IORA
Ecological Solutions

Designing Forest, Biodiversity & Climate Incentives through the 16th Finance Commission: Assessment of Fiscal Options

Submission to the 16th Finance Commission of India

October 2025

Designing Forest, Biodiversity and Climate Incentives through the 16th Finance Commission: Assessment of Fiscal Options

By

Iora Ecological Solutions Pvt. Ltd (IORA)

October 2025

“If you want one year of prosperity, plant corn,

If you want ten years of prosperity, plant trees,

If you want on hundred years of prosperity, educate people.”

-Confucius, about 3000 years back

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Foreword

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Dated: October 21, 2025

Foreword

Forests and the rich biodiversity they nurture lie at the very core of India's ecological and economic security. They sustain livelihoods, regulate climate, safeguard water resources, and provide a multitude of ecosystem services that are indispensable to human well-being. As India charts its path toward climate resilience and sustainable development, it is essential that ecological considerations are seamlessly woven into the country's fiscal and policy architecture.

Successive Finance Commissions of India have progressively recognised this imperative. Beginning with the 12th Finance Commission's acknowledgment of forestry, to the inclusion of forest cover in the devolution formula under the 14th Finance Commission, and the dedicated 10 percent weightage for 'forest and ecology' in the 15th Finance Commission—each step has strengthened the recognition of the vital linkages between ecology, economy, and equity. The 16th Finance Commission now stands at a defining juncture, with an opportunity to broaden the scope of Ecological Fiscal Transfers (EFTs) beyond forests, encompassing biodiversity conservation, climate resilience, and ecosystem restoration.

This report—Designing Forest–Biodiversity and Climate Incentives through the 16th Finance Commission: Assessment of Options—is a timely and valuable contribution. It synthesises expert insights and offers a robust framework for integrating ecological parameters into India's fiscal planning. The study reviews past approaches, identifies data and institutional gaps, and proposes measurable indicators to guide future devolutions to the forestry and environment sectors. Its approach is rooted in rewarding states not only for maintaining ecological balance but also for measurable improvements in performance.

The report emphasises the need to align fiscal incentives with quantifiable ecological outcomes, expanding the focus to include Trees Outside Forests (ToF), wetlands, grasslands, mangroves, and coastal and marine ecosystems. It proposes a dual-tiered framework—comprising core indicators such as dense and open forest cover, ToF extent, groundwater stress, and forest fire incidence, alongside aspirational indicators such as biodiversity integrity, ecosystem restoration, and adaptive capacity. It also calls for integrated ecological databases, Green Budget Tagging, ring–fencing of fiscal transfers, alignment of fund release cycles, empowerment of local institutions, and stronger collaborations with scientific and technical institutions.

I commend IORA Ecological Solutions—Mr. Swapan Mehra, CEO, and Dr. (Mrs.) Madhu Verma, Senior Economic Advisor & Chief Environmental Economist, the Study Lead – and their dedicated team for this insightful and forward–looking study. I'm confident that the findings and recommendations presented in this report will be of great value to the 16th Finance Commission in developing an innovative framework for ecological fiscal transfers—one that recognises the true worth of India's forests, biodiversity, and ecosystems, and rewards states for their stewardship in preserving them for future generations.

[Bharat Lal]

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Message

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Former Member, National Statistical Commission

Dated: October 22, 2025

Message

India stands at a critical juncture in its development journey, where the pursuit of economic growth must be harmonised with the protection of its rich ecological and natural heritage. Forests, biodiversity, and ecosystems form the backbone of environmental sustainability and are critical assets for inclusive growth, human well-being, and climate resilience. Recognising their ecological and economic significance within the framework of fiscal federalism is therefore both timely and imperative.

Having been engaged for long with issues of regional development, equity, and fiscal policy, I view this initiative as a significant step forward in embedding ecological considerations within the architecture of intergovernmental transfers. It reflects a growing recognition that environmental sustainability and economic progress are not opposing objectives but complementary pillars of long-term national development.

This report, "Designing Forest-Biodiversity and Climate Incentives through the 16th Finance Commission: Assessment of Options", makes an important contribution to this endeavour. Building upon the progressive steps taken by the previous Finance Commissions, it advances a comprehensive framework for integrating ecological parameters into fiscal transfers. The study's analytical rigour anchored in scientific reasoning, economic analysis, and extensive multi-stakeholder engagement adds both depth and empirical robustness to its findings.

Particularly commendable is its emphasis on measurable and performance-oriented incentives, besides the stock variables that reflect the current deficits. By proposing a mix of stock-and-flow indicators that address the twin objectives of ecological conservation and improvement therein, the report ensures that fiscal transfers are designed not merely as compensatory mechanisms but as catalytic instruments that drive sustained ecological outcomes. This distinction between 'stock', viz. the existing ecological assets and 'flow', viz. the annual ecological delta, is vital for a fair and forward-looking devolution formula. Recognising both stock and flow, ensures that states are not only compensated for ther natural disadvantages and rewarded for maintaining their natural wealth but also incentivised for recent efforts toward restoration, enhancement, and sustainable management.

The process adopted for the study is equally robust. The team constituted a Scientific and Technical Advisory Committee (STAC), with members of which, it engaged at every step of the study, and vetted the methodology and analysis. The team conducted three regional workshops, engaging more than a hundred participants in each, representing diverse ecological regions, and convened over a dozen Expert Consultations to bring in multiple disciplinary perspectives, validate methodologies, and refine policy recommendations. This participatory and consultative approach has greatly enriched the study, ensuring that the analysis framework is both scientifically robust and operationally grounded. The report's focus on developing integrated ecological databases, institutionalising Green Budget Tagging (GBT), and enhancing institutional as well as community-level capacities lays a strong foundation for accountability, transparency, and impact assessment.

The enormous efforts by Dr. (Mrs.) Madhu Verma, Senior Economic Advisor and Chief Environmental Economist, IORA Ecological Solutions (IORA), Mr. Swapan Mehra, CEO, IORA, and their dedicated team at IORA in producing this study, successfully address the sensitive issues of economics of federalism along with emerging ecological concerns. This work will help in operationalisation of the recommendations of the Sixteenth Finance Commission within an innovative and forward-looking framework that recognises the true value of India's Natural Capital while promoting cooperative and sustainable federalism.

I am also confident that the report will serve as a valuable reference for policy makers, and administrators along with researchers and practitioners for a serious rethinking on fiscal mechanisms that can foster ecological resilience, equitable growth, and sustainable development across India.

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Executive Summary

Forests, biodiversity, and climate resilience together underpin India's ecological sustainability and long-term economic stability. Yet, the fiscal architecture through these assets has remained narrow in scope and uneven in impact. While successive Finance Commissions (FCs) have progressively acknowledged the ecological role of forests— from grants in the FC12, to an introduction of forest cover in the devolution formula under the FC14, and finally, to a 10 percent weightage for forests and ecology in the FC15—this graduation framework has largely remained forest-centric and insufficiently aligned with the broader ecological services that states provide. States rich in natural capital continue to face significant opportunity costs by foregoing revenue from agriculture, industry, and infrastructure while simultaneously bearing the fiscal burden of conservation, restoration, and disaster management.

This study, undertaken to convey the FC16, a new ambitious framework set out to examine how ecological fiscal transfers (EFTs) could be broadened and strengthened to reflect India's full ecological diversity and climate resilience needs. The approach combined a review of global and national literature on EFTs, analysis of past FCs proposals, and the development of guiding questions to frame dialogue. A multi-layered consultation process was therefore carried out: a Scientific and Technical Advisory Committee (STAC) provided technical validation, regional consultations captured diverse subnational realities, and targeted interviews with experts ensured feasibility within India's fiscal federal structure. This way, this report makes a fresh and new methodological breakthrough. Subsequently, climate and economic modelling further tested the robustness of proposed ecology related indicators. This iterative process allowed the study to identify both immediate, operational options and longer-term aspirational directions towards fiscal reforms.

In terms of findings, four major recommendations are placed before the FC. First, the highlight that while the forest cover criterion was a landmark reform, it does not sufficiently capture the complexity of India's ecological landscape. Wetlands, grasslands, coastal and marine systems, agroforestry, and Trees Outside Forests (ToF) are critical to water security, biodiversity richness, and carbon sequestration, yet remain excluded from fiscal reform formulas. Similarly, performance-linked incentives remain weak, with limited accountability on how transferred funds are deployed.

To address these gaps, the study then proposes that the core ecological indicators for the FC16 should be structured as stock-and-flow measures—recognising both the existing ecological assets (stock) and the changes in these assets over time (flow). This approach ensures that fiscal transfers not only compensate states for the opportunity costs of maintaining ecological resources but also incentivise them to bring about positive improvements in forest cover, ecological health, and related outcomes. Building on the study's analytical and consultative foundation, the report recommends a two-track framework of ecological indicators to guide the FC16 approach. The first track comprises operational stock-and-flow indicators—forest cover and density (Very Dense Forest (VDF) and Moderately Dense Forest (MDF)), Carbon Stock, ToF, Protected Area (PA) coverage, Groundwater Status, and Forest Fire Mitigation—grounded in nationally

available datasets and designed to reward both conservation and improvement. The following table summarises are core indicators with the rational for incorporation with the FC metric.

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Indicator	Metric definition	Rationale	Data Source
Forest Cover and Density	**Stock**: State's share of national forest area and density class (Very Dense and Moderately Dense). **Flow**: Biennial changes in state's forest area and density to national forest area and density class. Reward increase in forest cover and density	Preserves continuity of ecological criterion; recognises quality via density; nationally standardised.	ISFR (FSI)
Protected Area coverage	**Stock**: State's share of national PA network. **Flow**: Change in state's PA coverage as a proportion of the change in National PA. Reward increase in PA coverage	Recognises durable conservation commitments with co-benefits for biodiversity, water, and zoonotic-risk reduction.	WII-ENVIS
Carbon stock	**Stock**: States's Share of national carbon stock. **Flow**: Change in state's carbon stock as proportion of the change in National carbon stock. Reward increase in carbon stock	Aligns with NDC sink targets; values quality of forest, not just area	ISFR (FSI)
Forest fire mitigation	**Stock**: State's share of forest area burnt of national total. **Flow**: Change in the state's area burnt due to forest fire as proportion of change in the area burnt at national level. Reward reduction in burnt area.	Rewards preparedness, prevention, and early response; reduces carbon loss and biodiversity risks.	ISFR (FSI)
Trees Outside Forests	**Stock**: State's share of ToF of national ToF. **Flow**: Change in the state's ToF as proportion of national ToF. Reward increase in ToF area.	Internalises tree cover benefits in agrarian/urban/peri-urban landscapes; links to resilience and livelihoods.	ISFR (FSI)
Groundwater resource status	**Stock**: State's share in number of critical and semi critical blocks of national total. **Flow**: Change in the state's critical and semi critical blocks as proportional to national total. Reward decrease in number of semi-critical/critical blocks	Integrates hydrological resilience; rewards proactive groundwater management; addresses one of India's most acute ecological risks.	CGWB

Thirdly, the set of indicators are widened—covering biodiversity integrity, ecosystem vulnerability, restoration outcomes, and disaster preparedness—that would be important for assessing the ecological performance of states in a more nuanced way. These indicators have the potential to significantly strengthen tax devolution formulas, provided a robust central database is developed and maintained to generate consistent, reliable, and comparable information across states. Until such systems are fully established,

they remain aspirational but signal the direction for future reforms.

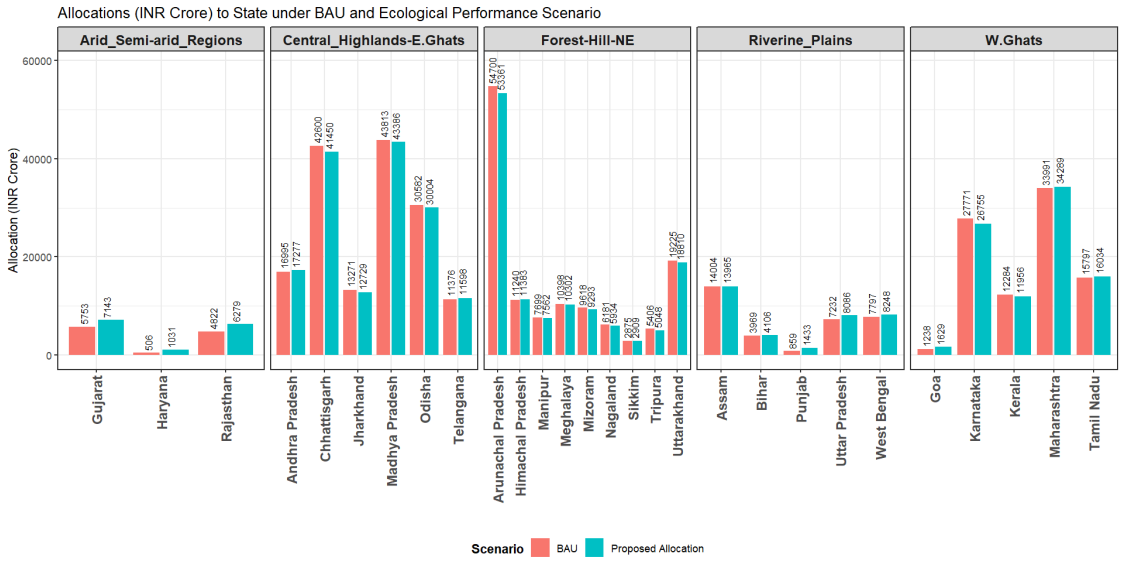
This is the fourth major proposal before the FC. A set of aspirational indicators—including soil health, water quality, grassland and agroforestry extent, restoration quality, invasive species, and biodiversity richness—were identified for phased adoption once national datasets and monitoring systems mature. The list of aspirational indicators are summarised in the following table.

These metrics, extending to blue-carbon and urban ecosystems, will enable future FCs to capture the full spectrum of ecological resilience, climate adaptation, and biodiversity performance across India.

Indicator	Description	Rationale	Status
Soil health (SOC, nutrient status)	Captures soil fertility, productivity, and climate mitigation potential.	Links agriculture, forestry, and carbon sequestration.	Requires standardised soil monitoring systems.
Status of water resources (quality & quantity)	Tracks surface water health and hydrological regulation.	Complements groundwater data; relevant for agriculture and drinking water security.	Limited comparable datasets.
Invasive species extent	Monitors spread of invasive species and management effectiveness.	Important for biodiversity and restoration outcomes.	Needs systematic surveys.
Population pressure on ecosystems	Tracks human-driven pressures (encroachment, extraction).	Highlights demand-side stresses on ecosystems.	Needs harmonised socio-ecological datasets.
Human–wildlife conflict reduction	Assesses conflict incidents and mitigation effectiveness.	Reflects conservation outcomes and coexistence.	Data fragmented across states.
Species/biodiversity richness	Evaluates diversity and abundance of species as integrity measure.	Core biodiversity indicator; strengthens ecological resilience assessment.	Requires consistent monitoring protocols.
Status of wetlands, mangroves, blue ecosystems	Tracks extent and health of aquatic and coastal ecosystems.	High carbon, biodiversity and coastal protection value.	Data uneven; state-specific coverage.
Organic farming adoption rates	Measure of contribute significantly to the environment and also human health	PKVY, State Reports	Certification data fragmented; adoption not fully tracked
Urban air and water pollution	Composite measure of state efforts for pollution abatement at the source	CPCB/SPCB, AMRUT	Regular but gaps in sensor coverage and standardisation.

Indicator	Description	Rationale	Status
Climate vulnerability index	Composite measure of ecological and community resilience to hazards.	Aligns with climate adaptation and risk reduction priorities.	Methodologies vary; requires national standardisation.
Sacred groves & community reserves	Recognises cultural heritage-linked conservation efforts.	Reflects community stewardship and ecological value.	Limited baseline data.

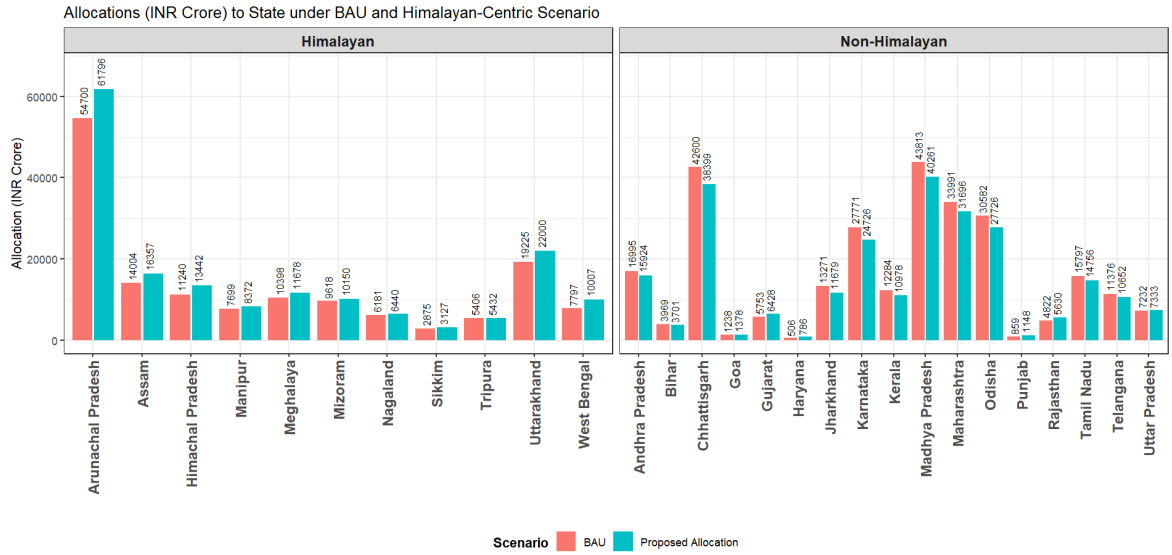
The study further undertakes a scenario-based analysis to test how embedding stock-and-flow ecological indicators would alter fiscal transfers among states. Using recent state-level data on forest cover, ToF, and protected-area extent, two analytical situations were modelled. In the Ecological Performance Scenario, while 80 percent of the divisible tax pool for forestry criteria to be divided based on the allocation algorithm used by the FC15, 20 percent of the divisible pool uses an ecological index developed giving 90 percent weightage to the stock indicator data (forest cover inside RFA, Protected Area and Extent of ToF) and 10 percent to the flow indicator data measuring the change with forest cover and Extent of ToF. Arunachal Pradesh, despite having the highest forest endowment, shows a loss of 167 sq. km. in VDF and 163 sq. km. in MDF, leading to a decline of INR 1,339 crore from its Business-as-Usual (BAU) allocation (INR 54,700 crore to ₹53,361 crore). Similar downward adjustments are observed in Chhattisgarh (−INR 1,150 crore) and Madhya Pradesh (−INR 1,947 crore) due to degradation in dense forest cover. In contrast, Himachal Pradesh records a gain of INR 143 crore, supported by marginal improvements in forest quality and ToF, while Uttarakhand experiences a modest reduction of INR 415 crore linked to canopy loss. Odisha loses INR 578 crore, whereas Telangana and Andhra Pradesh gain INR 222 crore and INR 282 crore, respectively, reflecting improvements in ToF. States in the Indo-Gangetic plains show encouraging results—Uttar Pradesh gains INR 854 crore, and Bihar INR 137 crore, owing to ToF expansion and forest densification.



Western coastal states demonstrate stability, with Maharashtra and Goa gaining INR 298 crore and INR 29 crore, respectively, while Kerala and Tamil Nadu register marginal declines. Notably, arid and semi-arid states benefit under this framework—Rajasthan gains INR 1,457 crore and Haryana INR 525 crore—as ToF and incremental forest density improvements are rewarded. Overall, the revised framework redistributes fiscal advantage from static forest-rich states to those showing positive ecological progress, reinforcing accountability and incentivising performance across all ecological regions. This confirms that introducing dynamic indicators rewards states that invest in restoration and sustainable management rather than those relying only on inherited ecological wealth.

A second scenario – Himalayan Centric Scenario was also assessed. This scenario prioritises the Indian Himalayan Region (IHR) by explicitly recognising its ecological fragility, ecosystem service contributions, and developmental constraints. The design allocates 40 percent of the total divisible pool to IHR states and 60 percent to non-IHR states, acknowledging the disproportionate ecological responsibilities borne by the Himalayan region in maintaining national hydrological balance, biodiversity, and carbon sequestration.

Similar to the previous run, this scenario employs an ecological index to determine state-wise allocations within each regional pool, Himalayan and non-Himalayan. Each of the two pools is divided into two buckets as detailed for Ecological Performance Scenario. This approach captures both ecological endowments and ongoing efforts, while also reflecting regional prioritisation for the Himalayan states. Under the Himalayan-Centric Scenario, Indian Himalayan Region (IHR) states emerge as key beneficiaries due to ecological weighting and regional prioritisation. Arunachal Pradesh shows the highest increase, rising from INR 54,700 crore to INR 61,796 crore (+INR 7,096 crore; 13 percent), while Uttarakhand and Himachal Pradesh gain INR 2,775 crore and INR 2,202 crore, respectively. Other Himalayan states, Assam, Meghalaya, Manipur, Mizoram, Nagaland, and Sikkim, register moderate gains ranging from INR 250 crore to INR 2,300 crore. Collectively, these enhancements channel fiscal support towards ecologically fragile yet nationally vital mountain ecosystems. Conversely, most non-Himalayan states record marginal reductions due to the 40 percent earmarking for the IHR. Chhattisgarh, Madhya Pradesh, and Odisha see declines of INR 3,000–4,000 crore, while Karnataka, Maharashtra, and Tamil Nadu fall by about INR 1,000–3,000 crore. Some states with improving ecological indicators, Rajasthan, Gujarat, Haryana, and Goa, gain modestly. Overall, the redistribution balances regional equity and ecological performance, reinforcing fiscal support for India’s most climate-vulnerable landscapes.



