tree cover.[12] Union Environment Minister Prakash Javadekar has claimed that India's green cover has increased by 15,000 km[2] in the last four years.[13]

There are other reports to the contrary, however. For example, the International Union on Conservation of Nature (IUCN) and MoEFCC's 2019 joint progress report on forest restoration reveals   that even

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a   The Bonn Challenge is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030.

as some 9.8 mha of deforested and degraded land have been brought under restoration since 2011, the overall forest cover has barely increased.[14] This reflects the failure of forest regeneration programmes in undertaking effective ecological restoration.

For India to achieve its climate commitments, it would need to bring 33 percent of its geographical area under forest cover by 2022. (The current forest cover is at 24 percent.) This would require an increase in the forest cover by nearly 2 percent every year till 2022.[15] However, forest cover in the country has grown by just 0.56 percent or 3,976 km² since 2017.[16]

This brief examines the Indian government's claims of increase in the country's forest cover. It analyses the current state of the country's forests, evaluates the effectiveness of forest restoration and conservation measures, and offers recommendations for a more focused forest regeneration effort.

THE STATE OF INDIA'S FORESTS

India's forest ecosystems support the economy and livelihood of approximately 300 million tribal and local people in forest villages.[17] Covering 80.73 mha or 24.56 percent of the geographical area of the country, forests are home to 80 percent of the terrestrial biodiversity, provide 40 percent of energy needs, and 30 percent of the fodder supply.[18] Besides driving sustainable growth, forests act as a natural stabilising agent for the climate as they regulate carbon cycle significantly. Carbon sequestration through photosynthesis is considered one of the most potent and inexpensive methods for climate change mitigation. The 2020 Assessment of Climate Change over the Indian Region directs the emphasis of forest policy towards green urban spaces and forests.[19] The report also highlights the role of trees in mitigating the devastating impacts of droughts, flash floods and landslides, and in increasing coastal infrastructure resilience.[20] Forests are the only unique, safe and inexpensive carbon capture and storage technology that is naturally available at scale with the potential to neutralise global CO_2 concentrations.

Unfortunately, due to the over-dependence on forests of large populations and the unsustainable exploitation of their resources, India has witnessed rapid deforestation[b] in the last decades, leading to the degradation of over 30 percent of its land and a loss of 1.6 mha of forest cover.[21] According to government data, in the last 30 years, 14,000 km² of forests were cleared to accommodate 23,716 development and industrial projects across India.[22] Besides

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b   Deforestation occurs when a land initially dominated by naturally occurring tree species is converted to provide certain services in response to human demand. The UN Food and Agricultural Organization (FAO) defines 'deforestation' as the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10-percent threshold. Swathes of forest areas around the world are cleared for agriculture, logging, mining and large-scale developmental projects.

rapid land conversion, the harvest of an estimated 850 Mt of fodder, 100 Mt of fuel wood, and 15 Mt of timber annually beyond the sustainable limits have led to the degeneration of India's forests.[23]

The *India State of Forest Report-2019* published by the Forest Survey of India classifies forest cover into: (i) Very Dense Forest (VDF); (ii) Moderately Dense Forest (MDF); and (iii) Open Forest (OF).[24] It estimates the total forest cover at 21.67 percent of the total geographical area of the country. Fig. 1 depicts the percentage of the forest cover categories in the country. The report mentions that total green cover has increased by 3,976 km^2 between 2017 and 2019, and attributes such improvement to better conservation and protection measures, agroforestry, and tree plantation drives .[25]

At the same time, however, India is seeing a massive deterioration in the health of its forests, with the growing stock (GS) decreasing significantly by 586.387 million cubic meters (M cum) or 12.26 percent. The reduction in GS, despite increasing forest cover, is an indicator of forest degradation (See Table 1). Within the forests recorded officially by government authorities, 94.96 percent are prone to crop injuries, 39.94 percent has inadequate regeneration, and 5.05 percent has no regeneration.[27] Forest degradation undermines the ability of forests to act as carbon sinks. Nevertheless, the ISFR-2019 report paints a fairly rosy picture of the status of tree cover and growing stock relative to the ISFR-2017 findings. The total growing stock increase is about 93.38 M cum or 1.6 percent compared to 2017 estimates.