The analysis underscores that ecological fiscal transfers must be designed to simultaneously compensate states for conservation-related disabilities and reward them for measurable improvements in ecological outcomes. By embedding these indicators into the FC16's devolution formula and associated grants, fiscal federalism in India can be transformed into a more equitable and performance-oriented mechanism that aligns state level incentives with national commitments on climate change, biodiversity conservation, and sustainable development.

In doing so, the FC16 has the opportunity to reposit devolution of ecological finance as not just a compensatory measure but as a catalytic investment in resilience, equity, and sustainability—one that secures the country's natural capital base while supporting states in their stewardship of forests, biodiversity, and ecosystems critical for India's future.

Abbreviations

AWS	Automatic Weather Station	**ISFR**	India State of Forest Report
BAU	Business as Usual	**JFMCs**	Joint Forest Management Committees
BMCs	Biodiversity Management Committees	**LiFE**	Lifestyle for Environment
BRSR	Business Responsibility and Sustainability Reporting	**LULUCF**	Land Use, Land-Use Change, and Forestry
BSI	Botanical Survey of India	**MDF**	Moderately Dense Forest
CAMPA	Compensatory Afforestation Fund Management and Planning Authority	**MIS**	Management Information System
CBD	Convention on Biological Diversity	**MoEF&CC**	Ministry of Environment, Forest and Climate Change of India
CGWB	Central Ground Water Board	**MRV**	Monitoring, Reporting and Verification
COP15	15th Conference of the Parties	**NABARD**	National Bank for Agriculture and Rural Development
CPCB	Central Pollution Control Board	**NAP**	National Afforestation Programme
CPI	Climate Policy Initiative	**NAPCC**	National Action Plan on Climate Change
CSR	Corporate Social Responsibility	**NBAP**	National Biodiversity Action Plan
CVI	Climate Vulnerability Index	**NbS**	Nature-based Solutions
EFR	Ecological Fiscal Reform	**NDC**	Nationally Determined Contribution
EFTs	Ecological Fiscal Transfers	**NFI**	National Forest Inventory
ENVIS	Environmental Information System	**NIPFP**	National Institute of Public Finance and Policy
FAO	Food and Agriculture Organisation	**NITI Aayog**	National Institution for Transforming India Aayog
FC	Finance Commission	**NKEFA**	National Key Ecological Function Areas (China)
FC11/ FC12/ FC13/ FC14/ FC15/ FC16	Eleventh/ Twelfth / Thirteenth / Fourteenth / Fifteenth / Sixteenth Finance Commission	**OF**	Open Forest

FSI	Forest Survey of India	**PACIT**	Problem identification, Analysis, Choice of policy/action, Implementation and Testing/evaluating
FY	Financial Year	**PAs**	Protected Areas
GBF	Global Biodiversity Framework	**PBRs**	People's Biodiversity Registers
GBT	Green Budget Tagging	**PES**	Payment for Ecosystem Services
GDP	Gross Domestic Product	**PRI(s)**	Panchayati Raj Institution(s)
GEP	Gross Ecosystem Product	**REC**	Rural Electrification Corporation Limited
GFW	Global Forest Watch	**REDD+**	Reducing Emissions from Deforestation and Forest Degradation (plus conservation, sustainable management, and carbon stock enhancement)
GHG	Greenhouse Gas	**SDGs**	Sustainable Development Goals
GIM	Green India Mission	**SDSS**	Spatial Decision Support System
GIS	Geographic Information System	**SEBI**	Securities and Exchange Board of India
GTF	Global Tiger Forum	**SGWB**	State Ground Water Board
HCVF	High Conservation Value Forest	**SNPP-VIIRS**	Visible Infrared Imaging Radiometer Suite – Soumi National Polar-orbiting Partnership
IBCA	International Big Cat Alliance	**SOC**	Soil Organic Carbon
ICFRE	Indian Council of Forestry Research and Education	**STAC**	Scientific and Technical Advisory Committee
ICMS-E	Imposto sobre Circulação de Mercadorias e Serviços Ecológico (Brazil's Ecological Value-Added Tax Transfer)	**SWOT**	Strengths, Weakness, Opportunities, and Threats
IHR	India Himalayan Region	**ToF**	Trees Outside Forests
IIFM	Indian Institute of Forest Management	**ULBs**	Urban Local Body(ies)
IMD	India Meteorological Department	**UNCCD**	United Nations Convention to Combat Desertification

INCOIS	Indian National Centre for Ocean Information Services	**UNFCCC**	United Nations Framework Convention on Climate Change
INR	Indian Rupees	**USD**	United States Dollar
IPCC	Intergovernmental Panel on Climate Change	**VDCs**	Village Development Committees
IREDA	Indian Renewable Energy Development Agency Limited	**VDF**	Very Dense Forest
ISFR	India State of Forest Report	**WFS**	Web Feature Service
ISRO	Indian Space Research Organisation	**WII**	Wildlife Institute of India
JFMCs	Joint Forest Management Committees	**WMS**	Web Map Service
INCOIS	Indian National Centre for Ocean Information Services	**WRIS**	Water Resources Information System
INR	Indian Rupees	**ZSI**	Zoological Survey of India

Units

°C –	Degree Celsius
Bcm –	Billion Cubic Metres
cm –	Centimetre
Gt –	Gigatonne
GW –	Gigawatt
ha –	Hectare
INR –	Indian Rupee
km –	Kilometre
m –	Metre
m^3 –	Cubic Metres
mm –	Millimetre
Mt –	Million Tonne
MW –	Megawatt
Ppm –	Parts Per Million
sq. km. –	Square Kilometer
t –	Tonne
tCO_2e –	Tonne of Carbon Dioxide Equivalent
TW –	Terawatt
USD –	United States Dollar

Introduction

1. Introduction

This chapter underscores the interdependence of forests, biodiversity, and climate systems as central to promote global and national ecological resilience. Forests cover 30–31 percent of global land, host over 80 percent of terrestrial species, and absorb ~30 percent of global annual emissions. Despite this, about 10 million ha of forests are lost each year globally, largely in the tropics, contributing 11 percent of CO_2 emissions. The loss of 80 million ha of primary forests since 1990 and widespread degradation from logging, fragmentation, and defaunation have eroded ecosystem integrity, reducing regeneration, carbon storage, and power of resilience.

Climate stressors such as altered rainfall, heatwaves, pests, and fires further compound these risks. Soil ecosystems, harboring ~59 percent of species, are deteriorating, undermining hydrology and fertility. Global responses remain fragmented across the UNFCCC, CBD, and UNCCD, though frameworks such as the Paris Agreement and Kunming–Montreal Global Biodiversity Framework (GBF) (30x30 target) aim to align biodiversity and climate agendas through Nature-based Solutions (NbS) and Payment for Ecosystem Services (PES) mechanisms.

India sustains 18% of the global population on 2.4 percent of land, endowed with four biodiversity hotspots with high endemism, yet remains severely threatened by climate vulnerabilities such as:

- **68% of cultivable land is drought-prone; 12 percent flood-prone.**
- **2.33 million ha of tree cover lost (2001–2023).**
- **300 million people depend directly on forests.**
- **175,169 sq. km. of Protected Areas (PAs) (5.32 percent of land).**
- **Charismatic species such as Tiger population: 2,967 → 3,682 (2018–2022; +23.7 percent); but under the threats of poaching.**
- **Very dense forest (VDF) cover: +2,431 sq. km., under the threat of depletion.**

National policies such as NAPCC, Green India Mission, CAMPA, NBAP, and EFTs provide a strong institutional base, but low ecological spending (1.9–3.2 percent of state budgets) and fragmented financing limit this impact. Green finance forms the backbone of both climate mitigation and biodiversity conservation but remains grossly inadequate relative to global and national needs. While mitigation has attracted significant private investment, adaptation and NbS continue to rely heavily on public expenditure, highlighting the structural imbalance in financing flows. Some instances are:

- **Global NbS finance (2022): USD 200 billion vs. need of USD 384–542 billion by 2030.**
- **India's NDC requirement: USD 2.5 trillion (2015–2030).**
- **FY21–22 flows: INR 3,712 billion mitigation (66 percent private); INR 1,092 billion adaptation (98 percent public).**
- **Forestry and land-use gap: ~INR 13,500 billion (~USD 162 billion) by 2030.**

This study aims to support the 16th Finance Commission (FC16) in designing an ecologically anchored devolution framework that (i) expands ecological indicators beyond forest area, (ii) integrates fiscal disability and performance-based metrics, and (iii) aligns with SDGs, GBF, and Paris goals to embed ecological resilience into fiscal policy.

1.1. Linkages across Forest, Biodiversity and Climate Change

1.1.1. Forests and Biodiversity in the Global Climate Framework

The interdependence of forests, biodiversity, and climate change constitutes a foundational nexus for planetary stability and human well-being. Forest ecosystems occupy roughly about 30 percent of terrestrial land and harbor more than 80 percent of terrestrial species of animals, plants, and fungi, while also regulating hydrological cycles, sequestering carbon, and sustaining livelihoods for billions of people (Anderegg et al., 2015, 2020). Their role in climate stabilisation is profound with forests absorbing between 2.6 and 7.6 gigatons of CO_2 annually, nearly 30 percent of anthropogenic emissions (Anderegg et al., 2020; Harris et al., 2021). Beyond carbon sequestration, forests underpin ecological resilience through biodiversity that maintains adaptive capacity and sustains services critical for food, health, and disaster risk reduction (Eisenhauer et al., 2024). Globally, more than half of GDP (~USD 44 trillion) is moderately or highly dependent on nature, including wood fuel used by 2 billion people annually, natural medicines relied upon by nearly 4 billion, and agriculture dependent on pollination and soil biodiversity (Anderegg et al., 2015; Russo, 2020; IPBES, 2016). The macroeconomic value of these services is estimated at USD 150 trillion annually, nearly double the capitalisation of global stock market operations (WEF, 2021).

Despite their systemic importance, forests face intensifying pressures. Deforestation and degradation drive biodiversity loss and reduce carbon storage, creating feedback loops that amplify climate instability (Pfenning-Butterworth et al., 2024). Between 2015 and 2020, 10 million

hectares of forests were lost annually, largely in tropical regions, accounting for 11 percent of global CO_2 sequestration (FAO, 2020). Since 1990, over 80 million hectares of primary forest have been lost, concentrated in biodiversity-rich zones where agricultural expansion, infrastructure, and commodity productions dominate (FAO, 2020; Curtis et al., 2018). Even where forests remain, selective logging, fragmentation, and defaunation erode ecological integrity, undermining seed dispersal, regeneration, and long-term carbon storage (Barlow et al., 2016; Bello et al., 2015). For example, the decline of large-bodied vertebrates alters seed dispersal and tree recruitment, reducing the long-term carbon storage potential of forests (Peres et al., 2016). Long-term monitoring indicates a 73 percent decline in wildlife populations between 1970 and 2020, with significant implications along global food webs (WWF, 2024). The research based on nearly 35,000 population trends and 5,495 species of amphibians, birds, fish, mammals and reptiles reveal that freshwater populations have suffered the heaviest declines, declining by 85 percent, followed by terrestrial (69 percent) and marine populations (56 percent) (WWF, 2024).

Climate-induced stressors superimpose additional risks. Altered precipitation, heatwaves, and extreme variability have triggered widespread tree mortality and disrupted species assemblages (Anderegg et al., 2015, 2020). Insect outbreaks and novel pathogens are intensifying under warming, while altered fire regimes contribute to unprecedented biomass loss (Seidl et al., 2017). Parallel processes in soil ecosystems, which harbor 59 percent of all species, reveal that degradation reduces soil fertility, hydrology, and carbon sequestration capacity (Eisenhauer et al., 2024). The cascading implications extend across systems: pollinator declines threaten 75 percent of food crops worth USD 577 billion annually (IPBES, 2016); freshwater integrity is undermined by wetland loss (35 percent since 1970) (WHO, 2025); and marine analogues, notably coral reefs, have lost 14 percent of live cover between 2009 and 2018, reducing biodiversity by nearly two-thirds (ICRI, 2021; Edyy et al., 2021).

Global governance frameworks attempt to address these links but remain fragmented. The Rio Conventions, *viz.* Convention on Biological Diversity (CBD, 1994), UN Framework Convention on Climate Change (UNFCCC, 1992), and UN Convention to Combat Desertification (UNCCD, 1994) provide mandates for biodiversity, climate, and land sustainability, but often operate in silos. Afforestation schemes that prioritise monocultures illustrate how fragmentation produces trade-offs, privileging carbon sequestration at the cost of biodiversity (Pörtner et al., 2021). Recent frameworks emphasise integration of biodiversity, climate, and land agendas. The Paris Agreement (2015) recognises forests via REDD+, the Kunming-Montreal GBF (2022) commits to 30 percent conservation of land and sea by 2030, and the UNCCD promotes land degradation neutrality. Together, these agendas emphasise NbS such as restoration, agroforestry, and ecosystem-based adaptation as means to align conservation with climate mitigation and development outcomes (Seddon et al., 2021).

Emerging financial instruments such as PES (Sangha et al., 2024), carbon markets (O'Connor, 2008), and nature-based climate solutions (Reise et al., 2025) represent opportunities to embed biodiversity into fiscal frameworks. Yet their effectiveness depends on equitable benefit-sharing, governance transparency, and rigorous monitoring to prevent leakages. Advances in remote sensing (Massey et al., 2023; Sheng et al., 2022), trait-based ecology (Sheng et al., 2022; Aubin et al., 2024), and Earth observation networks (Hird et al., 2021) enhance monitoring capacity, but institutional uptake remains uneven. Closing the gap between ambition and outcomes requires stronger institutional capacity, harmonised ecological datasets, and integration of biodiversity metrics into global climate policy.

Taken together, the global forest–biodiversity–climate nexus is characterised by accelerating vulnerabilities but also transformative opportunities. The erosion of primary forests, coupled with biodiversity loss, exacerbates climate instability and undermines sustainability of economic and social foundations. Conversely, strategies that safeguard intact ecosystems, restore ecological complexity, and sustain functional interactions simultaneously stabilise climate and conserve biodiversity. Embedding such strategies within multilateral frameworks and financial mechanisms provides a pathway for ecological resilience at planetary scale.

1.1.2. The Indian Context: Forests, Ecosystem Services, and Climate Resilience

India has historically recognised forests as essential to human well-being, anchored in constitutional jurisprudence that interprets Article 21-Right to Life as encompassing the right to a healthy environment. Forests in the country function not only as ecological stabilisers but also as cultural, spiritual, and livelihood anchors. Sustaining 18 percent of the global population on just 2.4 percent of global land area, this positions India as both megadiverse and ecologically vulnerable, reflected in a plethora of endemic, threatened, vulnerable, and charismatic species, collectively shaping conservation initiatives (MoEF&CC, 2023). Four global biodiversity hotspots *viz.* the Himalaya, Indo-Burma, Sundalands–Nicobar Islands, and the Western Ghats harbor high levels of endemism and ecological distinctiveness. The country is endowed with 12.6 percent of mammals, 4.5 percent of birds, 45.8 percent of reptiles, and 55.8 percent of amphibians that are endemic (ZSI, 2024). Flagship species such as the Bengal Tiger, Asiatic Lion, One-horned Rhinoceros, and Snow Leopard symbolise to biodiversity wealth, while critically endangered species like the Great Indian Bustard and Dugong highlight growing ecological fragility. These patterns underscore why India remains central to global conservation priorities, balancing human development with the stewardship of its unique natural heritage. Yet this richness faces intensifying threats from habitat loss, fragmentation, invasive species, and compounded climate adverse impacts.

Empirical evidence suggests increasing implications on India's major floral and faunal groups through range shifts, phenological disruption, population declines, and altered community dynamics.


Rhinoceros unicornis


Dugong dugon


P. leo persica


P. tigris tigris


Ardeotis nigriceps

Avian distributions and migratory patterns are moving in response to shifting climate envelopes and altered seasonality, with long-distance migrants particularly vulnerable to habitat loss and timing mismatches (Deomurari et al., 2023). Mammalian species, particularly tigers, are exhibiting altered movement and elevational shifts as animals track changing temperature and precipitation regimes, with consequences for habitat connectivity and human–wildlife interactions (Prakash et al., 2022). Insect assemblages, including managed and wild pollinators, face phenological mismatch with flowering plants, altered voltinism and distributional changes that threaten pollination services essential to agriculture and wild plant reproduction (Subedi et al., 2023). Amphibians show high sensitivity to warming and hydrological change with global analyses and regional studies indicating climate as a major driver of declines through drying of breeding sites, thermal stress, and increased disease susceptibility (Luedtke et al., 2023). Reptile vulnerability assessments likewise identify thermal limits and loss of microhabitats as key risks, with trait-based studies predicting heterogeneous but often severe impacts under warming scenarios (Bohm et al., 2016). Freshwater and marine fishes are experiencing changes in habitat suitability, phenology and landings linked to rising water temperatures, altered stream flows from glacial retreat and monsoon variability, and extreme events that disrupt spawning and fisheries productivity (Pande and Posti, 2023). These collective responses and multi-taxa interactive dynamics positions India amidst a dual challenge: conserving globally significant biodiversity while building resilience against climate-induced risks that manifest unevenly across its varied geographies.

India's geo-climatic profile accentuates systemic vulnerabilities (NDMA, 2024). Nearly 68 percent of cultivable land is drought-prone, 12 percent is flood-prone, and 5,700 km of coastline is exposed to cyclones and tsunamis. Heat stress projections indicate 34 million jobs could be lost by 2030, while a 2°C rise in global temperature could reduce GDP growth by 2.8 percent and lower living standards for half the population by 2050 (Shah, 2025). Hydrological pressures compound these risks: over-extraction has pushed Punjab's withdrawals to 156 percent of recharge (CGWB, 2024), and per capita water availability is projected to decline from 1,486 m^3 in 2021 to 1,367 m^3 by 2031 (PIB, 2024a). Glacial retreat in the Hindu Kush Himalaya at 14.9 ± 15.1 meters annually threatens perennial river flows (PIB, 2024b), while declining soil organic carbon from 1 percent in the 1950s to 0.3 percent today (PTI, 2022) undermines fertility and sequestration. These converging risks imply far-reaching socio-economic and ecological consequences. Rising heat stress and hydrological imbalance are expected to sharply reduce agricultural output, strain rural livelihoods, and heighten competition over water resources. Combined with glacial retreat and soil degradation, these trends threaten to erode India's food and water security, disrupt labor productivity, and slow GDP growth, pushing climate vulnerability from an environmental issue to a systemic development challenge.

Forests remain central to resilience, with 300 million rural people directly dependent (MoEF&CC, 2023) for fuel, fodder, grazing, and non-timber forest products. Yet India lost 2.33 million hectares of tree cover between 2001 and 2023 (GFW, 2023), a 6 percent decline relative to 2000, driven by urbanisation, agriculture, and infrastructure. Around 54.4 percent of forests are exposed to occasional fires,

7.49 percent to moderately frequent fires, and 2.4 percent to high incidence levels (Barik and Roy, 2023). Freshwater ecosystems supporting 190 fish species in biodiversity hotspots such as the Western Ghats are in decline due to pollution and overexploitation (Sayer et al., 2025). Coral reefs and mangroves, critical buffers against extreme events, face warming seas and sea-level rise, threatening coastal livelihoods.

Socio-economic implications are equally significantly damaging, with the 2022 pre-monsoon heatwave reducing wheat productivity by 4.5 percent (Sidhu et al., 2023). Projections suggest that climate change could cut agricultural production by 16 percent by 2030, translating to a 2.8 percent GDP reduction (Shah, 2025). Pollution-related productivity losses cost 8.5 percent of GDP in 2019 (~USD 221 billion) (Gupta and Damani, 2021), while combined heat stress and pollution led to 259 billion labor hours lost between 2001 and 2020, equivalent to USD 624 billion (Parsons et al., 2022). It is estimated that globally 26.4 million people have been internally displaced due to disasters in 2023, of which Indian figures are estimated at 5,28,000 people (IDMC, 2024). While not all weather-related disasters are resultant of climate change, it has been known to make some hazards more frequent and intense, while also exposing communities to higher vulnerabilities.

However, current conservation efforts in India are anchored in a large and growing network of PAs. According to government records, there are 1,014 PAs comprising 106 National Parks, 573 Wildlife Sanctuaries, 115 Conservation Reserves, and 220 Community Reserves, together covering about 175,169.42 sq. km., i.e. roughly 5.32 percent of India's land area (MoEF&CC, 2025a). These PAs serve as the backbone for habitat protection, anti-poaching enforcement, species monitoring, and connectivity planning.

Within these landscapes, several flagship and threatened species have shown signs of recovery under sustained PA management. The All India Tiger Estimation (Qureshi et al., 2022) reports a rise from ~2,967 tigers in 2018 to 3,682 in 2022, a ~24 percent increase, signaling improved habitat, prey base, and anti-poaching effectiveness, under NTCA's leadership. The Asiatic lion in Gujarat has also experienced growth: from 674 individuals in 2020 (MoEF&CC, 2025b) to 891 in 2025, reflecting successful conservation through collective will, dedication, and policies rooted in co-existence. Beyond big cats, other species offer promising though mixed signals. The dian Bustard, once widespread in dry grassland and semi-arid zones, now persists in extremely low numbers (fewer than ~150 in the wild), but recent captive-breeding efforts have produced new chicks and increased the captive population by more than one-third since 2019 (Dasgupta, 2025). In Rajasthan's Desert National Park, authorities have piloted an egg replacement program in which wild eggs are swapped with dummy ones for incubation, then returned before hatching to maintain natural rearing. Such innovations aim to buffer vulnerable populations while their habitats are safeguarded. Building upon this success, India has spearheaded global coalitions such as the Global Tiger Forum (GTF) and the recently launched International Big Cat Alliance (IBCA)—both anchored in India—to strengthen transboundary cooperation and resource mobilisation for big cat conservation across Asia and Africa. The emergence of these platforms reflects India's leadership in aligning national biodiversity gains with international conservation goals under the GBF.

On the forest cover and density front, the India State of Forest Report 2023 reveals that India's combined forest + tree cover stands at 827,357 sq. km., or 25.17 percent of land area, with a net increase of 1,445.81 sq. km. since 2021 (156 sq. km. inside existing recorded forests, 1,289 sq.km outside). Importantly, within recorded forest areas, VDF have increased by 2,431.50 sq. km., even though moderately dense forest (MDF) and open forest (OF) categories have contracted. This rise in high-density forest patches implies that within many PAs and adjoining landscapes, forest restoration and protection are yielding deeper structural gains, not just superficial expansion.

Taken together, these data confirm that well-supported PAs can deliver measurable ecological recovery, evidenced from forest densification, resurgence of top predators, and support for critically endangered species. These successes make a strong case for targeted, enhanced funding, especially for high-conservation-value landscapes and species recovery programs.

Nonetheless, India has positioned itself as an innovator in nature-based and governance solutions with the development of a suite of institutional responses. The National Action Plan on Climate Change (NAPCC, 2008) embeds the Green India Mission (GIM) (5 million hectares of new forest cover and 5 million hectares improved quality). The National Biodiversity Action Plan (NBAP, 2008, 2014) and Biological Diversity Act (2002) provide biodiversity governance. The Compensatory Afforestation Fund Management and Planning Authority (CAMPA) offsets forest diversion, while the National Forest Policy (1988) targets one-third of land under forests. India's Bonn Challenge pledge seeks restoration of 26 million hectares of degraded land by 2030. Furthermore, participatory models such as Joint Forest Management and recognition of community rights under the Forest Rights Act (2006) link conservation with local stewardship. NbS including afforestation, reforestation, wetland restoration, and agroforestry are integrated into development, enhancing carbon sequestration and livelihoods. Ecosystem accounting and Gross Ecosystem Product (GEP) (Verma et al, 2019a) valuation embed ecological metrics into economic planning. The "One Health" approach is also gaining traction, linking human, animal, and ecosystem health.

Yet challenges persist. Forestry budgets increased only 19 percent after ecological transfers, compared to 42 percent growth in overall state budgets, showing weak prioritisation (Busch et al., 2021). Funds are rarely ring-fenced, often diverted to general budgets, diluting ecological outcomes. Biodiversity spending, at 1.93–3.19 percent of state budgets (Pandey et al., 2021), is fragmented across sectors, lacking coherence or monitoring. Reliance on forest area as the core metric incentivises static measures and risks perverse incentives such as monoculture plantations. Despite these limitations, econometric evidence suggests forest cover increased after 2017, indicating EFTs may have begun influencing afforestation and protection policies. The financing challenge, however, remains acute. Meeting global biodiversity and climate goals requires hundreds of billions annually, while current flows are insufficient. In India, this gap is magnified by the need to balance human development with safeguarding four global biodiversity hotspots. Mobilising international climate and biodiversity finance, expanding national ecological expenditure, and engaging private capital through instruments such as Corporate Social Responsibility (CSR) and technological innovativeness are essential.

EFTs through the FC reforms illustrate the potential of fiscal federalism to align financial incentives with conservation, embedding biodiversity integrity within national economic resilience.

1.2. Green Financing in India: Status and Needs

Green finance has emerged as a cornerstone of global climate and biodiversity action, yet the scale of flows remains far below what is needed. Since COP15 in Copenhagen (2009), developed countries have pledged to mobilise USD 100 billion annually to support developing countries, a commitment reiterated at Paris in 2015 and Glasgow in 2021. In practice, however, actual transfers have fallen significantly short: independent assessments such as the Climate Finance Shadow Report (2020) estimate that while developed countries reported an average of USD 59.5 billion annually in public climate finance, the net climate-specific assistance reaching developing countries was closer to USD 19–22.5 billion. This mismatch between commitments and delivery underscores the structural gap in global climate finance, with limited private participation and disproportionate reliance on public funds.

UNEP's State of Finance for Nature (UNEP, 2023) indicates that finance flows to NbS remain small relative to the need. In 2022, total flows stood at about USD 200 billion against a need of USD 384 billion by 2025 and USD 542 billion annually by 2030. Of these, approximately 82 percent (USD 165 billion) came from public sources and only 18 percent (~USD 35 billion) from private actors. This reflects the structural reality that most NbS and biodiversity-related interventions lack reliable revenue streams, leaving governments to shoulder the overwhelming burden. The consequence is a persistent mismatch between needs and flows, with private finance still marginal despite the fact that more than half of the world's GDP is directly dependent on ecosystem services. The cost of inaction is correspondingly large: under a 3°C warming scenario, India alone could lose up to 12.5 percent of GDP annually by 2070, equivalent to USD 35 trillion in cumulative losses (DEI, 2021; CPI, 2024).

At the national level, however, the picture is more nuanced and sector-specific. A recent meta-analysis by CPI (2024) shows that private capital already dominates tracked mitigation finance. In FY 2021/22, total mitigation finance reached INR 3,712 billion (~USD 50 billion) per year, of which domestic private sources accounted for about 66 percent (INR 2,048 billion / ~USD 28 billion). Commercial financial institutions, corporates, and households formed the bulk of this private supply, channelled into solar and wind power, grid infrastructure, energy efficiency, and electric mobility. By contrast, adaptation and NbS finance remain overwhelmingly public (WEF et al., 2024). In the same year, adaptation flows reached INR 1,092 billion (~USD 15 billion), of which 98 percent came from central and state budgets, with negligible private contributions. This divergence underscores that while NbS and adaptation are still structurally dependent on public resources, mitigation projects with established commercial models have been more successful in mobilising private flows. Rather than contradictory, the two findings point to complementary realities across sectors, i.e., where revenue certainty exists, private finance leads, while where benefits are diffused or non-market, public finance remains indispensable.

An important dimension of green finance in India is the scaling of renewable energy, which delivers co-benefits for water resource management and wildlife

protection. As of October 2025, the country achieved a milestone when renewables met 51.5 percent of the nation's total electricity demand of 203 GW, with solar generation at 44.50 GW, wind at 29.89 GW and hydro at 30.29 GW. At that time, non-fossil fuel sources (renewables + hydro + nuclear) stood at 256.09 GW (over 51 percent of total capacity), while fossil-fuel-based sources were 244.80 GW (about 49 percent) (MoP, 2025). Within renewables, solar power reached 127.33 GW and wind power 53.12 GW. Because renewable energy systems, especially solar and wind, require markedly less operational water than conventional thermal power plants (WRI 2015), their growth eases pressure on scarce freshwater resources. In and around ecologically sensitive zones and wildlife reserves, the deployment of renewable energy infrastructure and reduced groundwater extraction helps in mitigating human-wildlife conflict (Basu, 2024) and reducing stress on aquifers (Nishank, 2022), thereby preserving habitat quality. By integrating renewable energy investments into green finance frameworks, India can simultaneously advance climate mitigation, water management, and biodiversity conservation.

Nevertheless, India's financial needs mirror this duality. The Government of India estimates that achieving its current Nationally Determined Contributions (NDC) will require USD 2.5 trillion (INR 162.5 trillion) between 2015 and 2030, equivalent to USD 170 billion annually (DEI, 2021; CPI, 2024). Mitigation accounts for around 70 percent of this requirement, while adaptation needs are equally significant, with cumulative investments of USD 1 trillion projected by 2030 (~USD 67 billion annually). The stakes are underscored by India's physical exposure that 80 percent of its population lives in districts highly vulnerable to hydro-meteorological extremes, and climate change could reduce agricultural yields by 16 percent by 2030, raising national poverty rates by 3.5 percent (WEF, 2024; Picciariello et al., 2021).

Within this context, India has scaled up flows in recent years (CPI, 2024). Tracked mitigation finance increased 20 percent between FY 2019/20 and FY 2021/22 (Table 1.1), while adaptation finance rose nearly threefold to INR 1,092 billion (USD 15 billion) (Table 1.2), driven largely by disaster risk management and on-farm agricultural activities. Sovereign green bonds worth INR 16,000 crore were issued in FY 2023, establishing benchmarks and expanding investable capital (MoF, 2023). Still, these flows meet only about 30 percent of India's NDC financing needs. Sectoral gaps are also evident: while private capital has crowded into mitigation, forestry and land-use sectors face a projected funding gap of INR 13,500 billion (~USD 162 billion) by 2030 (WEF, 2024).

Private participation, while indispensable, remains constrained in adaptation and NbS by barriers such as limited pipelines of bankable projects, unclear regulatory frameworks, land-tenure complexities, and the absence of standardised monitoring and verification. A survey of Indian corporates found that 89 percent report sustainability strategies and 70 percent include natural climate solutions, yet most projects remain under USD 1 million, financed via CSR budgets rather than mainstream portfolios (WEF, 2024). Only 7 percent generated carbon credits, while 62 percent relied on CSR allocations, underscoring the limited integration of NbS into financial portfolios.

Government initiatives are attempting to address these constraints. SEBI's Business Responsibility and Sustainability Reporting (BRSR) mandate for the top 1,000 listed companies has improved

transparency, while the Green Credit Programme (2023) creates tradable credits for afforestation, conservation, and ecosystem services (MoF, 2023). Development finance institutions such as IREDA, NABARD, and REC provide concessional loans and guarantees to crowd in private investors. However, scaling requires deeper reforms anchored in standardised taxonomies, stronger MRV systems, and expanded pipelines of bankable projects to reduce risk and compress the cost of capital.

Within India's fiscal federal architecture, the FC and EFTs illustrate how domestic policy design can embed ecological incentives into financial systems. The duality reinforces the case for fiscal mechanisms that prioritise land-based resilience, biodiversity, and ecosystem services, primarily focussing on domains where private capital is structurally unlikely to flow without strong public incentives. By linking intergovernmental transfers to ecological performance, this represents one of the world's largest institutionalised mechanisms for biodiversity finance, complementing broader climate finance by aligning state-level incentives with national and international commitments, thus leveraging domestic fiscal policy as a green finance tool.

Table 1.1: Landscape of Green Financing in India for FY21-22 with Sources and Intermediaries (Public vs. Private) for Climate Mitigation (Conversion rate taken: 1 USD = INR 74)

Source / Intermediary	Public/Private	INR (Billion)	USD (Billion)
Commercial Financial Institutions (FIs)	Private	1,425	19.2
Corporations	Private	297	4.0
Foreign Direct Investment (FDI)	Private	108	1.5
Philanthropy	Private	3	0.04
Residential, Commercial, and Institutional	Private	555	7.5
Other (PE and VC funds)	Private	50	0.7
Bilateral FDI	Public	156	2.1
Multilateral FDI	Public	74	1.0
Public Sector Undertakings (PSUs)	Public	449	6.0
Union and State Government Budget	Public	596	8.0
Total Private	**Private**	**2,438**	**33.0**
Total Public	**Public**	**1,274**	**17.0**
Grand Total		**3,712**	**50.0**

Source: CPI, 2024

Table 1.2: Landscape of Green Financing in India for FY21-22 with Sources and Intermediaries (Public vs. Private) for Climate Adaptation (Conversion rate taken: 1 USD = INR 74)

Source / Intermediary	Public/Private	INR Billion	USD (Billion)
Foreign Direct Investment (FDI)	Private	0.6	0.01
Philanthropy	Private	0.3	0.004
Other (PE and VC funds)	Private	2	0.02
Bilateral FDI	Public	2	0.03
Multilateral FDI	Public	21	0.3
Union and State Government Budget	Public	1,066	14.4
Total Private	**Private**	**2.9**	**0.03**
Total Public	**Public**	**1,089**	**14.7**
Grand Total		**1,092**	**15.0**

Source: CPI, 2024

1.3. Scope of Work

Activity 1. Policy review, secondary data collection and preparation of guiding questions for stakeholder groups

Existing secondary data from official and credible sources is utilised, supplemented by consultations with sectoral experts. A cross-sectoral approach spanning environment, fiscal policy, and development domains is applied to generate a systems-level cause-and-effect understanding and to prepare guiding questions for structured stakeholder engagement.

Activity 2. Engagement and dialogue with target stakeholders

Consultations with state-level officials, line departments, think tanks, private sector representatives, and relevant communities are undertaken across five regions—eastern, western, northern, southern, and central India—to capture perspectives across diverse geographies. A high-level national stakeholder workshop or roundtable is convened to consolidate systemic opinions and ensure representation at the national scale.

Activity 3. Modelling an drafting of Formula

Climate modelling is conducted by integrating key environmental, fiscal, and development parameters to draft an evidence-based devolution formula. Pilot studies in select regions are implemented to assess the effectiveness and feasibility of the proposed indicators and strategies.

Activity 4. Validation of Formula

The draft devolution formula is presented to experts consulted during earlier phases, along with additional specialists, for feedback and refinement. This process ensures maximum inclusion and alignment of recommendations from stakeholders within the fiscal allocation strategy.

Activity 5. Presentation of findings and final draft report to the relevant stakeholders

Findings from the analysis, modelling, and consultations are presented to stakeholders engaged in the FC16 process for feedback and suggestions. Inputs are incorporated, wherever applicable, before

finalising and submitting the recommendations to the Commission.

1.4. Objectives of the study

To take up a scoping study on developing recommendations for the FC16 and supporting the revision of India's goal that analyses the potential of the forest and land sector, to allow for the enhancement of its goal. The analysis will consider the current national goals of forestry and biodiversity, wetlands, water and air quality improvement, agroforestry as well as trees outside forests, and enhancement and conservation of coastal and marine ecosystems.

Broaden ecological metrics to include diverse ecosystems: The study aims to develop clear criteria that expand assessment beyond forests, capturing the full range of India's ecosystems. This includes forestry and biodiversity, sustainable agriculture, and water resource management, alongside emerging priorities such as climate adaptation and risk mitigation, renewable energy distribution, air pollution reduction, and human–wildlife conflict prevention. By moving past a forest-centric view, the objective is to design a framework that reflects the country's ecological diversity and its links to livelihoods and resilience.

Integrate considerations for fiscal disability and performance-based funding: The study focuses on embedding indicators that address ecosystem restoration and its contribution to biodiversity, carbon storage, and ecological health. At the same time, it accounts for fiscal disability by recognising that some states face structural disadvantages in managing natural resources. Performance-based indicators will therefore balance ecological outcomes with fiscal realities, creating a fairer and more effective system of resource transfers.

Alignment with National and Global Goals: The study seeks to integrate indicators that capture sustainable agriculture and circular economy practices, aligning fiscal policy with India's commitments to national priorities and global frameworks such as the Sustainable Development Goals (SDGs) and climate agreements. By linking fiscal incentives to sustainability pathways, the objective is to strengthen coherence between state-level actions and broader environmental and development goals.

Study Methodology and Key Findings

2. Study Methodology and Key Findings

This chapter highlights the core team's progressive contributions across three FCs (13-15), which collectively transformed ecological considerations from ad-hoc grants into a structured, formula-based fiscal mechanism. This evolution reflects a systematic deepening of ecological logic within India's fiscal federalism, supported by empirical research and inter-institutional collaboration.

- **FC13 (2010–15):** Introduced compensatory forest grants (INR 5,000 crore) recognising opportunity costs and forest management responsibilities.
- **FC14 (2015–20):** Developed the *High Conservation Value Forest Index* linking ecological, biophysical, and economic parameters. Resulted in a 7.5 percent forest cover weight in tax devolution—India's first formula-based EFT.
- **FC15 (2020–25):** Expanded to "forest and ecology" with 10 percent weight, integrating air quality, water management, and climate adaptation. Devolved INR 4.22 lakh crore across related sectors, institutionalising ecological criteria in fiscal transfers.

Methodological Framework

The study adopted a multi-stage, evidence-based design over 1.5 years anchored in the principle- operationalise only what is measurable and verifiable today, and parallelly develop aspirational metrics for phased integration:

- **Literature review:** Global EFT models and fiscal–ecological lessons
- **STAC review:** Ensured scientific rigor and policy feasibility
- **Regional consultations:** Three phases covering all states to capture ecological and fiscal diversity
- **Expert consultations:** Refined incentive design and institutional mechanisms
- **Validation:** Consolidated feedback to align reforms with FC mandates

Key Findings

- **Institutional evolution:** Ecology embedded as a fiscal criterion but still forest-area centric and weakly outcome-linked
- **Design limitations:** Lack of ring-fencing, fragmented spending, and static metrics reduce effectiveness
- **Consultation outcomes:** Expand scope to other ecosystems such as wetlands, grasslands, mangroves, agroforestry, and urban systems; integrate climate vulnerability; align fiscal and ecological cycles
- **Governance & data constraints:** Data silos (FSI, CGWB, CPCB, ISRO), weak local institutions (BMCs, JFMCs, PRIs), and absence of unified ecological accounting.

2.1. Background on Core Team's Contribution to the Forestry and Ecology Sector through various FCs of India

Over three successive FCs, the core team involved in this report has played a pivotal role in strengthening the integration of ecology, forests, and climate into India's fiscal architecture (Table 2.1) (Verma et al., 2019b). Beginning with the 13th Finance Commission (FC13), where foundational frameworks for compensating states with large forest areas were conceptualised, the team's contributions evolved through successive cycles—from designing grant-linked ecological mechanisms to mainstreaming forest and ecological indicators into the horizontal devolution formula.

Under the FC13, the work led by the Indian Institute of Forest Management (IIFM) introduced mechanisms that linked fiscal transfers to forest management responsibilities, incorporating opportunity costs, restoration needs, and ecosystem values into the design. This set the groundwork for the 14th Finance Commission (FC14), where a formal collaboration between IIFM, the Forest Survey of India (FSI), and IORA refined these mechanisms through the development of the High Conservation Value Forest (HCVF) Index, integrating biophysical, economic, and conservation parameters. The study provided empirical justification for forest-based fiscal transfers and quantified costs of conservation, directly influencing the inclusion of a 7.5 percentage forest cover weightage in the devolution formula, thus marking the institutionalisation of EFTs in India.

In parallel, the team lead of the FC14 study, who also leads the current report, co-authored the global review paper (Busch et al., 2021) *"A Global Review of Ecological Fiscal Transfers"* published in *Nature Sustainability*. This landmark paper examined EFT mechanisms across Brazil, Portugal, France, China, and India, as well as emerging systems in ten other countries. It identified common themes in EFT emergence, design, and effects, and found that global EFT flows grew from USD 0.35 billion per year in 2007 to USD 23 billion per year in 2020, underscoring both India's leadership and the international relevance of its fiscal innovation.

Building on this foundation, the 15th Finance Commission (FC15) expanded the ecological scope beyond forests to encompass air quality, water management, and climate change, introducing new performance-based grants. The team's continued engagement helped align the framework with India's NDCs, SDGs, and NAPCC.

Table 2. 1: Knowledge Collaborations and Outcomes of Core Team across FCs

Finance Commission (FC)	Knowledge Partners	Problem Addressed	Key Recommendations / Suggestions	Resulting Change in Devolution/ Grant
FC13 (2010–15)	IIFM	Need to compensate states managing large forest areas; absence of mechanisms recognising opportunity costs of conservation; imbalance due to uniform parameters.	Developed formulae integrating forest area, canopy density, restoration and opportunity cost; proposed untied and performance-linked forest grants.	Introduced INR 5,000 crore Forest Grant; 25 percent tied to forest preservation; laid foundation for linking fiscal transfers with ecological performance.
FC14 (2015–20)	IIFM, FSI, IORA	Need to move beyond forest area metrics and account for forest quality, ecosystem services, and fiscal disability.	HCVF Index with 13 indicators; quantified opportunity, maintenance, and restoration costs; recommended institutional monitoring.	Incorporated 7.5 percentage forest cover weightage in tax devolution; resulted in INR 2.96 lakh crore devolved to states; institutionalised EFTs.
FC15 (2020–25)	IORA, MoEF&CC	Need to integrate broader environmental and climate goals (pollution, restoration, adaptation) into fiscal design.	Retained forest weightage but expanded scope to air, water, and climate; proposed performance-linked grants aligned with NDCs and SDGs.	Introduced 10 percentage weightage for “Forest and Ecology”; established new grants — INR 1.69 lakh crore for pollution abatement, INR 1.35 lakh crore for climate change, and INR 62,438 crore for forest restoration; total INR 4.22 lakh crore devolved under forest and ecology criteria.