Fig. 1: Forest cover in India
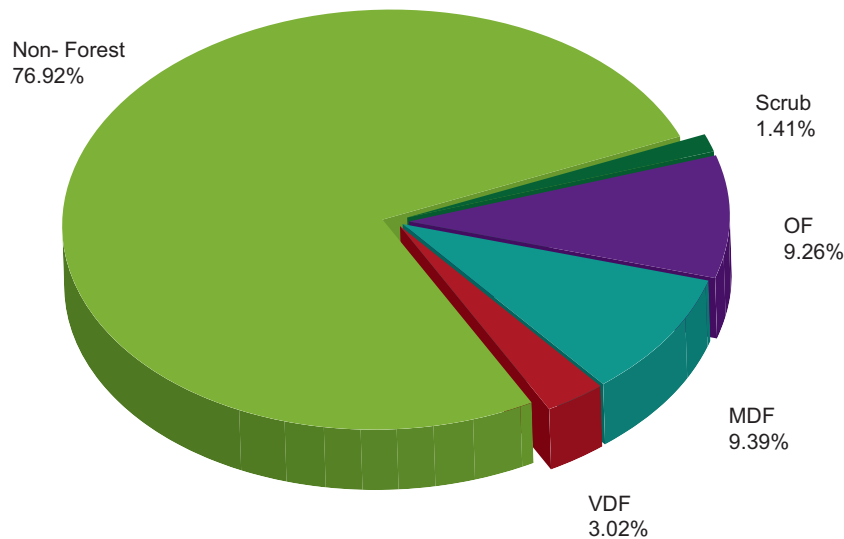
Source: ISFR-2019.[26]

Table 1. Trends of Forest Resources as Reported in India's State of Forest Reports (ISFR)

Forest Resource Accounting Variable	ISFR 2003	ISFR 2005	ISFR 2009	ISFR 2011	ISFR 2013	ISFR 2015	Net Change between 2003 to 2015	% Change between 2003 to 2015
Forest Cover (in square kilometers)	686,767	692,027	690,899	692,027	697,898	701,673	14,906	2.17
Growing Stock in Forest (million cubic meters)	4781.414	4602.04	4498.7	4498.7	4173.36	4195.047	-586.367	-12.26
Growing Stock in Forest and Tree outside forests (million cubic meters)	6413.752	6218.28	6098.2	6047.15	5658.05	5768.387	-645.365	-10.06

Source: TERI 2017,[28] based on data from Forest Survey of India 2003, 2005, 2009, 2011, 2013, 2015

According to the latest ISFR report, (2019),[29] the total forest and tree cover in the country has increased by 5,188 km² in the last two years. However, the cover under the category of 'dense' and 'moderately dense' forests as determined in 2017 has degraded into open forests, scrub, and even non-forest areas at an unprecedented rate (See Table 2). Open forests have low tree cover density, and therefore, an even lower carbon sequestration capacity.[30]

Table 2: Forest cover change matrix for India between 2017 and 2019 assessments

2019 Assessment						
Class	**VDF**	**MDF**	**OF**	**Scrub**	**NF**	**Total ISFR 2017**
Very Dense forest (VDF)	97,309	626	50	2	171	98,158
Moderately dense forest (MDF)	1755	303,781	699	109	1974	308,318
Open Fores (OF)	127	2244	289,358	1069	8999	301,797
Scrub	2	48	1,732	41,831	2,366	45,979
Non forest (NF)	85	1,773	12,660	3,286	2,528,413	2,533,217
Total ISFR 2019	99,278	308,472	304,499	46,297	2,528,923	3,287,469
Net Change	1,120	154	2,702	318	-4,294	

🟩 Gain

🟥 Loss

Source: India State of Forest Report 2019[31]