Recognising forests as a national public good and multifunctional ecological asset, and addressing environmental pollution and climate change alongside fiscal disability, the FC15 added the 'Ecology' indicator and raised the overall weightage for 'Forest and Ecology' to 10 percent. This change prioritised very dense and moderately dense forests as core metrics and led to a cumulative devolution of INR 4.22 lakh crore to the states under the forest and ecology criteria. Through iterative policy inputs and research, the team contributed to the evolution from grant-based incentives (FC13) to formula-based forest devolution (FC14), to integrated ecological devolution with performance-linked grants (FC15). This continuum reflects the deepening of the ecological and climate rationale within India's fiscal federalism, backed by evidence-driven collaborations between research institutions, government agencies, and policy experts.

2.2. Study Approach

The study was undertaken by IORA over a period of 1.5 years, aimed to systematically explore mechanisms for enhancing EFTs in India. The overarching approach combined rigorous literature synthesis, multi-level stakeholder engagement, and iterative expert validation to develop a robust framework of indicators and criteria that can guide the FC in strengthening climate-sensitive allocations to the forestry and ecology sectors (summarised in Figure 2.1). The methodology was designed to balance technical rigor with practical feasibility, ensuring that recommendations were both scientifically grounded and implementable within the Indian governance context.

The research adopted a sequential, multi-stage process, beginning with an extensive review of national and international experiences in environmental fiscal transfers, followed by deliberations with a STAC to refine candidate indicators and develop structural recommendations (Annexure 1). This was complemented by three regional consultations (Annexure 2) to capture subnational ecological and governance realities, and a series of key expert interviews (Annexure 3) to ensure

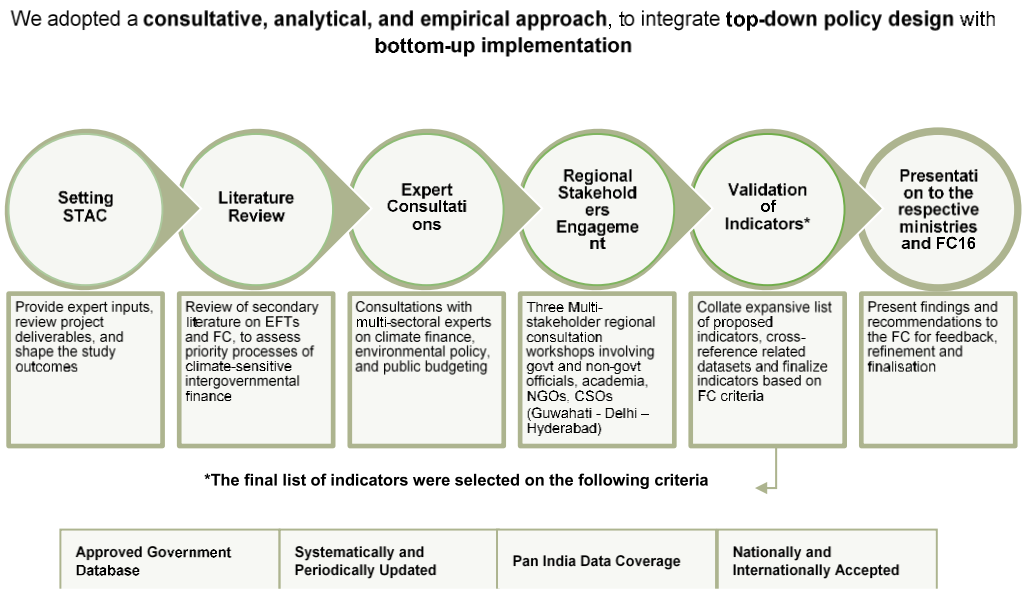


Figure 2: 1 Overview of Study Methodology Adopted

that the proposed framework could be effectively operationalised within India's fiscal architecture. This integrated approach allowed the study to generate both operational indicator which are the metrics designed for immediate, practical application and monitoring, for immediate implementation and aspirational indicators, which are metrics conceptually important for ecological resilience and climate adaptation but not yet feasible for immediate fiscal integration, to guide long-term climate-sensitive fiscal reform.

2.3. Review of Literature on Ecological Fiscal Transfers

2.3.1. Global Experience with Ecological Fiscal Transfers

When it comes to fiscal wisdom on ecological and environmental matters, early economic policymakers largely drew on the 'Polluter Pays Principle' (Pigou, 1920), a cornerstone of welfare economics. The idea was straightforward that those responsible for environmental degradation, be it of forests, air, water, soil, biodiversity or climate, should bear the cost of damages they cause through tax, penalties, or compensatory payments. While conceptually sound, its practical implementation has faced significant challenges. Identifying the actual polluter, especially when the damage involves public goods such as clean air, groundwater, or biodiversity, has proven complex. Diffuse pollution sources, overlapping jurisdictions, and limited monitoring capacity further complicate accountability. Moreover, designing and administering appropriate taxation or compensation mechanisms, and legally determining the quantum of penalties, have posed persistent institutional and governance challenges. As a result, while the Polluter Pays Principle laid the foundation for environmental fiscal policy, its translation into effective practice has remained uneven and context-dependent (Tisdell, 2010; GTZ, 2004).

While such economic measures are still in force in most countries, EFTs have emerged globally as innovative mechanisms that integrate ecological performance into intergovernmental fiscal systems (Busch et al., 2021). By linking fiscal transfers to ecological criteria, such as the extent and management quality of PAs, ecosystem integrity, or climate-relevant outcomes, they seek to align subnational fiscal incentives with environmental objectives. The underlying rationale stems from the spatial mismatch between the benefits of ecosystem services, which are widely shared, and the costs of conservation, which are often locally borne. EFTs correct this imbalance by compensating or incentivising subnational governments to undertake conservation and climate-resilient actions that deliver public goods of national and global significance.

To illustrate the diversity of institutional designs and ecological priorities embedded in global EFT systems, a comparative overview of selected country experiences is presented in Table 2.2. The examples highlight variations in scale, fiscal design, and ecological focus, from Brazil's pioneering ICMS Ecológico to emerging schemes in Indonesia, demonstrating how countries have adapted EFT mechanisms to their environmental governance imperatives. Together, these cases highlight how ecological criteria can be operationalised within fiscal transfer frameworks to incentivise conservation, strengthen subnational accountability, and integrate climate and biodiversity objectives into mainstream public finance.

Table 2. 2: International Case Studies of EFTs with Key Outcomes

Country	Region/ Scale	Year	Ecological Criteria Used	Share/Scale of Transfers	Key Outcomes	Key Challenges	Literature
Brazil (ICMS Ecológico)	18 of 27 States	1991 (Paraná)	Protected areas, water resource, indigenous lands, waste treatment, environmental quality	1–20 percent of state VAT shared with municipalities	Tripled municipal protected area coverage; accelerated PA designation	Variable governance quality; "paper parks"; dependence on local capacity	Droste et al., 2017, 2018; de Paulo et al., 2019; May et al., 2012
Portugal	National	2007	Share of protected areas in municipal territory	2.5–2.7 percent of national-to-local transfers	Expanded regional and local conservation areas; decentralised management	Limited fiscal size; uneven enforcement	Serra, 2011; Santos et al., 2012, 2015
France	National	2019 (expanded to Natura 2000)	Natura 2000 site coverage	Targeted transfers to >1,100 municipalities	Improved compensation for conservation restriction	Modest fiscal magnitude; narrow ecological scope	Busch et al., 2021; Borie et al., 2014
China (NKEFA Scheme)	National	2010	Composite index: biodiversity, forest cover, water quality, land stress, performance bonuses	~0.95 percent of total intergovernmental transfers (79 billion yuan in 2020)	Largest EFT globally; improved ecological monitoring capacity	Complex indicators; uneven local compliance	Cao et al., 2021; Busch et al., 2021; Wang et al., 2024
Indonesia (TAPE & provincial pilots)	Subnational (North Kalimantan and others)	2019 onwards	Forest cover, waste management, water and air quality	Early-stage pilots	Enhanced local engagement; emerging fiscal incentives	Weak data systems; low fiscal absorption; policy coherence gaps	Mumbunan et al., 2012; Anto et al., 2024
India	National	2015 (FC14 onward)	Forest cover share in FC formula	7.5 percent (FC14); 10 percent (FC15)	Incentivised state-level forest maintenance; recognition of ecosystem services in fiscal policy	Lack of earmarking; limited tracking of ecological outcomes	Verma et al., 2014, 2019b

2.3.2. EFTs as a Fiscal Instrument for Mainstreaming Ecology and Climate Resilience

EFTs have evolved from narrowly focused conservation incentives into strategic fiscal instruments capable of embedding ecological and climate objectives into national and subnational budgetary systems. By integrating environmental indicators into intergovernmental transfer formulas, EFTs shift ecological stewardship from discretionary or project-based spending to a *mainstreamed fiscal mandate*. The ecological and climate rationale of EFTs operates through three reinforcing pathways. First, they compensate local jurisdictions for opportunity costs associated with land-use restrictions and conservation mandates, preventing disincentives to protect high-value ecosystems. Second, they incentivise proactive creation and improved management of protected and restored areas, transforming conservation from a compliance activity into a fiscal opportunity. Third, they internalise environmental externalities across jurisdictions, reducing "race-to-the-bottom" competition for tax bases and encouraging collective progress toward biodiversity and climate goals.

Empirical evidence demonstrates measurable outcomes in biodiversity protection, pollution reduction, and ecosystem service enhancement. At the same time, global experience highlights that the effectiveness of EFTs depends on institutional design: credible and transparent allocation formulas, monitoring systems, and clear legal mandates that protect funds from dilution within general budgets. In India, too, the inclusion of forest cover as a criterion in FC devolution represents a foundational step toward ecological fiscal governance. However, the next frontier lies in adding a flow-based and outcome-oriented metrics to stock based indicators, and expanding coverage to other ecosystems including wetlands, grasslands, mangroves, and coastal systems. This evolution would align fiscal devolution with the objectives of climate resilience, adaptation, and ecosystem restoration articulated in India's national commitments.

Ultimately, EFTs represent a transformative opportunity to align fiscal policy with ecological integrity and climate resilience. Even minor adjustments in existing intergovernmental transfers, if guided by robust ecological criteria, can unlock substantial domestic financing for environmental priorities—bridging the gap between conservation mandates and fiscal incentives, and embedding climate-sensitive governance within the financial architecture of the state.

2.3.3. The FC and the Evolution of EFT in India

The FC of India, constituted every five years under Article 280 of the Constitution, is the country's principal institution for managing vertical and horizontal fiscal imbalances between the Union and the states. Traditionally guided by revenue capacity, expenditure needs, and equity considerations, the FC's remit has progressively evolved to reflect broader national priorities. Over the past two decades, it has emerged as a critical instrument for integrating environmental and climate dimensions into India's fiscal climate change, and global environmental commitments. The trajectory of this evolution traces a clear arc—from the early recognition of forests as a fiscal liability to the creation of one of the world's largest EFT systems (Table 2.3).

Table 2. 3: Evolution timeline of Internalising Forestry and Ecology within the FC in India with salient features of each phase and international climate commitment relevance

FC	Period	Ecological Feature Introduced	Salient Provisions	Scale of Transfers / Outcomes	Limitations / Critiques	International and Climate Relevance
FC11	2000–2005	First recognition of "fiscal disability" of forest-rich states	Recommended grants-in-aid linked to preparation of working plans for forest management	Conceptual recognition; no significant financial weight	Lacked substantive allocations; no monitoring framework	Early step toward recognising forests as global public goods; aligned with UNFCCC principles but no explicit linkage
FC12	2005–2010	Grants for forests introduced explicitly	INR 1,000 crore allocated among states in proportion to forest area	First fiscal transfer linked directly to forest area	Amount too small; did not incentivise conservation outcomes	Preceded REDD+ discussions; represented India's first move towards compensating ecosystem services
FC13	2010–2015	Expanded allocations for forests	Linked transfers to working plans and forest conservation	Acknowledged forests as national public good	Relied only on area data from FSI; no attention to density, quality, or biodiversity	Aligned with India's NAPCC and global push for ecosystem-based climate strategies
FC14	2015–2020	Paradigm shift: forest cover integrated into tax devolution formula	Assigned 7.5 percent weight to forest cover in horizontal devolution	USD 6.9–12 Billion/year; USD 51 Billion over 2015–19; ~USD 174–303 per ha annually	Relied on static 2013 baseline; area-based only; no ring-fencing of funds	Coincided with Paris Agreement (2015); supported India's NDC target of 2.5–3 bn tonnes CO_2 sink by 2030; global model for EFTs
FC15	2020–2025	Expanded criterion to "forest and ecology"	Increased weight to 10 percent	States receive ~2–3 percent extra devolution; reinforced EFT institutionalisation	Still forest-area centric; lacks performance indicators; excludes non-forest ecosystems	Explicit ecological framing aligned with SDG 15 ("Life on Land"); reinforces India's Paris commitments; positioned as scalable model for REDD+ and natural climate solutions

The Eleventh Finance Commission (FC11) (2000–2005) first acknowledged that states with large forest cover suffered from "fiscal disability" due to the opportunity costs of conserving forests for national and global benefit (Chaturvedi, 2016), which constrained industrialisation and intensive agriculture (Dasgupta and Srikanth, 2021). It proposed compensatory grants-in-aid linked to the preparation of scientific working plans for forest management (Bhatkhande and Pethe, 2024). However, the implementation remained limited, and subsequent recommendations did not fully operationalise the intent. The Twelfth Finance Commission (FC12) (2005–2010) extended this principle by allocating a grant of INR 1,000 crore, distributed among states based on their forest area, though the magnitude remained small relative to overall transfers. The scale of these early efforts was constrained by fiscal conservatism and the absence of reliable ecological data to support differentiated allocation criteria.

The Thirteenth Finance Commission (FC13) (2010–2015) built upon this foundation, recommending additional allocations for forest conservation while recognising forests as national public goods. Its approach, however, continued to rely on area under forest cover as reported by the FSI, without factoring in forest density, biodiversity richness, or ecological quality. The Commission itself acknowledged this limitation, noting that ideally, state entitlements should have been based on density and species composition rather than area alone (Bhatkhande and Pethe, 2024). This reliance on coarse, area-based metrics foreshadowed a recurring challenge, integrating ecological quality into fiscal design given data constraints and definitional inconsistencies.

A structural shift occurred with the Fourteenth Finance Commission (FC14) (2015–2020), which for the first time incorporated forest cover directly into the horizontal tax devolution formula, assigning it a weight of 7.5 percent. This move institutionalised ecological fiscal transfers at scale by linking state entitlements from central tax revenues to their share of national forest area. Between 2015 and 2019, an estimated USD 6.9–12 billion per year was distributed to states on this basis, amounting to USD 174–303 per hectare of forest annually (Busch and Mukherjee, 2017). In total, USD 51 billion was devolved during this period on account of forest cover (Dasgupta and Srikanth, 2021). This made India's EFT system the largest globally, surpassing similar initiatives in Brazil, Portugal, and France. The rationale was dual: compensating states for the opportunity cost of maintaining forests while also providing fiscal incentives to sustain and expand them.

The Fifteenth Finance Commission (FC15) (2020–2025) extended this innovation by renaming the criterion "forest and ecology" and increasing its weight to 10 percent. This semantic and substantive broadening reflected recognition that ecological concerns extend beyond forests (Aryan, 2025), though the formula continued to rely primarily on forest cover data. This development institutionalised EFTs as a stable and recurring component of India's fiscal devolution system, reducing uncertainty and reinforcing long-term incentives. Forest-rich states such as Madhya Pradesh, Chhattisgarh, Odisha, and Arunachal Pradesh emerged as key beneficiaries. On average, states received an additional 2–3 percent of their total devolution due to the forest and ecology criterion (Table 2.4).

Table 2. 4: Comparison of environmentally linked fund allocation (in INR crore) recommendation across FCs (Appended from FC12-15 reports)

FC	Forest and Ecology Grant	Forest and Ecology Devolution	Water Sector	Urban Waste Mgmt.	Heritage	Renewable Energy / Efficiency	Disaster Management
FC12 (2005 –10)	1,000	-	20,000	5,000	625	–	21,333 (CRF + NCF)
	Environment only via grants; no ecological devolution criterion						
FC13 (2010 –15)	5,000	–	5,000	10,000	1,500	5,000	21,714 (SDRF) +15,000 (NDRF)
	First to include renewable energy and efficiency						
FC14 (2015 –20)	–	7.5 percent weight in devolution	–	Part of 2,87,436 LB grants	–	–	61,219 (SDRF) + NDRF
	Introduced forest cover as devolution criterion; large-scale LB grants linked to sanitation and water						
FC15 (2020 –26)	-	10 percent weight in devolution	45,000 (agriculture and irrigation) Linked via sectoral grants	Part of 4,36,361 LB grants	–	Sectoral grants for power and efficiency	1,60,153 (SDRMF) + NDRMF
	Stronger ecological devolution; disaster risk management focus; performance-linked sectoral reforms						

However, despite this fiscal innovation, the connection between ecological transfers and measurable environmental outcomes has remained weak. Evidence suggests that while EFTs have expanded state forestry budgets in absolute terms, they have not significantly altered spending priorities. For instance, Busch and Mukherjee (2017) and Busch et al. (2021) found that state forestry budgets grew by 19 percent in the three years following the introduction of EFTs, compared to the previous three years. Yet, the share of forestry within total state budgets fell from 0.99 percent to 0.83 percent, implying that much of the additional revenue was

absorbed into general expenditures rather than earmarked for conservation. Similarly, analysis by the Center for Global Development showed that while total state budgets grew by 42 percent during the same period, the corresponding increase in forestry spending was modest indicating that EFTs have not meaningfully shifted fiscal priorities toward ecological investment. The absence of ring-fencing meant that states were not required to earmark these transfers for forestry, weakening the intended incentive effect. Biodiversity and ecosystem finance in India is fragmented in nature. Research on public expenditure analysis (Pandey et al., 2021) highlight that governments allocate between 1.93–3.19 percent of their budgets to biodiversity and ecosystem-related activities. These outlays are dispersed across multiple institutions and sectors, with no unified mechanism for tracking or assessing ecological outcomes.

Despite these design challenges, emerging evidence suggests positive trends. Even with imperfect metrics, the FC's inclusion of "forest and ecology" criteria represents a structural shift, placing environmental considerations alongside conventional principles of equity and efficiency. An econometric analysis (Aryan, 2025) found that after 2017, states recorded a statistically significant increase in forest cover, indicating that EFTs may have begun to influence afforestation and protection policies. India added an average of 2,66,000 hectares of forest annually between 2010 and 2020, ranking among the top three countries globally for forest expansion (Das, 2022). While this cannot be attributed solely to FC-linked EFTs, fiscal incentives likely complemented programs such as the GIM and CAMPA schemes.

The experience of Environmental Fiscal Reforms (EFR) in India, as documented by Kadekodi et al. (2004), underscores the importance of integrating ecological objectives into fiscal policy through both incentives and disincentives. Their analysis highlights that while India has developed an extensive legal and institutional framework for environmental protection, fiscal instruments such as pollution charges, user fees, and targeted subsidies remain underutilised and poorly coordinated. Strengthening the design of such instruments, aligned with the principles of "polluter pays" and "user pays", alongside the creation of dedicated environmental funds and performance-based fiscal transfers, can significantly enhance ecological governance. The FC16, in considering ecological criteria for intergovernmental transfers, can draw from this approach to design fiscal incentives that reward states for environmental stewardship, efficient resource management, and biodiversity conservation, thereby aligning fiscal federalism with sustainable development goals.

From a global perspective, India's FC-led reforms represent a pivotal step in embedding environmental performance into constitutional fiscal structures. They align with mechanisms like REDD+, advance SDG 15 (Life on Land), and directly contribute to India's Paris Agreement commitment of creating an additional 2.5–3 billion tonnes of CO_2-equivalent carbon sink by 2030. Yet, challenges remain structural. The continued reliance on forest area as a blunt metric ignores differences in density, degradation, and biodiversity. The lack of performance-based criteria and the absence of ring-fencing mechanisms limit outcome accountability. Furthermore, by framing forests primarily as fiscal liabilities, current transfers risk reinforcing compensatory rather than incentive-oriented behavior.

The ecological scope of EFTs also remains narrow, privileging forests while excluding other critical ecosystems such as grasslands, wetlands, deserts, mangroves, and coastal systems—all of which underpin climate adaptation and resilience. Expanding the "forest and ecology" criterion to encompass these systems, and introducing performance-linked ecological metrics (e.g., carbon stock change, restoration rates, or ecosystem integrity indices), would strengthen the incentive framework and align fiscal design with India's broader climate and biodiversity ambitions.

2.4. Key Findings from Consultations and Expert Inputs

2.4.1. Scientific and Technical Advisory Committee (STAC)

The STAC provided critical guidance throughout the study, ensuring methodological robustness, institutional relevance, and policy alignment of recommendations proposed for the FC16. Across the deliberations, members emphasised clarity, credibility, and the practical feasibility of ecological and climate-related fiscal reforms. The Committee's discussions collectively shaped the contours of indicator selection, data validation, fiscal design, and institutional mechanisms for implementing climate-sensitive transfers.

Design of Incentives in Fiscal Transfers

The Committee underscored that the design of fiscal instruments should ensure incentive compatibility—rewarding measurable ecological performance while remaining administratively simple and politically acceptable. Members supported a hybrid model combining devolution-based transfers, as adopted for forests and ecology in earlier Commissions, with targeted grants-in-aid for specific priorities such as biodiversity conservation, disaster preparedness, and climate adaptation. This would maintain a unified fiscal framework while allowing responsiveness to diverse state-level ecological and fiscal contexts.

Indicator Selection and Reliability

Members emphasised that indicators must be measurable, verifiable, comparable, and derived from credible, government-verified datasets to ensure acceptance by the FC. They advised moving in addition to stock indicators (such as forest cover) to include flow indicators that reflect change over time—such as improvement in forest density, carbon stock accumulation, or reduction in degraded or burnt areas. This shift was seen as essential to assess state performance dynamically rather than statically. The Committee also recommended expanding the ecological base beyond forests to include wetlands, rivers, grasslands, mountains, glaciers, coastal ecosystems, and ToF, highlighting significant data gaps for several of these systems.

Balancing Fiscal Instruments

The discussions reinforced the need to balance formula-based devolution for core ecological functions with performance-linked allocations that incentivise demonstrable outcomes. Members cautioned against over-engineering fiscal design and emphasised the importance of aligning financial mechanisms with institutional capacities. Lessons from previous FCs were seen as critical to ensure continuity and adaptability in approach.

Mainstreaming Climate Vulnerability and Resilience

Vulnerability and resilience were proposed as emerging criteria for fiscal devolution. Members suggested integrating climate

vulnerability indices to direct higher support to states most exposed to environmental and climate risks. A Disaster Preparedness Index, integrating forest, water, and climate parameters, was discussed as a potential innovation to align fiscal transfers with adaptive capacity and resilience-building objectives.

Institutional and Political Economy Considerations

A recurring concern was that funds devolved through FCs often merge into general state budgets without being ring-fenced for ecological outcomes. Members recommended linking fiscal transfers to performance, dedicating funds for capacity building, and decentralising a portion of resources to local institutions such as Biodiversity Management Committees (BMCs) and panchayats. Alignment of fiscal and ecological planning calendars was identified as a persistent challenge requiring systemic coordination.

Emerging Themes for Future Consideration

The Committee identified the need to strengthen datasets and monitoring frameworks on glaciers, heatwaves, biodiversity, avoided deforestation, and other emerging climate indicators to inform future FC cycles. The inclusion of urban ecosystems was also highlighted as a growing priority, given their vulnerability to rapid urbanisation and their role in national resilience.

2.4.2. Regional Consultations

Ecosystem-Specific Gaps and Vulnerabilities

Across consultations, participants underscored that India's fiscal architecture insufficiently reflects the diversity and ecological functions of its landscapes.

- **Forest Bias:** The FC's reliance on "forest cover" as a single ecological indicator excludes grasslands, wetlands, degraded forests, and community-managed landscapes that provide equally critical ecosystem services.
- **Invisible Ecosystems:** Agroforestry, rainfed and *jhum* landscapes, coastal and marine systems, and urban green areas remain under-recognised in fiscal logic despite their carbon sequestration, biodiversity, and livelihood roles.
- **Community and Common Property Systems:** Customary land tenure, particularly in the North-East and central tribal belts, conflicts with fiscal models premised on private property. Recognising collective stewardship is essential for equitable incentives.
- **Opportunity Costs:** Forest-rich and ecologically fragile states face foregone revenue and developmental constraints that current fiscal mechanisms do not compensate adequately.
- **Climate Vulnerability:** Mountains, coasts, and drylands face specific risks (floods, landslides, cyclones, droughts), yet there are no vulnerability-weighted fiscal instruments to address these asymmetries.

Ecological Data and Monitoring Gaps

A consistent concern across all regions was the fragmentation and inconsistency of ecological data (details in Annexure 4).

- **Data Silos:** Sectoral datasets (FSI, CGWB, CPCB, BSI, ZSI, IMD, ISRO) remain unintegrated, leading to conflicting baselines.
- **Underrepresented Systems:** Wetlands, grasslands, marine ecosystems, and urban green areas

lack standardised monitoring or consistent indicators.

- **Verification and Transparency:** Absence of third-party audits, open-access datasets, and outcome tracking weakens accountability.
- **Need for Integration:** Experts strongly supported a **"**One State, One Data System**"** that combines remote sensing, biophysical indicators, and community-sourced data (e.g., People's Biodiversity Registers).
- **Technology & Research:** Adoption of spatial decision support systems (SDSS), automated weather stations (AWS), and open-data policies was urged for robust monitoring and adaptive planning.

Institutional Capacity and Governance Readiness

Institutional readiness emerged as a foundational gap for effective ecological fiscal transfers.

- **Local Institutions:** Bodies like BMCs, Joint Forest Management Committees (JFMCs), and Village Development Committees (VDCs) possess legitimacy but lack technical and financial autonomy.
- **Departmental Fragmentation:** Weak coordination among forestry, agriculture, irrigation, and urban agencies limits convergence on ecosystem-based planning.
- **Capacity and Staffing:** Most state forest and environment departments face acute shortages of technical staff, GIS capacity, and data management systems.
- **Decentralised Finance:** Over-centralisation of funds at state levels restricts flow to local institutions. Participants advocated direct, performance-linked transfers to local

Regional Consultations for Recommendations to the 16th Finance Commission

entities with fiduciary oversight mechanisms.

- **Cross-sector Collaboration:** Integration of eco-sensitive norms into infrastructure, agriculture, and urban planning was seen as essential for embedding resilience across sectors.

Fiscal Architecture and EFT Design

Participants across all consultations emphasised that fiscal design reforms must move from static, area-based devolution to dynamic, outcome-based, multi-ecosystem models.

- **Beyond Forest Cover:** Incorporate indicators such as biodiversity richness, carbon stock, soil health, hydrological functions, and climate vulnerability.
- **Performance-Based Transfers:** Link allocations to measurable ecological outcomes (e.g., restoration success, groundwater recharge, carbon gains).
- **Green Budget Tagging (GBT):** Highlighted as a scalable model for tracing ecological expenditure (Assam and Uttar Pradesh examples).
- **Ring-Fencing and Timing:** Ecological funds must be ring-fenced and released in sync with ecological calendars (e.g., pre-monsoon for afforestation).
- **Vulnerability-Linked Allocation:** Fiscal formulas should consider exposure and adaptive capacity rather than static biophysical attributes.
- **Ecosystem-Specific Grants:** Separate budget lines for wetlands, mountains, coastal systems, and urban ecosystems were proposed to ensure ecosystem relevance and avoid “forest dominance”.

Regional Integration and Coordination

- **Cross-Boundary Governance:** Ecological systems such as river basins, coastal zones, and mountain ranges span administrative borders, requiring joint funding frameworks and harmonised monitoring.
- **Shared Baselines:** Regional-level ecological accounting and common monitoring protocols were seen as prerequisites for integrated management.
- **Private and Community Co-Financing:** Encouraging blended finance models, including corporate ecological responsibilities and traditional community institutions, could enhance fund efficiency.
- **Capacity Investments:** At least 10 percent of total ecological fiscal transfers should be earmarked for sub-state capacity building to strengthen implementation readiness at the district and village levels.

2.4.3. Expert Consultations

Design of Incentives in Fiscal Transfers

- **Incentive compatibility:** All experts emphasised that fiscal transfers should maintain incentive value without being over-engineered. Excessive conditionalities dilute autonomy and delay implementation.
- **Hybrid design:** A balance between unconditional devolution (predictability) and performance-based components (accountability) was repeatedly recommended.
- **State heterogeneity:** Several experts highlighted that opportunity costs of conservation vary non-linearly with forest share; incentive models must reflect diverse ecological and economic contexts.

- **Performance and outcome linkage:** Shifting from static criteria to dynamic, outcome-based models such as restoration milestones, soil health improvements, or resilience indicators.
- **Innovative instruments:** Competitive mechanism to reward both retrospective and prospective ecological performance, mitigating entitlement bias.
- **Avoiding over-engineering:** Experts warned against complex designs with heavy compliance burdens that penalise weaker states; instead, focus on "smart grants" with minimal but meaningful conditionalities.

Indicator Selection and Reliability

- **Beyond forest cover:** Strong consensus that forest cover alone cannot capture ecological performance. Indicators must encompass soil, water, wetlands, biodiversity, and climate vulnerability.
- **Principles for selection:** Indicators should be measurable, verifiable, comparable, science-backed, and consistent with stock-to-flow dynamics (e.g., change in carbon stock, forest productivity, groundwater trends).
- **Composite indices:** Use of multi-dimensional ecological indices. Suggestions included as a National Soil Index, Climate-Ecology Composite Index, or Wetland Health Card to enable cross-state comparability.
- **Data credibility:** All experts pointed to gaps in ecological databases and the need for interoperable data systems, periodic updates, and third-party verification mechanisms.
- **Proxy indicators:** When direct metrics are unavailable, use proxies such as heatwave days, groundwater recharge, or land-use transitions to represent vulnerability and adaptive capacity.

Balancing Fiscal Instruments: Devolution vs. Grants

- **Distinct roles:** Devolution should address long-term fiscal capacity and structural cost disabilities, while grants target specific, time-bound ecological or climate outcomes.
- **Earmarking vs. flexibility:** Experts agreed on the need for ring-fencing ecological funds to prevent dilution into general pools, yet allowing flexibility for locally appropriate implementation.
- **Smart grants:** Simplified, outcome-oriented grant design with streamlined reporting and adaptive mechanisms.
- **Performance-linked disbursals:** Tranche-based or matching models to ensure transparency and results.
- **Pilot fiscal models:** Testing new designs such as corporate- or city-level pilots before full-scale rollout could improve policy adaptability.

Mainstreaming Climate Vulnerability and Resilience

- **Integrating resilience:** Fiscal transfers must reflect exposure, sensitivity, and adaptive capacity to climate risks. Suggested indicators include frequency of extreme events, health and infrastructure access, and disaster preparedness.
- **Transition risks:** Compensation and diversification support for coal-dependent and resource-stressed economies.
- **Just transition:** Grants for reskilling, livelihood diversification, and loss and damage financing to protect vulnerable states.
- **Catchment treatment and biological sequestration:** Strengthen support for

ecosystem-based adaptation and mitigation through watershed restoration, agroforestry, and carbon farming.

- **Dual metrics:** Reward climate mitigation (e.g., renewable energy expansion) while tracking ecological risks (e.g., hydropower-induced landslides) to prevent maladaptation.

Institutional and Political Economy Considerations

- **Credibility and predictability:** Statutory transfers must not be subject to macro-fiscal expediencies; credibility underpins effectiveness.
- **Institutional bottlenecks:** Weak enforcement, interdepartmental fragmentation, and slow fund disbursal undermine ecological outcomes.
- **Administrative asymmetries:** States with low capacity face higher compliance costs under conditional grants — a case for differentiated accountability frameworks.
- **Political cycles vs ecological timelines:** Experts cautioned that 5-year fiscal cycles mismatch the decades-long nature of ecological restoration, requiring continuity mechanisms.
- **Cultural and behavioral levers:** Integrating India's traditional conservation ethos and frugality practices into modern fiscal systems.

2.4.4. Constraints in Operationalising EFTs: Common Evidence from Consultations

Consultations found out that efforts to integrate ecological and climate considerations into fiscal transfers face systemic challenges that limit effectiveness across ecosystems.

- **Funding Gaps and Skewed Incentives:** EFTs remain heavily forest-centric, overlooking other integral ecosystems. Fiscal incentives reward dense forests but exclude degraded or restoration-prone areas. Agricultural transfers continue to favor input- and water-intensive crops, while urban ecosystems lack dedicated ecological budgets. Weak ring-fencing allows ecological funds to merge into general state budgets, diluting outcomes. Seasonal mistiming—like afforestation or fire funds arriving post-season—further erodes efficiency.
- **Weak Utilisation and Institutional Readiness:** Local institutions such as BMCs, JFMCs, and Panchayati Raj Institutions (PRIs) remain under-resourced, limiting their ability to absorb and manage funds. Sectoral silos persist leading to fragmented implementation and missed synergies.
- **Data and Monitoring Deficits:** India's fiscal design still relies on narrow, area-based metrics (mainly FSI forest data), excluding biodiversity richness, carbon stock, and hydrological functions. Data remains fragmented across agencies, and dynamic ecosystems such as *jhum* landscapes, wetlands, and marine systems are poorly represented.
- **Governance and Capacity Constraints:** Departments lack skilled staff, analytical tools, and biodiversity accounting systems. Dedicated units for wetlands, coasts, or urban ecology are largely absent, while state biodiversity boards remain underfunded and overly centralised.
- **Temporal Misalignment:** Fiscal cycles rarely align with ecological rhythms—funds often disbursed after monsoon or harvest seasons—reducing ecological impact.

Opportunities and Gaps in the Current System

3. Opportunities and Gaps in the Current System

This chapter critically assesses India's current EFT framework and outlines principles for developing a broader, multi-ecosystem devolution formula for the FC16. While FC14 (7.5 percent forest weight) and FC15 (10 percent forest and ecology weight) successfully embedded ecology into fiscal devolution, their impact on actual ecological spending remains limited.

- After FC14, state budgets grew 40 percent, but forestry budgets rose only 19 percent.
- Forestry expenditure in most states remains below 1 percent of total spending despite large devolution amounts.
- Smaller, ecologically rich states like Himachal Pradesh (1.42 percent), Sikkim (1.25 percent), and Meghalaya (1.11 percent) show higher proportional commitment to forestry relative to fiscal capacity.

This uneven fiscal response stems from three interlinked challenges:

- **Fungibility of funds:** Untied EFT resources are often absorbed into general budgets, weakening ecological accountability.
- **Institutional and capacity constraints:** Weak budget tagging, poor interdepartmental coordination, and absence of ecological accounting systems hinder traceability of spending.
- **Absence of performance-linked incentives:** Current stock-based metrics reward existing forest area but not ecological quality, restoration, or adaptive resilience.

The chapter argues that linking devolution to measurable ecological outcomes**,** supported by transparent data systems and reporting protocols, would enhance accountability and shift EFTs from a compensatory to a catalytic mechanism for conservation and resilience.

Given India's ecological diversity, future devolution must move beyond a forest-centric model toward a multi-ecosystem approach that reflects the full spectrum of ecosystem services. The following principles guide the formulation of such a framework:

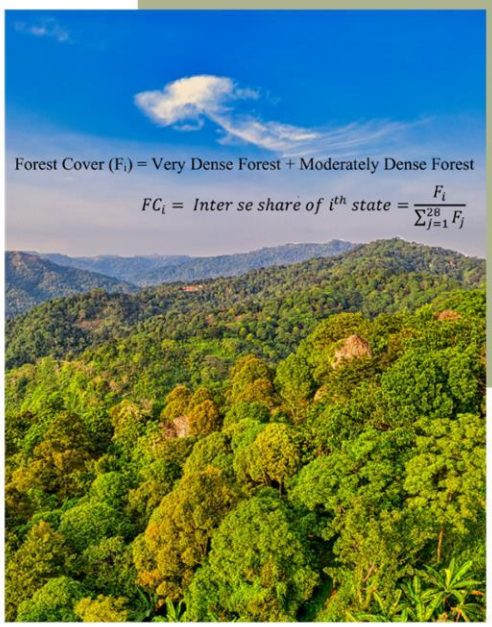
- **Data Availability and Credibility:** Indicators must rely on standardised, verifiable, and regularly updated datasets.
- **Nationwide Comparability:** Metrics must be uniformly measurable across all states to maintain equity.
- **Clear Fiscal Logic:** Each indicator should represent ecological benefits and local cost disabilities.
- **Policy Alignment:** Indicators must align with India's national and international commitments.
- **Administrative Simplicity:** Methods must be transparent, easy to compute, and free from and free from excessive technical complexity to ensure state-level acceptance and comparability.

3.1. Critical analysis of the Current Formula

The introduction of EFTs under the FC14 and FC15 has fundamentally reshaped the fiscal space for states in managing ecological assets. By incorporating a forest and ecology criterion, weighted at 7.5 percent under the FC14 and enhanced to 10 percent under the FC15, the devolution framework institutionalised ecological considerations within India's fiscal federal system. This provided predictable and untied fiscal flows intended to compensate forest-rich states for their ecological services and land-use constraints.

Empirical evidence, however, shows that the translation of these allocations into forestry expenditure remains uneven and modest. A study by Busch et al. (2021) finds that following the FC14, state budgets expanded by over 40 percent, while forestry budgets grew by only about 19 percent. This divergence highlights that while EFTs improved fiscal capacity, the ecological share of state spending has not kept pace. Similarly, NIPFP's econometric analysis (Kaur et al., 2021) identifies a flypaper effect, where intergovernmental ecological transfers influence environmental spending more strongly than states' own-source revenues—indicating some stickiness of funds toward ecological heads, but still limited in magnitude.

The devolution-based allocations under the FC15 have provided states with significant fiscal space to address ecological priorities through forestry expenditure (details in Annexure 5). The allocations are considerable, with forest-rich states such as Arunachal Pradesh (INR 54,700 crore), Madhya Pradesh (INR 43,813 crore), and Chhattisgarh (INR 42,600 crore) receiving large shares, while smaller allocations



were made to states with relatively low forest cover such as Punjab (INR 859 crore) and Haryana (INR 506 crore). This reflects the formula's intent to compensate states both for their ecological contributions and for the opportunity costs of land locked under forests.

However, expenditure data reveals a mixed picture. Forestry expenditure as a proportion of total state expenditure remains modest across most states, often below 1 percent (Figure 3.1). For instance, Andhra Pradesh spent only 0.14 percent (~INR 322 crore) of its budget on forestry despite receiving over INR 18,000 crore in devolution under forest and ecology criteria. Similarly, large allocations to Madhya Pradesh and Uttar Pradesh translated into forestry expenditures of merely 0.04 percent (nearly INR 100 crore) and 0.17 percent of total expenditure (up to INR 905.26 crore, respectively. In contrast, smaller states with high ecological endowments, such as Himachal Pradesh (1.42 percent; ~INR 715 crore), Sikkim (1.25 percent; ~INR 139 crore), and Meghalaya (1.11 percent; ~INR 234 crore), show a stronger budgetary prioritisation of forestry relative to their expenditure base.

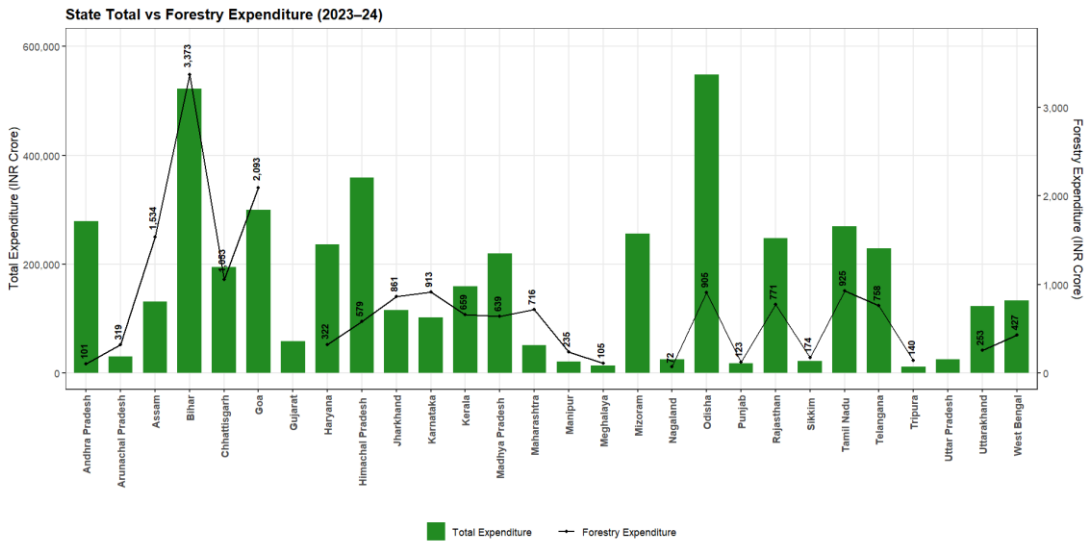


Figure 3: 1 States' Total Expenditure (All Sectors) vs. Expenditure in Forestry Sector in the Fiscal Year 2023-24

**Values for Forestry Expenditure (2023-24) for Gujarat, Mizoram, and Uttar Pradesh unavailable*

This uneven performance stems from three interrelated challenges:

- **Fungibility of funds and weak expenditure alignment:**
  While ecological transfers expand untied fiscal space, states often redirect these funds toward competing development priorities, diluting ecological intent. The absence of earmarking or reporting mechanisms prevents clear attribution of devolution flows to forestry outcomes.
- **Institutional and capacity constraints:**
  Weak budget classification systems limited cross-departmental coordination, and overlapping mandates between finance, forest, and planning departments reduce efficiency in fund utilisation. Many states lack dedicated public financial management structures or ecological budget tagging frameworks to track EFT-linked spending.
- **Absence of performance-linked incentives:**
  Current devolution criteria are stock-based, rewarding existing forest cover but not rewarding improvements in quality, restoration, or resilience. This limits dynamic incentives for conservation. Integrating flow-based indicators would strengthen the outcome orientation of fiscal transfers and align them with national climate and biodiversity targets.