While the 2019 report highlights increased tree cover, according to the Global Forest Watch (GFW)[32] the percentage of intact forest in India accounted for only about 6.7 percent as of 2016 (See Figure 2). The tree cover referred to in the 2019 report accounts for natural (intact) forests along with plantation and other non-forested areas. This considerably skews the perception of the actual capability of the Indian peninsula for carbon sequestering. The capacity to store carbon is 40 times higher for natural forests as compared to plantations. Additionally, 96 percent of the tree cover loss from 2013 to 2019 has occurred in natural forests (See Figure 3).[33]

Figure 2. Intact Forest in India

As of 2016, **6.7%** of **India's** tree cover was **intact forest**

Intact Forest
2.31 Mha

Other Tree Cover
32.1Mha

Non Forest
281Mha

Source: Global Forest Watch [34]

Figure 3: Loss of Tree Cover in India's Natural Forests (2013 – 2019)

From **2013** to **2019, 96%** of tree cover lost in **India** occurred within **natural forests**. The total loss within natural forest was equivalent to **347Mt** of CO_2 emmissions
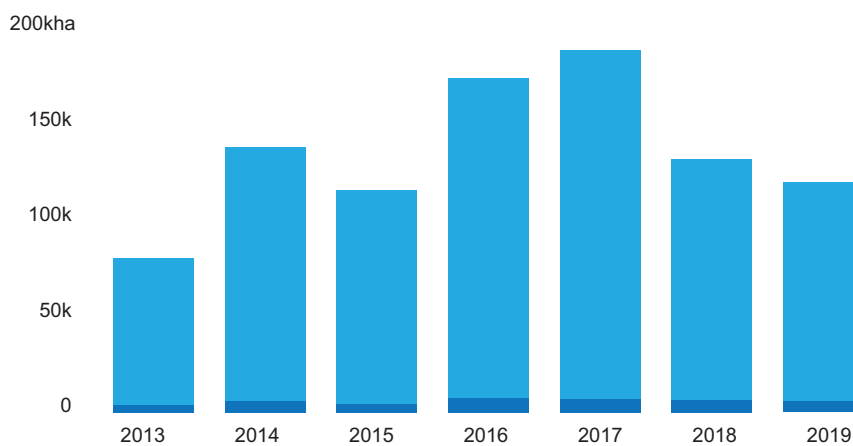
2010 tree cover extent | > 30% tree canopy

Source: Global Forest Watch[35]

Deforestation and loss of tree density of forests decreases the carbon assimilation capacity and reduces the forest soil's organic carbon, thereby affecting the productivity of the ecosystem to act as a carbon storage. Therefore, the larger the green cover of the forest and the older and healthier the trees are, the better is its capacity to sequester carbon.

The capacity of a very dense forest is naturally highest, followed by the moderately dense, and the open forests. Dense tropical forests that are rich in biodiversity have the greatest potential to absorb the highest amount of carbon dioxide (CO_2) from the atmosphere.[36] Continuous, unchecked deforestation and forest degradation has resulted in significant reduction (12.6 percent) in the growing forest stocks and caused nearly 172 tonnes of carbon emissions as per World Resources Institute (WRI) over the last two decades.

To begin with, India is already a country that is most vulnerable to climate change. An undermined capacity of forests in balancing the ecosystem due to a rapid pace of deforestation would only exacerbate the frequency and intensity of climate change impacts such as unprecedented rains in monsoon, and severe droughts. Furthermore, for a highly resource-dependent country such as India, any severe degradation of forests would have far-reaching ramifications for the economy, food and water security, and climate solutions. According to a study by the non-government TERI (The Energy and Resource Institute), the degradation of India's forests