Moreover, the absence of integrated monitoring systems constrains accountability. Data relevant to forestry and ecosystem performance remain fragmented across multiple agencies (FSI, CGWB, CPCB), limiting interoperability and the ability to evaluate ecological outcomes. Linking ecological indicators to fiscal performance, could enable transparency, facilitate evaluation, and support performance-based tranches within future FC frameworks.

With institutional mechanisms that link allocations with expenditure and measurable outcomes, ecological devolution can become more catalytic than just being compensatory. Strengthening budgetary tracking, integrating ecological databases, and embedding performance-sensitive indicators are essential next

steps for ensuring that fiscal transfers translate into tangible conservation gains and enhanced ecological resilience.

3.2. Principles for Developing a Holistic Devolution Formula for Forestry and Ecology

India is home to diverse landscapes including forests, wetlands, grasslands, coastal and marine systems, drylands, agricultural ecosystems, and mountain regions, each of which delivers critical services that buffer against climate risks. Wetlands regulate floods and groundwater recharge; mangroves and coastal ecosystems reduce cyclone impacts; grasslands and drylands sustain pastoral livelihoods and prevent desertification; and Himalayan ecosystems ensure long-term water and food security. These systems act as natural buffers to climate variability, and their degradation directly increases vulnerability particularly for communities most dependent on ecosystem services for livelihoods and well-being.

A future-ready devolution formula must therefore adopt a holistic ecological perspective, moving beyond a forest-centric approach to reflect the full range of ecosystem services that contribute to climate resilience and biodiversity conservation. This requires developing indicators that not only measure forest cover but also capture state-level performance in managing heterogeneous ecosystems, enhancing ecological health, and sustaining services vital for human security. Embedding such a multi-ecosystem approach into fiscal transfers will incentivise states to integrate climate adaptation and biodiversity goals into development pathways, ensuring that ecological stewardship is equitably rewarded across all landscapes. The following criteria as specified in the FC reports were used to identify indicators for recommendation (Table 3.1).

Table 3. 1: Criteria used to identify indicators for recommendation

Criterion	Core Rationale	Example
1. Data Availability and Credibility	Indicators must be based on reliable, standardised, and regularly updated datasets at the state level to ensure consistency and transparency.	• Forest cover was chosen because the FSI provides biannual, state-wise, comparable data. • Any new indicator should rely on official and verifiable datasets. • Data credibility is central to maintaining comparability and institutional trust in the formula.
2. Nationwide Comparability	Indicators must be uniformly applicable across all states to ensure fairness and equity in fiscal devolution.	• Forest cover works well because all states have measurable forest area. • Indicators like biodiversity indices or ecosystem service valuations can be uneven, subjective, or data-poor, limiting cross-state comparability.
3. Clear Fiscal Logic	Each indicator should embody both positive and negative externalities, providing a sound fiscal rationale for compensatory transfers.	• Positive externalities i.e. national benefits from state-level ecological assets (e.g., carbon sequestration, water recharge, biodiversity protection). • Negative externalities / cost disabilities that clearly demarcates local opportunity costs (e.g., land locked under forests, restrictions on groundwater use, loss of development revenue).
4. Policy Relevance and Alignment	Indicators should align with India's national and international policy commitments on climate change, biodiversity, and sustainable development.	• Forests link directly to India's NDCs under the Paris Agreement, REDD+, and national conservation mandates. • Future indicators could include Wetlands, Water-use efficiency and Air quality and urban resilience align with SDG 6, SDG 15 and SDG 11, respectively.
5. Administrative Simplicity and Transparency	Indicators must be straightforward to calculate, easy to communicate, and transparent in methodology to maintain credibility and avoid disputes.	• Simpler, well-defined metrics enable smoother implementation and reduce risks of manipulation, delays, or inter-state disputes. • Overly complex composite indices may undermine transparency and comparability.

Recommendations for Internalising Forest, Biodiversity and Climate Change Concern

4. Recommendations for Internalising Forest, Biodiversity and Climate Change Concerns

This chapter converts the study's consultative evidence into a two-track indicator and policy agenda: (i) operational indicators ready for immediate integration into the FC formula, and (ii) aspirational indicators for phased adoption once data, monitoring and institutional capacity mature. The chapter also lists practical state-level advisories to ensure FC transfers translate into measurable ecological outcomes.

Operational indicators (for immediate adoption; stock + flow)

These draw on nationally curated datasets and are designed to be auditable and resistant to manipulation. Each indicator pairs a stock (current endowment) with a flow (change against 2023 baseline) to reward both stewardship and improvement.

- **Forest cover & density:** VDF/MDF share → Δ density
- **Carbon stock:** Percent of national share → Δ carbon
- **Fire mitigation:** burnt-area share → Δ burnt area ↓
- **ToF:** Percent of national ToF share → Δ ToF area/growing stock ↑
- **PA coverage: P**ercent of national PA share → Δ PA area ↑
- **Groundwater: P**ercent of national critical/semi-critical blocks → Δ critical/semi-critical blocks ↓

Aspirational indicators (medium-term)

These indicators are identified as conceptually vital but currently data- or capacity-constrained. Priority items include species/biodiversity-integrity indices, soil health (SOC), ecosystem restoration quality, invasive-species extent, grasslands/agroforestry mapping, wetlands/mangroves/blue carbon metrics, human–wildlife conflict reporting, population-pressure metrics, urban ecosystem indicators, and a standardised Climate Vulnerability Index. These require national standardisation, harmonised monitoring protocols, and routine coverage before fiscal use.

Advisory to states (implementation enablers)

- Build centralised state ecological databases; deploy open-data dashboards and participatory GIS.
- Institutionalise GBT to track biodiversity/forestry/climate expenditure.
- Ring-fence a defined share of FC transfers for ecological priorities; classify as non-lapsable/non-transferable.
- Align disbursal timing with ecological calendars (pre-monsoon for planting, etc.).
- Allocate ≥10 percent of ecological transfers for sub-state capacity building; enable direct, audited transfers to JFMCs/BMCs/PRIs/ULBs.
- Design transition support for resource-dependent states (Just Transition measures).

Drawing on the literature review, deliberations of the STAC, expert, and regional consultations, the indicator framework (details of all proposed indicators are enlisted in Annexure 6) was refined into two distinct categories that together chart both immediate reforms and longer-term priorities. The first category comprises **proposed indicators** that can be operationalised without delay. These are grounded in nationally available datasets, are updated with sufficient frequency to support reliable monitoring, and are relatively resistant to manipulation. They provide a robust foundation for strengthening the FC's ecological criteria by moving beyond static, area-based measures and incorporating both stock and flow indicators that have direct conservation and climate implications.

The second category consists of **aspirational indicators** that emerged strongly from the consultations as conceptually essential for a comprehensive ecological fiscal framework, but which cannot yet be implemented due to data limitations, the absence of national standardisation, or inadequate monitoring systems. These indicators capture aspects such as biodiversity richness, ecosystem vulnerability, and restoration success that are central to ecological resilience and just transitions. While not suited for immediate adoption, they form a medium-term agenda for phased integration as institutional capacities and technical systems are strengthened.

Together, the two categories provide a balanced framework, anchoring the FC's current formula in operational improvements, while setting out a pathway for more ambitious ecological integration in future cycles.

4.1. Proposed Operational Indicators for Immediate Use

The proposed operational indicators identified through the study are those that can be integrated immediately within the FC's formula, as they draw on nationally curated datasets with regular update cycles and standardised methods. To align fiscal incentives with ecological outcomes, they are organised into stock (measuring the present level of an ecological asset or condition) and flow (measuring the direction and magnitude of change from a common baseline) (summarised in Table 4.1). The stock layer anchors the formula in present ecological endowments that matter for national ecological security, while the flow layer rewards proactive action and continuous improvement. This balance ensures that states are recognised not only for maintaining their ecological assets but also for investing in their enhancement, risk reduction, and climate resilience.

Stock indicators capture existing levels of ecological endowments that are relatively resistant to manipulation. They include the share of forest and ecology in the devolution formula, measured through forest cover and density, and the coverage

of PAs as a proportion of a state's geographical area. These represent foundational ecological assets that provide enduring benefits to biodiversity, water security, and public health.

Flow indicators measure incremental change over time against a baseline year (2023). They capture improvements in ecological quality, resilience, and sustainability by rewarding states for positive shifts and penalising deterioration. Flow measures include biennial changes in forest cover and density, carbon stock, area affected by forest fire, expansion of ToF, net additions to PA coverage, and improvements in groundwater availability (through reduction in critical and semi-critical blocks). Together, these measures create a dynamic incentive structure that values not only ecological stock but also the direction of ecological governance and policy action.

4.1.1. Forest Cover and Density

Forest area and, critically, canopy density together constitute the most direct, spatially explicit measure of a jurisdiction's standing stock of vegetative natural capital and the structural integrity of habitats that underlie a wide array of ecosystem services. The FSI defines forest cover as "*all lands, more than one hectare with a tree canopy density of more than or equal to 10 percent irrespective of ownership, legal status and land use. Such lands may not necessarily be a recorded forest area. It also includes orchards, bamboo and palm*". Canopy density classes used in ISFR *viz.* VDF (≥70 percent canopy), MDF (40–70 percent canopy) and OF (10–40 percent canopy), are the result of comprehensive satellite mapping calibrated with ground validation and standardised interpretation protocols; these classes serve as robust proxies for above-ground biomass, habitat complexity and watershed protective function. The scientific rationale for privileging density rather than area alone rests on the empirical relationship between canopy closure and per-hectare carbon, biodiversity habitat value and resilience to disturbance: denser stands generally store more carbon, provide richer structural niches for faunal and floral assemblages, and reduce soil erosion and runoff more effectively than sparse tree cover. FSI through their biennial ISFR(s) documents both the methodology for canopy-density mapping and the detection of substantial density degradation pockets, demonstrating that density is a dynamic, measurable attribute directly relevant to conservation and fiscal incentives. For national and international consistency, the ISFR mapping and NFI protocols align with longstanding remote-sensing and inventory practices, making canopy density an auditable stock indicator and an essential complement to flow measures that reward recovery of canopy density over time.

- ***Stock:*** **State's share of national forest area and density (VDF+MDF).**
- ***Flow:*** **Biennial change in state's forest area and density relative to national forest area and density class.**
- **Reward increase in forest cover and density**
- ***Source:*** **ISFR (FSI)**

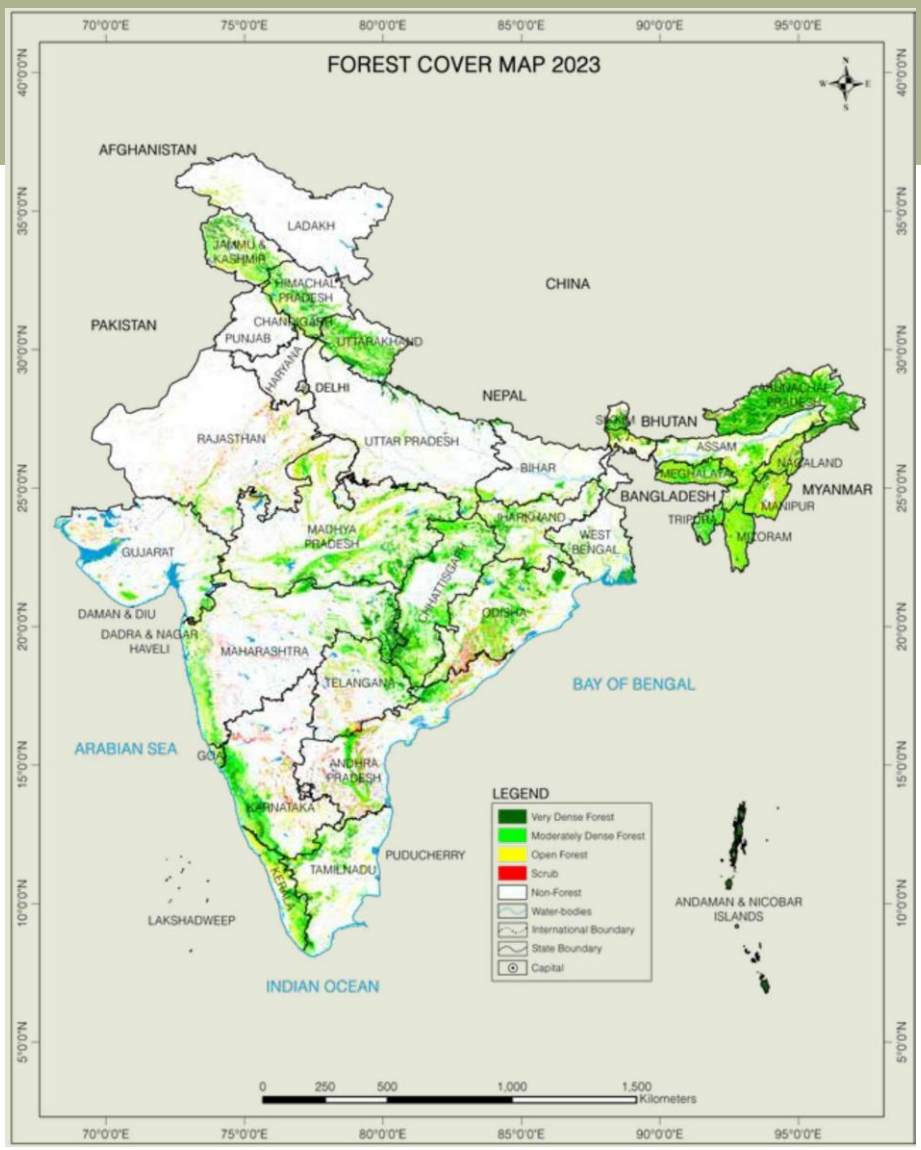


Figure 4. 1 Forest cover map of India (ISFR, 2023)

4.1.2. Carbon Stock (Forest and ToF)

Carbon stock is an integrative metric of ecosystem quality because it quantifies a fundamental regulating service such as climate regulation, while also reflecting forest structural attributes, successional stage and management history. ISFR 2023 adopts IPCC Good Practice Guidance approaches (stock-difference and stratified activity data combined with emission factors from National Forest Inventory plots) to estimate carbon across all pools (above- and below-ground biomass, dead organic matter, litter and soil organic carbon), explicitly describing the stratification by forest type and canopy density that increases precision. Carbon accounting thereby operationalises quality: two jurisdictions with identical forest area may exhibit very different carbon densities because of age, species composition, management and soil pools, and an EFT regime that includes carbon stock as a stock indicator aligns subnational incentives with NDCs and LULUCF reporting obligations. The ISFR methodology based on national inventory samples, species- and physiography-

specific volume and biomass equations and laboratory determination of carbon fractions, provides auditable steps for deriving state-level carbon stocks, while the stock-difference approach allows rigorous measurement of flows attributable to policy interventions and natural disturbances. Inclusion of carbon stock thus embeds climate mitigation outcomes within fiscal devolution in a way rewards durable, measurable sequestration and forest quality improvements.

- ***Stock:*** **State's share of national carbon stock.**
- ***Flow:*** **Change in the state's carbon stock as a proportion of change in national carbon stock.**
- **Reward increase in carbon stock**
- ***Source:*** **ISFR (FSI)**

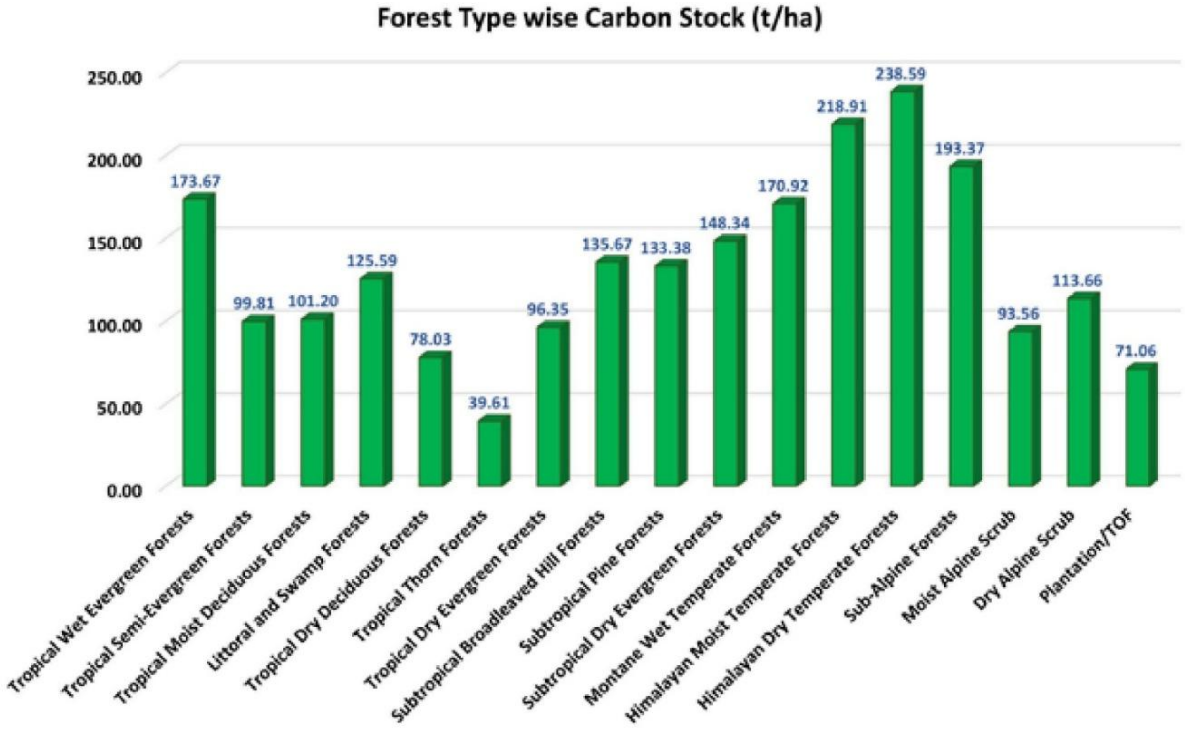


Figure 4. 2: Forest type wise Carbon Stock (in tons per hectare) in India (ISFR, 2023)

4.1.3. Forest Fire Mitigation

Forest fires are acute, non-linear agents of carbon release, biodiversity loss and degradation of hydrological function; they can rapidly reverse years of sequestration and compromise habitat continuity. ISFR 2023 documents the operational evolution of near-real-time fire monitoring, the addition of higher-resolution SNPP-VIIRS detections, pre-fire alerts based on Fire Weather Index modelling and the novel compilation of burnt-area estimates and PA-level fire reporting. A stock indicator that captures historical and structural fire vulnerability (for example, proportional long-term share of a state's forests in high fire-prone grid classes or a multi-year mean of burnt area) accurately reflects legacy risk exposure, while a flow indicator such as biennial reduction in burnt area or in the proportion of forests under very-high danger ratings rewards investments in preparedness, fuel-management, rapid response and community fire mitigation.

The practical feasibility of such an indicator is demonstrated by ISFR's Van Agni geo-portal, WMS/WFS dissemination to State Forest Departments and time-series records of hotspot detections; these data streams make both attribution and independent verification of changes in fire incidence practicable. Incorporating forest-fire metrics into fiscal transfers therefore aligns financial incentives with risk reduction and disaster management objectives as recognised in national programmes for forest fire management.

- ***Stock:*** **State's share of forest area burnt relative to national total.**
- ***Flow:*** **Change in the state's area burnt due to forest fire as a proportion of the change in burnt area at the national level.**
- **Reward reduction in burnt area.**
- ***Source:*** **ISFR (FSI)**

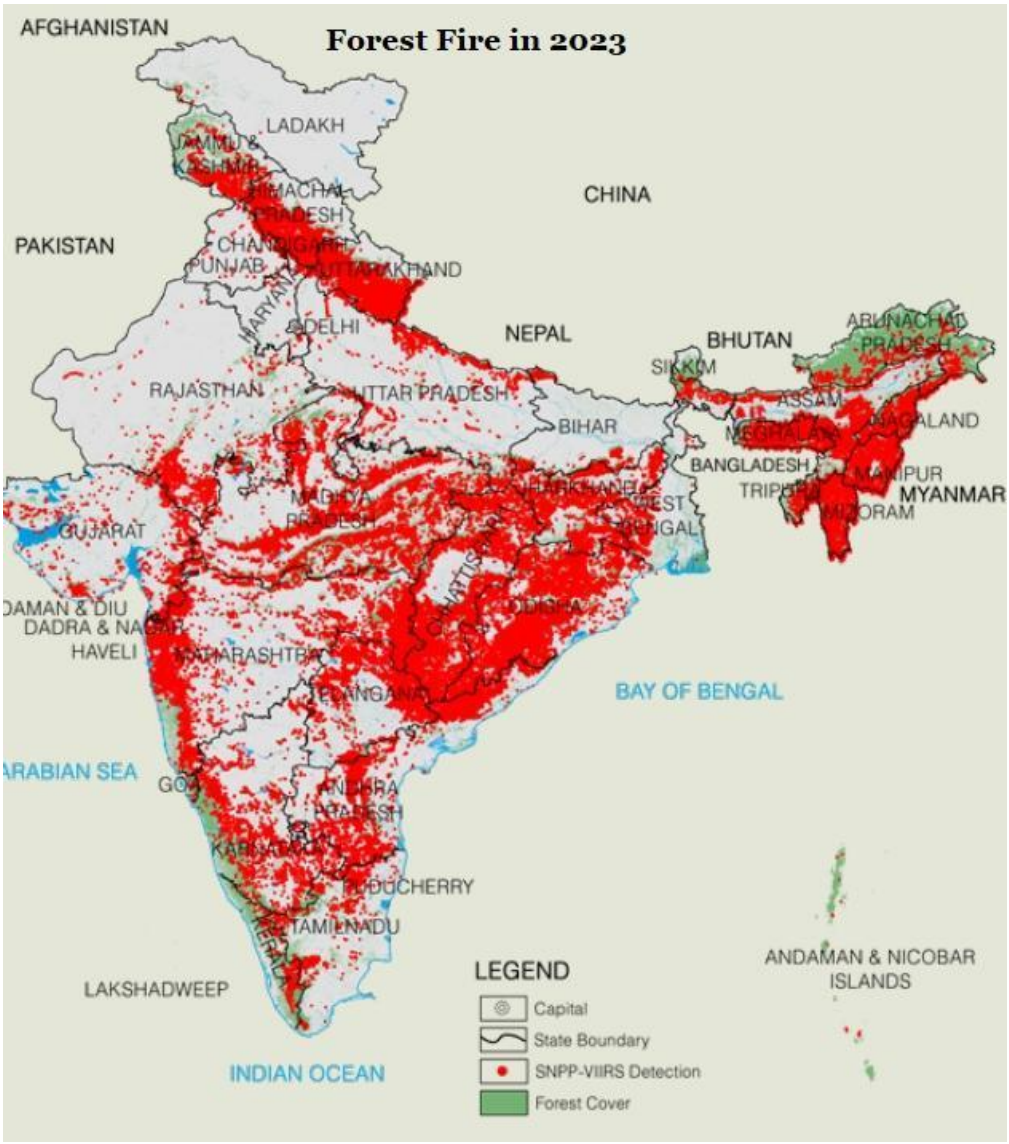


Figure 4. 3 Incidences of Forest fire across India in the year 2023 (ISFR, 2023)

4.1.4. Trees Outside Forests (ToF)

Trees outside formally recorded forests occurring in agricultural landscapes, linear shelterbelts, plantations, urban areas and agroforestry systems, constitute a substantial and increasing portion of national growing stock, provide critical livelihood resources, and deliver localised regulating services such as air-pollution attenuation, microclimate moderation and on-farm erosion control. ISFR 2023 documents that approximately 30 percent of the country's growing stock occurs outside recorded forest areas and provides methodology and national estimates derived from extensive ToF inventory sampling, including rural and urban strata. Recognising ToF in any ecological fiscal metric corrects an important bias of forest-area-only indicators that would otherwise under-reward states with active agroforestry, urban greening or on-farm tree management programs. Moreover, ToF plays an outsized role in supplying industrial wood, supporting household energy and diversifying rural incomes; measuring ToF as both a stock (area and growing stock) and a flow (net increase in ToF area or per-hectare growing stock) creates incentives for integrated landscape stewardship that complements protected-area conservation and natural forest restoration. ISFR's statistically defensible grid-based NFI design and ToF sample frame make ToF estimates verifiable and suitable for incorporation into a composite ecological index.

- ***Stock:*** **State's share of ToF relative to national total.**
- ***Flow:*** **Change in the state's ToF as a proportion of the change in national ToF.**
- **Reward increase in ToF area.**
- ***Source:*** **ISFR (FSI)**

Figure 4. 4: TOF in urban and agricultural setting

4.1.5. Protected Area (PA) Coverage

The spatial extent of legally constituted PAs is a canonical indicator of a government's durable conservation commitment. PA coverage and quality together reflect a state's sustained efforts toward biodiversity conservation and ecological stability. PAs safeguard endemic, threatened, and keystone species while maintaining critical habitats that sustain landscape connectivity, regulate hydrological regimes, and moderate local and regional climates. They also generate multiple co-benefits, including soil protection, carbon sequestration, and ecosystem resilience, all of which underpin long-term human and ecological well-being. Data on the extent and distribution of PAs are officially compiled and updated by the Wildlife Institute of India (WII)–ENVIS Centre, based on legally notified areas under the Wildlife (Protection) Act, 1972. Because the notification and demarcation of PAs are formal administrative acts, PA coverage is

a verifiable and consistent measure of conservation effort. Integrating this coverage as a stock indicator, together with supplementary ecological condition metrics such as canopy density or habitat integrity (where data are available), provides a comprehensive understanding of conservation performance over time. This approach directly links fiscal and policy recognition to enduring biodiversity outcomes and the sustained maintenance of ecological assets.

- ***Stock:* State's share of national PA network.**
- ***Flow:* Change in the state's PA coverage as a proportion of the change in national PA.**
- **Reward increase in PA coverage**
- ***Source:* WII–ENVIS**

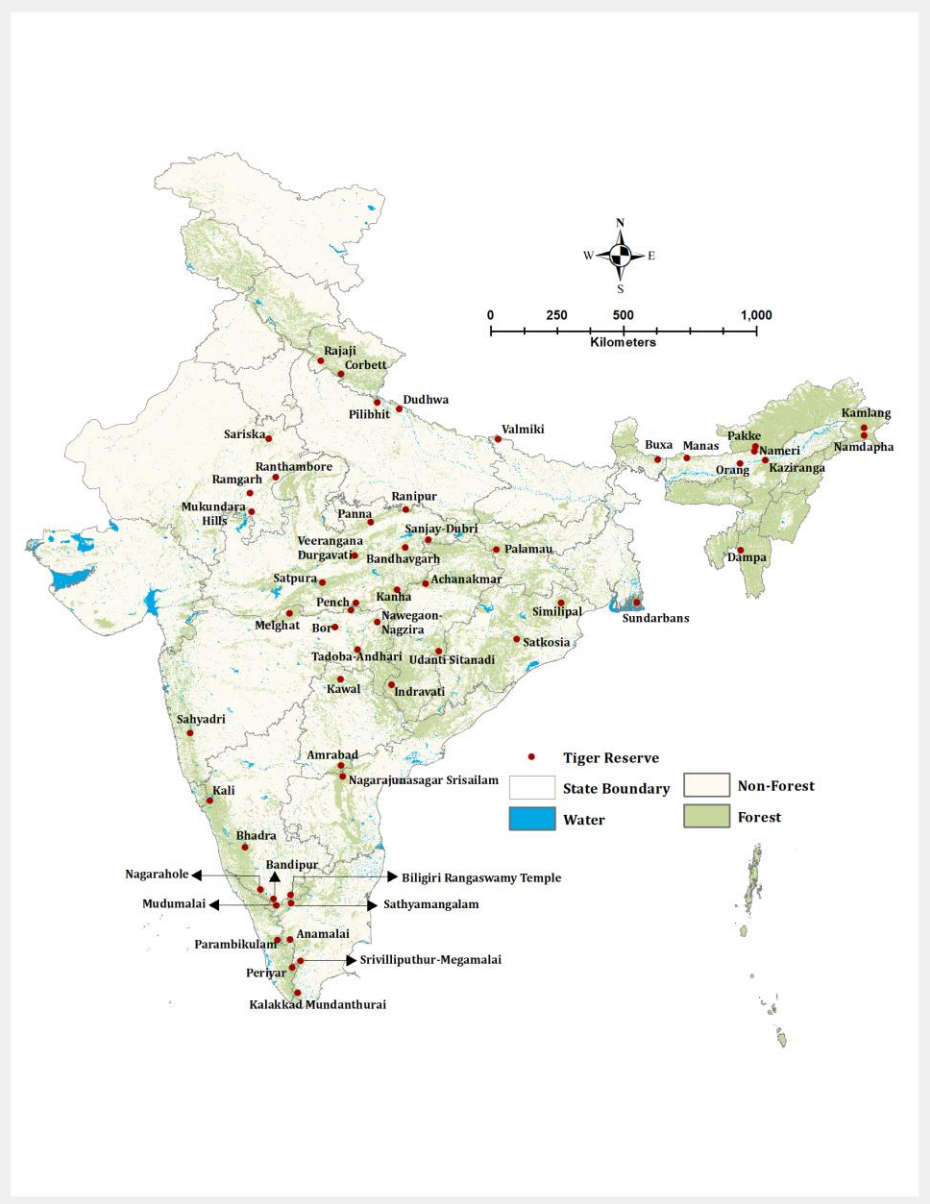


Figure 4. 5: Tiger Reserves across India (Source: NTCA, 2025)

4.1.6. Groundwater Resources

Groundwater availability represents a critical dimension of ecological and hydrological resilience, directly influencing agricultural productivity, ecosystem health, and water security. It reflects the sustainability of sub-surface water extraction relative to recharge, thus serving as a key indicator of environmental stress and governance performance. The Central Ground Water Board (CGWB), under the Ministry of Jal Shakti, provides the official dataset and classification for groundwater resources through its periodic assessment of Dynamic Ground Water Resources of India. Each assessment unit is categorised as Safe, Semi-Critical, Critical, or Over-Exploited based on the stage of groundwater extraction, defined as the ratio of total annual extraction to annual extractable groundwater resource, expressed as a percentage. Blocks where extraction exceeds/approaches recharge capacity are marked as semi-critical or critical, reflecting zones of hydrological vulnerability and unsustainable water use. The proportion of critical and semi-critical blocks within a state can serve as a stock indicator of existing groundwater stress, while reductions in these categories represents a flow indicator of improved groundwater governance and sustainable use. The indicator thus incentivises integrated catchment management, efficient irrigation, and aquifer recharge interventions that address one of India's most pressing environmental challenges. Since CGWB assessments are standardised, peer-reviewed, and publicly released, this metric is both verifiable and comparable across states, making it suited for inclusion in ecological fiscal frameworks that reward hydrological resilience and long-term sustainability.

- ***Stock:* State's share in number of critical and semi-critical blocks of national total.**
- ***Flow:* Change in the state's critical and semi-critical blocks as a proportion of national total.**
- **Reward decrease in number of semi-critical/critical blocks**
- **Source: CGWB**

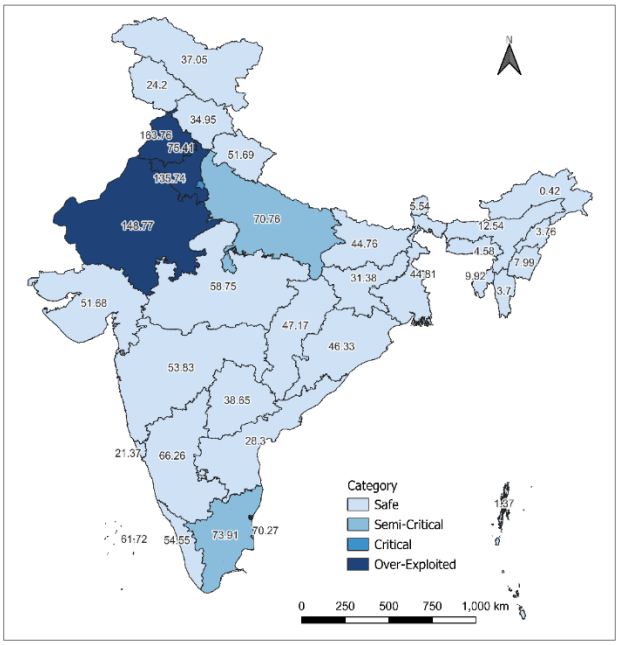


Figure 4. 6: Current state wise ground water extraction levels in India (CGWB, 2024)

Table 4. 1: Proposed Operational Indicators with Stock–Flow Metric Definitions, Rationale, and Data Sources

Indicator	Stock	Flow	Metric definition	Rationale	Data Source
Forest Cover and Density	State's share of national forest area and density class (VDF and MDF).	Biennial changes in state's forest area and density to national forest area and density class.	Reward increase in forest cover and density	Preserves continuity of ecological criterion; recognises quality via density; nationally standardised.	ISFR (FSI)
Protected Area coverage	State's share of national PA network.	Change in state's PA coverage as a proportion of the change in National PA.	Reward increase in PA coverage	Recognises durable conservation commitments with co-benefits for biodiversity, gene-pool protection, water, and zoonotic-risk reduction.	WII-ENVIS
Carbon stock	States's Share of national carbon stock.	Change in state's carbon stock as proportion of the change in National carbon stock.	Reward increase in carbon stock	Aligns with NDC sink targets; values quality of forest, not just area	ISFR (FSI)
Forest fire mitigation	State's share of forest area burnt of national total.	Change in the state's area burnt due to forest fire as proportion of change in the area burnt at national level.	Reward reduction in burnt area.	Rewards preparedness, prevention, and early response; reduces carbon loss and biodiversity risks.	ISFR (FSI)
Trees Outside Forests	State's share of ToF of national ToF.	Change in the state's ToF as proportion of national ToF.	Reward increase in ToF area.	Internalises tree cover benefits in agrarian/urban/peri-urban landscapes; links to resilience and livelihoods.	ISFR (FSI)
Groundwater resource status	State's share in number of critical and semi critical blocks of national total.	Change in the state's critical and semi critical blocks as proportional to national total.	Reward decrease in number of semi-critical/critical blocks	Integrates hydrological resilience; rewards proactive groundwater management; addresses one of India's most acute ecological risks.	CGWB

4.2. Scenario-Based Ecological Allocation Analysis

4.2.1. Integrating Stock and Flow Indicators into Fiscal Devolution

To explore the implications of expanding EFTs beyond a forest-only approach, alternative scenarios was constructed using state-level data for forest density inside RFA/GW, PA, and the extent of ToF (we have used only these three indicators for our analysis to create a picture of the change in allocation when a performance aspect is added to the allocation algorithm). Business as Usual (BAU) replicates the FC15 approach, where allocations are based solely on a state's share of aggregate national forest cover. The Scenario disaggregates forest cover into VDF and MDF, into inside and outside RFA to include extent of ToF (indicating the states effort towards greening) in line with the FSI's classification, to capture ecological efforts alongside natural capital.

To operationalise this framework, the total divisible tax pool is divided into two allocation buckets - Allocation Bucket 1 (80 percent) follows the traditional logic of the FC15, which bases transfers on forest-related criteria embedded in the tax devolution formula. This component ensures continuity with existing fiscal federal principles that compensate states for maintaining forest cover as a national public good. Allocation Bucket 2 (20 percent) introduces an ecological index, designed to integrate both stock and flow variables. This component captures states' ecological performance and improvements over time, rewarding both preservation and proactive action (See Annexure 7).

In constructing the ecological index, the stock component is represented by the extent and quality of natural capital — specifically, dense forest cover within RFA, PA coverage, and the extent of ToF. These stock indicators are reweighted to reflect ecological importance, assigning 0.8 weight to dense forest cover, 0.1 to PA extent, and 0.1 to ToF area. The flow indicator is the change of density cover and extent of ToF from a base year. Each state's stock and flow indicators are normalised using z-scores to ensure comparability across variables of different scales. The normalised values for stock and flow are then combined by averaging to form a composite z-score. To avoid negative values and ensure all indices are positive, a small epsilon value (0.000001) is added to the composite scores. The ecological index is then constructed by weighting the stock and flow z-scores in a 90:10 ratio, where 90 percent weight is assigned to stock to represent enduring ecological capital, and 10 percent to flow to account for recent ecological performance and improvement. Finally, the index is converted into allocation shares by dividing each state's positive index value by the total sum across all states. These shares determine each state's portion of the 20 percent ecological allocation bucket, which is then added to the 80 percent allocation derived from the standard FC15 logic (See Annexure 7). This blended approach maintains continuity with the established forest-based fiscal framework while incorporating dynamic ecological indicators, offering a pathway toward performance-sensitive and ecologically balanced fiscal devolution.

Link between Ecological Performance and Allocation Outcomes

The introduction of new ecological performance aspect significantly alters the distribution of fiscal transfers across states (Figure 4.1). By examining allocations for Forested, Hill, and North-Eastern states, Arid and Semi-arid regions, Riverine

plains, Central highlands, Eastern and Western Ghats, and Coastal regions we can discern how inclusion of flow aspect in the performance based allocation approaches shift incentives and fiscal space. The data reveals a clear relationship between changes in natural capital and changes in fiscal allocation. States that recorded declines in dense or moderately dense forest cover (negative flow) saw corresponding reductions in their ecological index values and, consequently, in their overall allocation. Conversely, states with stable or improving ecological performance experienced relatively higher or retained shares.

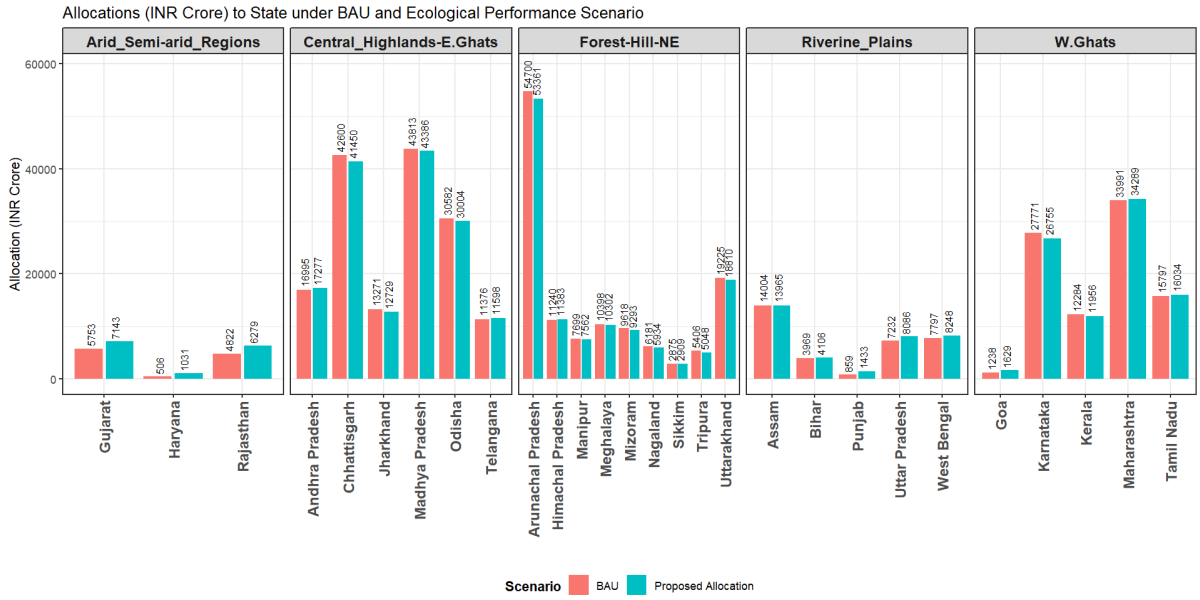


Figure 4. 7: Allocations to States under BAU and Ecological Performance Scenario

For instance, Arunachal Pradesh, despite having the highest baseline forest endowment, shows a decline of 167 sq. km. in VDF and 163 sq. km. in MDF between 2021 and 2023 (Figure 4.2; further details of all states provided in See Annexure 7). This ecological regression translates into a loss of INR 1,339 crore compared to its BAU allocation (INR 54,700 crore to INR 53,361 crore, Table 4.2). The state's reduced flow score diminished its composite index, underscoring how ecological loss directly curtails fiscal advantage. Chhattisgarh recorded a 289 sq. km. reduction in VDF and 57 sq. km. gain in MDF (See Annexure 7), reflecting partial degradation. Correspondingly, it experienced an INR 1,150 crore decrease in its allocation (See Table 4.2). The negative performance outweighed the state's strong stock base, reaffirming that fiscal incentives are now more sensitive to ecological trends rather than static endowments. Similarly, Madhya Pradesh, with an overall reduction of 417 sq. km. in VDF and 397 sq. km. in MDF (See Annexure 7, Figure 4.2), faced an INR 1,947 crore decline, highlighting how degradation in dense forest zones directly diminishes fiscal flow under the new scenario (See Table 4.2).