Fig. 4: Forest and Landscape Restoration Opportunities
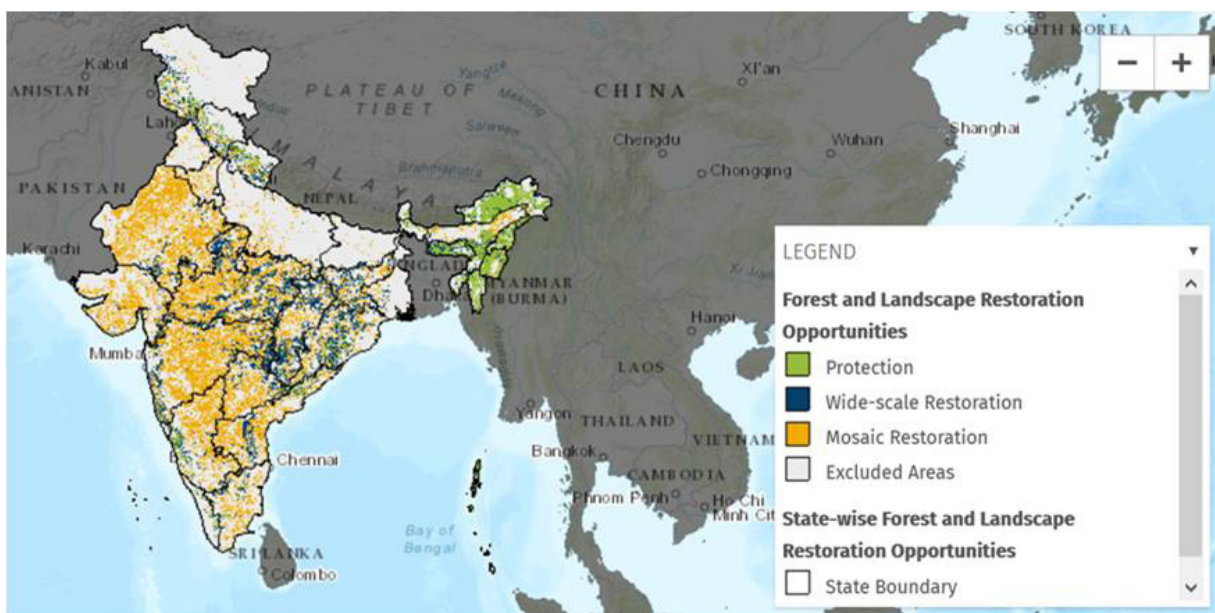
Source: WRI[38]

is depriving the country of 1.4 percent of its GDP annually.[37]

Fig. 4 provides an insight into the 140 Mha available for possible protection opportunities and landscape restoration.[39] Halting the depletion and degradation of forest ecosystems and promoting their restoration can contribute over one-third of the total climate change mitigation that India requires to meet the Paris Agreement targets by 2030.[40]

FOREST GOVERNANCE IN INDIA: KEY POLICIES

The creation of forestry policies in India traces back to British rule, when forest governance was highly centralised. Systematic forest management began with the passing of the Charter of Indian Forests by the British colonialists in 1855, and then moved on to scientific and organised forestry[41] with the appointment of an Inspector General of Forests in 1864. Since 1952, India has devised proactive policies and programmes aimed at forest conservation and restoration. The Indian Forest Policy of 1952 provided a formal recognition to the protective role of forests and established a national target of 33 percent for forest cover.[42] Later, the Forest (Conservation) Act 1980 (amended in 1988 and 2003) and Wildlife (Protection) Act 1972 were enacted to control further deforestation of forest areas in India by making the approval of the central government mandatory for the

diversion of forest land for non-forest purposes. The National Forest Policy was issued some years later, in 1988,[43] and brought a paradigm shift from a revenue-oriented forest management approach to a conservation-oriented one.

The 1988 policy, which was finally implemented in 1990, laid the foundation of the joint management approach that necessitated the coordination between village communities, NGOs, and State forest departments. Over the years, the unabated degradation of the country's forest cover pushed the government to enact The National Forestry Action Programme in 1999, with the key aim of raising forest cover to 25 percent by 2007 and 33 percent by 2012.[44] Consolidating all afforestation schemes under the Ministry of Environment and Forests, the National Afforestation Programme (NAP) was launched in 2002[45] as part of the Tenth Five-Year Plan. Meanwhile, the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 recognises the traditional rights of communities over forest land and addresses issues concerning the transfer of forest lands under the management of tribal communities, to the state government.[46] This also highlighted the history of Indian forest management as being spearheaded by local communities. The National Action Plan on Climate Change (NAPCC) 2008[47] commits to bring one-third of India's geographic area under forest cover, through afforestation.

These policies would indicate that India has a strong policy framework that emphasises the conservation aspect of forest ecosystems. Furthermore, in an attempt to restore deforested and degraded land, India has taken up various other commitments, such as the Nationally Determined Contributions, and the Bonn Challenge. However, despite these rigorous efforts in policy and programmes, India's combined forest and tree cover has only increased to 24.56 percent of the geographical area,[48] provoking significant concerns over the achievement of both the country's targets for forest conservation, and climate goals.

EVALUATING INDIA'S AFFORESTATION PROGRAMMES

Definition and methodology

The Forest Survey of India (FSI) relies on satellite imagery. It defines 'forest cover' as "all patches of land, with a tree canopy density of more than 10% and more than one hectare in area, irrespective of land-use, ownership and species of trees."[49] By this definition, any mango/orchards, coconut and coffee plantations, or urban parks are also 'forest cover,' therefore, giving an incomplete picture of the country's forest resource. A technical assessment by the UNFCCC of India's submission on forest cover has raised concerns about the country's definition of forests, as it masks deforestation and exaggerates the expanse of forest cover. Experts estimate at least 87,910 km^2, or about 12.7 percent of the total forest cover, could be the area under plantations or monocultures—for produce such as tea, coffee, areca nut, eucalyptus, mango, rubber, and oil palm—which all fall under India's definition.[50]

Forest degradation is difficult to detect from spatial data and is a critical parameter to monitor impacts on biodiversity and carbon sequestration.[51] A satellite image only captures the density of tree canopy and is incapable of differentiating between a plantation and a forest. Moreover, satellite mapping fails to give any insight into the quality and status of biodiversity of these forests. Therefore, even when the area of forest and tree cover shows a rise, there is no accurate knowledge on the exact area or cover under 'natural forests,' or biodiversity—such as in the Western Ghats or Himalayan forests.

The FSI methodology has been critiqued for other reasons as well, such as lack of clear description of the change matrix,[c] its broad definition of recorded forest area (RFA), and absence of appropriate monitoring of forest fragmentation. The issues of RFA and forest fragmentation are

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c   The change matrix highlights the percentage of very dense forest that has been converted to open forest, thereby revealing the true capacity for carbon sequestering.

yet to be addressed since the FSI do not have available personnel on a contractual basis[52] in place of scientists who could undertake higher-level research.
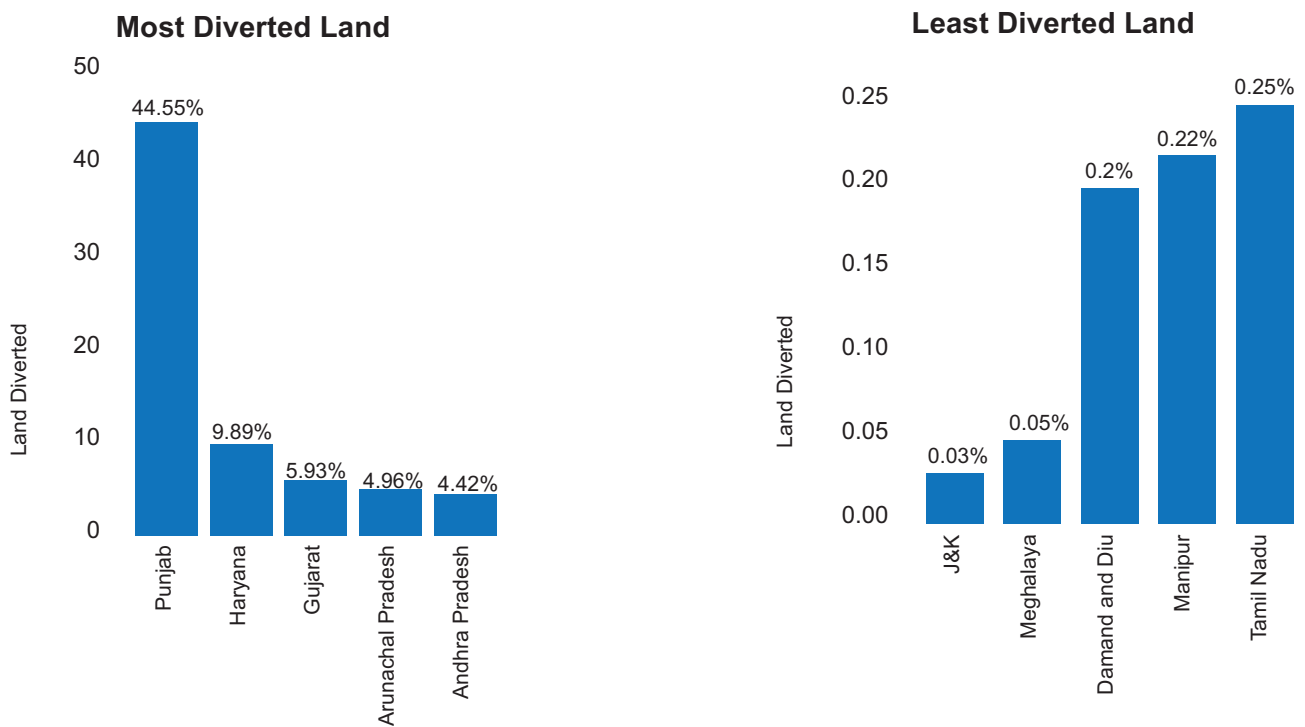
Forest diversion

Due to this definition and assessment, the government therefore believes that forests are replaceable and could be easily recreated on another land, allowing rapid diversion of forest land for infrastructure development and industrial purposes. Between 2015 and 2018, the MoEFCC has issued permits to clear and divert 20,314.12

ha of forestland;[53] this is almost the size of Kolkata.

Between 2017 and 2018, nearly 50,000 ha (500 km^2) of forest was diverted for industries, mining, and roads. In the first half of 2019, 9220.6 ha was approved for diversion, of which nearly 60 percent was in very dense and moderately dense forest (See Figure 5). India's state of forest report does not account for the changes, increase or decrease of forest cover, plantation rates, or forest regeneration. A WRI study found that India has lost 122, 748 ha of prime forest in four years.[55]

Figure 5: Forest Land Diverted for Industrial Projects

Source: Firstpost[54]

Figure 6: Forest Land Recommended for Diversion (January - June 2019)

Forest land by canopy density

34.22%
Open Forest

55.97%
Moderately Dense

6.23%
Scrub

3.58%
Very Dense
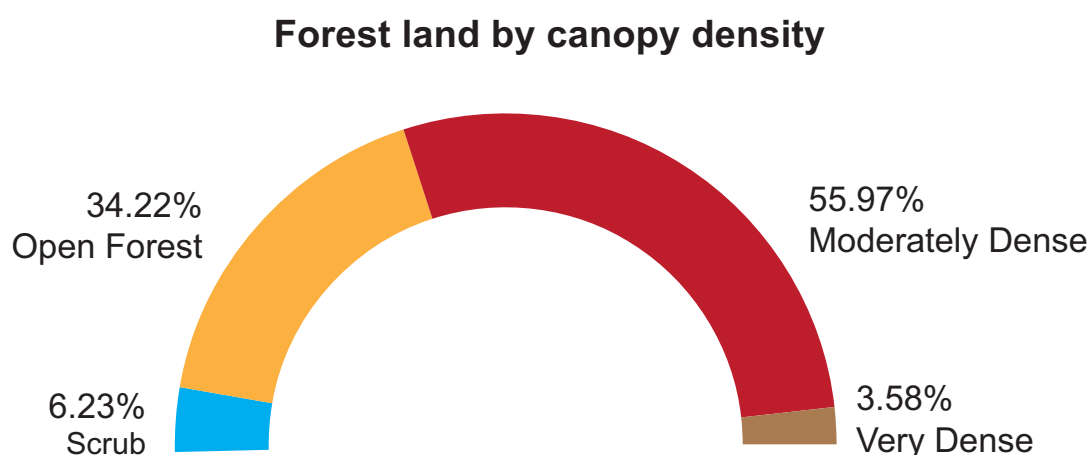
Figures in percentage. Forest Land recommended for diversion in Jan- June 2019

Source: Analysis of Forest Diversion in India 2019[56]

Table 3: Diversion for Non-Forestry Projects

State	Number of Projects	Total Forest Land approved for diversion (in ha)
Andra Pradesh	3	37.82
Bihar	28	453.43
Chhattishgarh	1	207.99
Goa	1	0.93
Gujarat	99	114.01
Haryana	251	519.53
Himachal Pradesh	52	434.36
Jharkhand	11	869.99
Karnataka	11	162.61
Kerala	2	0.26
Madhya Pradesh	220	795.36
Maharashtra	2	151.81
Mizoram	1	23.69
Odisha	14	4514
Punjab	123	411.07
Rajasthan	27	370.34
Tamil Nadu	6	18.45
Telengana	11	2055.05
Tripura	2	1.8
Uttar Pradesh	1	63.27
Uttarakhand	64	159.74
West Bengal	2	102.33

Source: Down to Earth[57]

Compensatory afforestation

The Compensatory Afforestation Programme Fund (CAF) Act, 2016[58] is an intended mechanism to offset the loss of forest by fixing a monetary value for the forest that is to be destroyed and collecting this as "compensation" before issuing forest clearances to projects that necessitate the use of forest areas for non-forest purposes, such as mining and infrastructure. The states are required to use these funds to undertake 'compensatory afforestation' (CA) on an equivalent piece of non-forest land or double the expanse of 'degraded forest' land.

To compensate the loss of 'natural forests,' the afforestation programme focuses on large-scale monoculture, single-variety tree plantations of non-indigenous, commercial species such as eucalyptus and teak, on a non-forest land.[59] As opposed to monoculture plantations, native forests are complex natural ecosystems that hosts 30-40 different native species, that are products of millions of years of evolution, shaped by the biophysical features of specific places.[60]

Unlike forests, government's monoculture plantations lack biodiversity or ecological value, and emphasises neither species selection, nor quality of planting materials and survival rates. Nor are they sufficient to create the ecosystem required for wildlife to thrive. These trees hold little carbon and when they are harvested, carbon is released as the wood is burned. In the absence of an impactful tree-based intervention and

forest restoration strategy, the programme has failed to create substantial ecological value. Furthermore, the CA fund provided for under the act has diminished the authority of *gram sabhas* and further aid forest departments since the funds generated from diversion of the land (around 660 billion) should have been given to the former but is instead being directed to the latter.[61]

Lack of sincere monitoring, assessment, and compliance mechanisms

Various evaluations have reported the rampant corruption and incorrect utilisation of the compensatory afforestation funds. Considering the scale at which forest lands are being diverted, for a land-stressed country hosting 18 percent of the world's population in 2.4 percent of its land, the availability of large swathes of equivalent land for afforestation is of immense challenge. Reports suggest areas where an equivalent amount of land has been earmarked for compensation, most of the lands are in use by the village communities for farming, grazing livestock, or dependency over forest produce. Majority of Indian states have confirmed the unavailability of land banks for planting new forests. In the absence of land, most afforestation is carried over a span of five to ten years, after which the same lands are replanted. The former Project Tiger director, P.K. Sen, in an interview with *India Today*, confessed, "species like Acacia and Eucalyptus were raised, which were then cut for timber and over-lapping plantations were carried out."[62] Such inadequate

offsetting of the loss of forest cover can lead to land conflicts and further undermine the resource rights and food security of vulnerable rural communities.

A ROADMAP FOR FOREST REGENERATION

India's imperative is to ensure that deforestation is curtailed and conservation efforts are pursued for existing biodiversity-rich forests and other vital ecosystems like wetlands and grasslands, which are highly productive and harbour wildlife, many of which are endangered. This would require the cessation of land use change, work on forest conservation with greater urgency, and more focused land restoration. At the policy level, forest plantations should no longer be equated with natural forests.

Redefining 'forests' and how to measure them

An important element of a sound roadmap for forest regeneration is a redefinition of what is considered a 'forest'. Moreover, rather than rely on satellite mapping of canopy cover or hectares of trees, focus should shift to the measurement of the relative density of a 'thriving forest' or an 'ecosystem'. FSI needs to reorient itself to an ecosystem assessment and restoration approach in order to assess the 'accurate' forest cover of India. There is also a need to delineate areas under orchards, bamboo, and palm cultivation (such as coconut) for an exact assessment of carbon stocks of forests.[63] Employing the latest satellite or aerial remote sensing and GIS technologies

for real-time mapping of the forest land, would offer an important solution.

India must submit to the UN the correct Forest Reference Levels (FRL) using satellite data and ground-truthing. This will support the UN's efforts at assigning value to the carbon stored in forests to create incentives for developing countries through Reducing Emissions from Deforestation and Degradation (REDD+).[64] In 2018, UNFCCC had directed India to modify its assessment and give a break-up of geographical areas under mono-cultures, plantations, and other types of forests. The assessment of forest cover should not be reduced to mere calculation of land areas. Forest cover is integral to India's sustainable development which is directly connected with livelihoods and biodiversity. By counting new plantations as forest cover, policies and programmes will continue to remain ineffective and ignore the ecological and livelihood security linked with forests, thereby allowing massive degradation of India's natural forests even further.

Updating forestry policies

Instead of allocating huge funds for a large-scale plantation model, the MoEFCC should recreate a policy framework on forest management aimed at curtailing deforestation and land use change, while improving the ecology and biodiversity of a landscape as a whole that would ensure food security, water availability, and climate adaptation for communities. Proper conceptualisation and benchmarking of 'natural forests' is

critical for creating the effective measures for restoration and conservation of forests. Employing a science-based methodology with a participatory approach will help government agencies determine the right type of tree-based interventions most suitable to certain land use. The Restoration Opportunities Assessment Methodology (ROAM) framework could be adopted at scale for rigorous analysis of spatial, legal, and socio-economic data to plan for the best interventions for forest restoration.

Effective institutional and monitoring mechanism

A successful forest programme will depend on creating strict institutional mechanisms for the effective utilisation and monitoring of funds. In the last decade, numerous petitions have been filed with the National Green Tribunal and Supreme Court on the misuse of CAMPA funds and negligent monitoring by the states. The state governments must put in place robust action plans for appropriate fund management, conduct an inventory of interventions, and create transparent information systems for relevant stakeholders. Geo-tagging technology would prove a valuable tool for online recording, monitoring, and checking leakages as well as efficient mapping of forest landscapes.[67]

Empowering local communities

For a forest landscape as diverse and densely populated as India's, the agency of local communities in operational decision-making and forest governance is essential. The participation of local communities must work synonymously with the coordination of impartial and credible processes to operationalise sustainable use and conservation strategies. Any effort to regenerate or afforest lands will require the government to recognise the long-standing knowledge systems and community efforts in protection of forests by formally establishing the authority of the *gram sabhas* in forest stewardship.

The decision over where, what and how to plant and regenerate degraded lands should be placed in the hands of local communities, who have greater capacity to undertake adaptive management and maintain close oversight compared to a distant forest bureaucracy. The National Bank for Agriculture and Rural Development's 'Wadi' model is an excellent example of community-managed plantations[68] that have delivered significant ecosystem and economic benefits. A performance monitoring system created through a combination of remote sensing and GIS technologies and ground-level verification would be immensely useful to evaluate the impacts.

CONCLUSION

The forest sector in India has a huge potential to mitigate climate change by achieving an additional 3 billion tonnes of carbon sequestration by 2030. However, achieving this would require serious efforts towards conservation, restoration and regeneration of the country's forests.

The sector has highly ambitious targets to achieve, yet there are significant implementation challenges. In the last few years, India has witnessed a degradation of its dense forest cover at an unprecedented rate. While it may seem that there is political will and financing available for an ambitious forest programme, there is an urgent need for reimagination and innovation in creating an integrated forest management framework, if India wants to harness its climate and sustainable development benefits. Given the critical state of India's forests, the government must demonstrate a sense of urgency in proper planning its afforestation programme and do serious implementation on the ground. ⦿RF

ABOUT THE AUTHOR

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