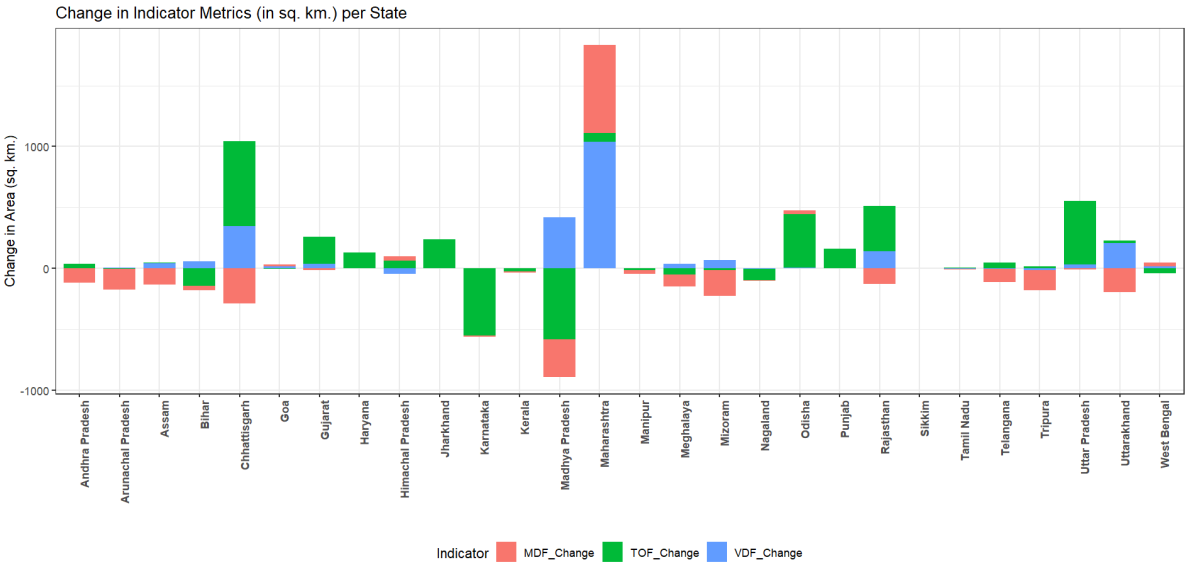


Figure 4. 8: Biennial (2021-2023) change in VDF, MDF, and ToF across States

In contrast, states that managed to stabilise or improve their ecological indicators showed smaller declines or even gains. Himachal Pradesh improved in both forest quality and ToF extent (with proportional increases of 0.0018, See Annexure 7), resulting in an INR 143 crore gain over its BAU allocation. Uttarakhand, though maintaining a high forest proportion, recorded marginal canopy losses, resulting in a INR 415 crore reduction in allocation which reflects the model's sensitivity to small but negative ecological shifts. Odisha, despite having the third-largest forest area, lost approximately 40 sq. km. of dense forest (See Annexure 7, Figure 4.2), and its allocation fell by INR 578 crore compared to BAU (See Table 4.2).

North-eastern states traditionally dominated under BAU due to legacy forest endowments, however, Mizoram, Nagaland, and Meghalaya now experience reduced allocations (INR 100– 300 crore losses, See Table 4.2) due to canopy degradation (See Annexure 7, Figure 4.2). The introduction of the flow component thus moderates the dominance of high forest states and brings performance accountability into play.

States in the Riverine Plains with limited forest stock but modest ToF improvements benefit from the recognition of ecological effort outside forest area. Uttar Pradesh with increase of 25 sq. km. in forest density and 520 sq. km. in Extent of ToF (See Annexure 7, Figure 4.2), gains the state INR 854 crore (Table 4.2) and Bihar with a 24 sq. km. increase in forest density and a loss of 140 sq. km. of ToF, gains slightly less INR 137 crores. This demonstrates that the inclusion of flow indicators and ToF metrics broadens participation in ecological fiscal rewards.

Central Highlands and Eastern Ghats show mixed patterns. Odisha and Chhattisgarh show loss INR 578 crore and INR 1,150 crore, respectively, while Andhra Pradesh and Telangana gain INR 282 crore and INR 222 crore, respectively, reflecting degraded forest stock despite moderate ToF gains.

Western Ghats and Coastal states with better ecological maintenance fared relatively well. Kerala had a reduction of INR 328 crore (Table 4.2) due to 10 sq. km. and 24.4 sq. km. loss in forest density and Extent of ToF respectively (See Annexure 7, Figure 4.2) while Tamil Nadu saw INR

137 crore loss show marginal reductions due to stability in forest indicators (loss of 10.7 sq. km. in forest density and increase of 7 sq. km. in ToF. Goa had increase allocation by INR 29 crore (with gain of 28 sq. km. of forest density) and Maharashtra by INR 298 crore record slight gains (Table 4.2) (with a gain of 1764 sq. km. in forest density and 70.1 sq. km. in ToF, See Annexure 7, Figure 4.2), reflecting relatively stable dense forest and expanding ToF areas.

Arid and Semi-arid states, which traditionally received small allocations, now see relative gains due to ToF and small improvements in ecological performance. Rajasthan with an increase of 13.5 sq. km. and 367 sq. km. in forest density and ToF (See Annexure 7, Figure 4.2) saw an increase of INR 1,457 crore in allocation (Table 4.2) and Haryana with 129 sq. km. increase in ToF (See Annexure 7, Figure 4.2) increased its allocation by INR 525 crore (Table 4.2).

Table 4. 2: Allocation difference between BAU and Ecological Performance Scenario

Grouping of states	States	Business as Usual		Ecological Performance Scenario		Difference (INR crore)
		Proportion of forest density (FC15 Annexure table)	Current allocation under FC15 (INR crore)	Allocation Share	Allocation in INR crores	
Forested Hill and NE States	Uttarakhand	0.046	19225	0.041	18810	-415
	Himachal Pradesh	0.027	11240	0.028	11383	143
	Arunachal Pradesh	0.130	54700	0.114	53361	-1339
	Sikkim	0.007	2875	0.007	2909	34
	Manipur	0.018	7699	0.017	7562	-137
	Meghalaya	0.025	10398	0.023	10302	-96
	Mizoram	0.023	9618	0.019	9293	-325
	Nagaland	0.015	6181	0.012	5934	-247
	Tripura	0.013	5406	0.009	5048	-358
Riverine plains	Punjab	0.002	859	0.009	1433	574
	Uttar Pradesh	0.017	7232	0.027	8086	854
	Bihar	0.009	3969	0.011	4106	137
	West Bengal	0.018	7797	0.024	8248	452
	Assam	0.033	14004	0.033	13965	-39
Central Highlands	Chhattisgarh	0.101	42600	0.087	41450	-1150
	Jharkhand	0.031	13271	0.025	12729	-542

Grouping of states	States	Business as Usual		Ecological Performance Scenario		Difference (INR crore)
		Proportion of forest density (FC15 Annexure table)	Current allocation under FC15 (INR crore)	Allocation Share	Allocation in INR crores	
and Eastern Ghats	Odisha	0.072	30582	0.066	30004	-578
	Madhya Pradesh	0.104	43813	0.099	43386	-427
	Telangana	0.027	11376	0.030	11598	222
	Andhra Pradesh	0.040	16995	0.044	17277	282
Western Ghats	Maharashtra	0.081	33991	0.084	34289	298
	Goa	0.003	1238	0.008	1629	392
	Karnataka	0.066	27771	0.054	26755	-1016
	Tamil Nadu	0.037	15797	0.040	16034	237
	Kerala	0.029	12284	0.025	11956	-328
Arid and Semi-arid regions	Gujarat	0.014	5753	0.030	7143	1390
	Haryana	0.001	506	0.007	1031	525
	Rajasthan	0.011	4822	0.029	6279	1457

The ecological performance-based approach introduces a balanced dynamic into fiscal devolution. It also demonstrate how integrating flow metrics and non-forest ecological contributions can rebalance fiscal equity across biogeographic zones. By integrating change-based (flow) indicators, it discourages unsustainable forest loss and incentivises ecological recovery. The observed declines in allocations for states losing dense forest cover and the corresponding gains for those improving ecological performance, confirm the effectiveness of linking natural capital maintenance to fiscal rewards.

4.2.2. Prioritising Himalayan States with their performance for allocation

The Indian Himalayan Region (IHR) states form India's critical ecological and hydrological infrastructure, sustaining the livelihoods and water security of nearly 400 million people across the Indo-Gangetic plains. Yet, these states face a compounding crisis of ecological fragility and fiscal vulnerability. Exemplified by the state of Himachal Pradesh, in the last four years alone (2022–2025), the state has lost over 1,700 lives and suffered economic damages of around INR 46,000 crore, by losses incurred in tourism, trade, and livelihoods (GoHP and UNDP, 2025). These recurring cloudbursts, GLOF, and land subsidence incidents, occurring with

increased frequency, are direct outcomes of over-extraction of natural resources, forest diversion for hydropower and infrastructure, and the accelerating effects of climate change on glacial systems. The IHR states are rich in natural capital, for example Uttarakhand generates annual flow benefits worth about USD 56.2 billion, equivalent to nearly USD 22,927 per hectare. In addition, the stock value of land, timber, and carbon storage is estimated at USD 835.4 billion (Verma et. al., 2019a). These services underpin India's climate stability, river regulation, and agricultural productivity. Given their critical role and escalating disaster exposure, prioritising Himalayan states in fiscal devolution, through regionally weighted ecological criteria, is essential to internalise their national contribution, offset disaster-induced economic shocks, and incentivise sustainable ecological stewardship.

This scenario prioritises the IHR by explicitly recognising its ecological fragility, ecosystem service contributions, and developmental constraints. The design allocates 40 percent of the total divisible pool to IHR states and 60 percent to non-IHR states, acknowledging the disproportionate ecological responsibilities borne by the Himalayan region in maintaining national hydrological balance, biodiversity, and carbon sequestration.

Similar to the previous run, this scenario employs an ecological index to determine state-wise allocations within each regional pool. Each of the two pools, Himalayan and non-Himalayan, is divided into two buckets as detailed in Section 4.2.1. This approach captures both ecological endowments and ongoing efforts, while also reflecting regional prioritisation for the Himalayan states.

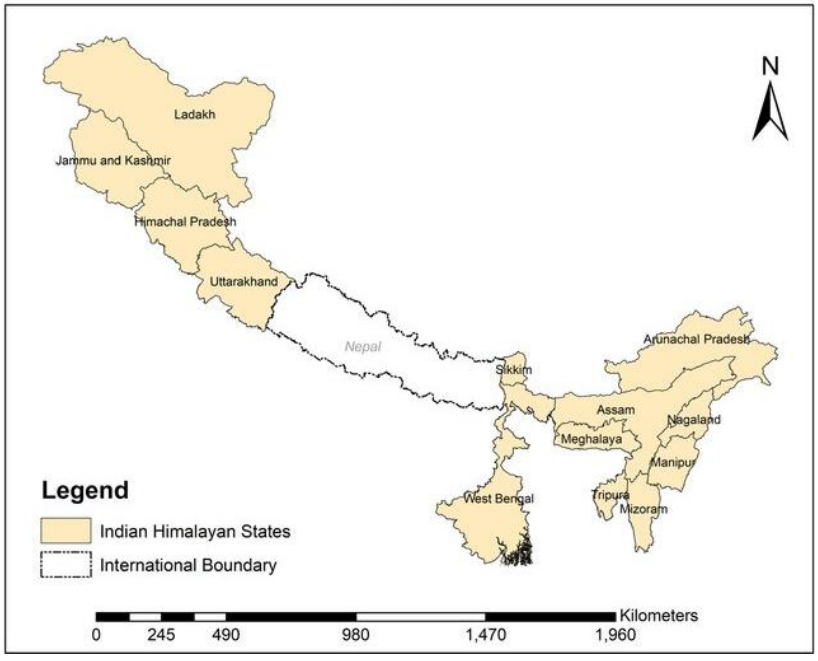


Figure 4. 9: States in the Indian Himalayan Region (Source: Mehta et al., 2023)

Allocation Outcomes

The Himalayan-centric adjustment results in a notable redistribution of fiscal transfers between ecological regions. IHR states experience an overall increase in allocation, while non-IHR states, particularly those with limited forest cover or ecological improvement, see modest declines.

Table 4. 3 Allocation difference between BAU and Himalayan Centric Scenario

Region	States	Business as Usual		Scenario Himalayan Centric		Difference (INR crore)
		Proportion of forest density (FC15 Annexure table)	Current allocation under FC15 (INR crore)	Allocation Share	Allocation in INR crores	
IHR	Uttarakhand	0.046	19225	0.1360	22,000	2,775
	Himachal Pradesh	0.027	11240	0.0967	13,442	2,202
	Arunachal Pradesh	0.130	54700	0.3634	61,796	7,096
	Sikkim	0.007	2875	0.0155	3,127	252
	Manipur	0.018	7699	0.0415	8,372	674
	Meghalaya	0.025	10398	0.0670	11,678	1,280
	Mizoram	0.023	9618	0.0427	10,150	532
	Nagaland	0.015	6181	0.0250	6,440	258
	Tripura	0.013	5406	0.0159	5,432	26
	Assam	0.033	14004	0.1089	16,357	2,353
	West Bengal	0.018	7797	0.0873	10,007	2,210
Non-IHR	Punjab	0.002	859	0.0101	1,148	289
	Uttar Pradesh	0.017	7232	0.0388	7,333	100
	Bihar	0.009	3969	0.0149	3,701	-268
	Chhattisgarh	0.101	42600	0.1338	38,399	-4,201
	Jharkhand	0.031	13271	0.0361	11,679	-1,592
	Odisha	0.072	30582	0.0992	27,726	-2,856
	Madhya Pradesh	0.104	43813	0.1528	40,261	-3,553
	Telangana	0.027	11376	0.0436	10,652	-724
	Andhra Pradesh	0.040	16995	0.0653	15,924	-1,071
	Maharashtra	0.081	33991	0.1276	31,696	-2,295
	Goa	0.003	1238	0.0091	1,378	140
	Karnataka	0.066	27771	0.0812	24,726	-3,044
	Tamil Nadu	0.037	15797	0.0598	14,756	-1,041
	Kerala	0.029	12284	0.0367	10,978	-1,306
	Gujarat	0.014	5753	0.0426	6,428	675
	Haryana	0.001	506	0.0081	786	280
	Rajasthan	0.011	4822	0.0405	5,630	808

Under the Himalayan-Centric Scenario, IHR states emerge as the principal gainers, reflecting the combined effect of ecological weighting and regional prioritisation. Arunachal Pradesh, with the largest forest stock in the country, records the most significant increase in allocation, rising from INR 54,700 crore under the BAU scenario to INR 61,796 crore with a gain of INR 7,096 crore, or about 13 percent. The additional weighting assigned to VDF and the prioritisation of Himalayan ecosystems substantially enhance its fiscal share. Similarly, Uttarakhand and Himachal Pradesh, both characterised by dense forest cover, steep slopes, and critical watershed functions, experience notable increases. Uttarakhand's allocation rises from INR 19,225 crore to INR 22,000 crore, while Himachal Pradesh's grows from INR 11,240 crore to INR 13,442 crore, corresponding to gains of INR 2,775 crore and INR 2,202 crore, respectively. Among the smaller Himalayan states, Sikkim sees a gain of INR 252 crore, Manipur INR 674 crore, Meghalaya INR 1,280 crore, Mizoram INR 532 crore, Nagaland INR 258 crore, and Tripura INR 26 crore. Even Assam, despite its partially degraded forest areas, benefits from recognition of its ecological service provisioning role, with its allocation increasing from INR 14,004 crore to INR 16,357 crore with a gain of INR 2,353 crore. West Bengal, which includes Himalayan districts and forest corridor linkages, also benefits significantly, with an increase from INR 7,797 crore to INR 10,007 crore (a gain of INR 2,210 crore). Collectively, these trends demonstrate that targeted regional weighting can effectively channel greater fiscal support toward ecologically fragile yet nationally critical Himalayan states.

In contrast, most non-Himalayan states experience relative declines in their allocations as a result of the 40 percent earmarking of the divisible pool for the Himalayan region. Chhattisgarh, Madhya Pradesh, and Odisha, which have traditionally been strong beneficiaries under forest cover-based criteria, witness reductions of INR 4,201 crore, INR 3,553 crore, and INR 2,856 crore, respectively. These decreases stem not from ecological underperformance but from the reallocation effect and modest gains in forest flow variables. Similarly, Karnataka, Maharashtra, and Tamil Nadu record declines of INR 3,044 crore, INR 2,295 crore, and INR 1,041 crore, respectively. Jharkhand and Andhra Pradesh also show moderate reductions of INR 1,592 crore and INR 1,071 crore, respectively, due to smaller improvements in forest and ToF indicators. However, some non-Himalayan states achieve marginal gains owing to stable or improving ecological parameters: Gujarat increases by INR 675 crore, Haryana by INR 280 crore, Goa by INR 140 crore, and Rajasthan by INR 808 crore. Overall, while the redistribution introduces modest trade-offs, it strengthens ecological federalism by aligning fiscal flows with both regional vulnerability and ecological performance.

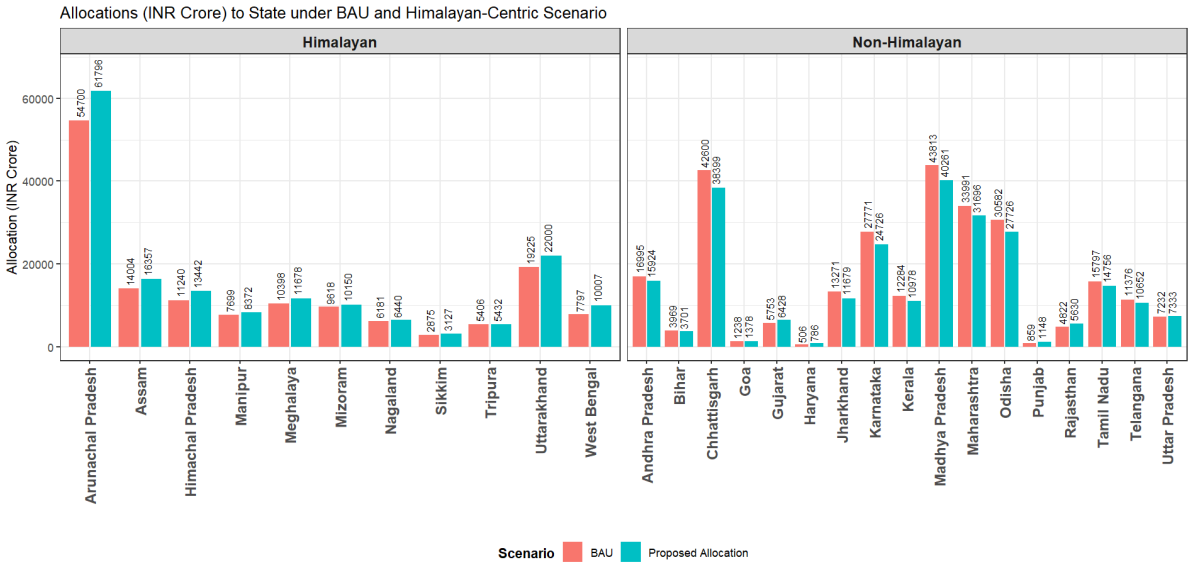


Figure 4. 10 Allocations to States under BAU and Himalayan Centric Scenario

The Himalayan-Centric Scenario underscores how regional ecological valuation can drive fiscal justice and ecological performance simultaneously. By earmarking 40 percent of the divisible pool for the Indian Himalayan Region and combining it with a dynamic Ecological Index, the scenario moves beyond uniform allocation to regionally differentiated fiscal incentives. This approach not only strengthens fiscal support for fragile ecosystems but also institutionalises the linkage between natural capital, ecological effort, and fiscal reward paving the way for a more ecologically balanced framework for intergovernmental transfers.

4.3. Aspirational Indicators for Future Consideration

Aspirational indicators, as defined in this study, are metrics that hold strong conceptual relevance for capturing ecological resilience, biodiversity conservation, and climate adaptation, but which are not yet feasible for immediate integration into fiscal frameworks due to current gaps in data, monitoring, and institutional readiness. The consultations generated a set of such indicators that, while scientifically robust and aligned with long-term policy objectives, could not be shortlisted for operationalisation at this stage. The primary limitations relate to data availability, uneven national coverage, lack of standardised methodologies, and inconsistent monitoring protocols across states. These indicators, summarised in Table 4.2, nonetheless constitute a medium-term agenda for phased adoption, once institutional and technical capacities are strengthened and harmonised datasets become available.

Notably, incorporating these indicators that extend to urban and peri-urban areas is equally critical, given the rapid expansion of cities, their intensifying ecological footprint, and the finite resource base on which they depend. Metrics on green cover, ecological corridors, water management, and waste flows in metropolitan and peri-urban spaces provide important measures of how cities are preparing for climate resilience, biodiversity integration, and sustainable growth. With more than one-third of India's population already urbanised and projections of continued expansion, the ecological pressures of urbanisation are set to grow disproportionately. Embedding

indicators for greener cities within fiscal frameworks therefore aligns with the broader resilience agenda, linking ecological performance not only to rural and forested landscapes but also to the sustainability of urban systems that drive the country's economy and house a growing majority of its citizens. These indicators, while conceptually strong, remain at a nascent stage and are more suitable for phased adoption once municipal datasets are harmonised and national monitoring frameworks are established.

Soil health emerged as a recurrent theme, particularly soil organic carbon (SOC) and nutrient status, which directly link agriculture, forestry, and carbon sequestration. While conceptually strong, soil monitoring remains uneven across states, and the absence of a nationally standardised soil health index prevents its immediate use. Similarly, the broader status of water resources encompassing both surface water quality and watershed health, was seen as an important complement to groundwater data. However, responsibility is currently fragmented across agencies such as CGWB, CPCB, and state water boards, with datasets lacking consistent baselines and comparability.

A number of ecosystem-specific indicators were also flagged as priorities. Grasslands and agroforestry coverage represent critical yet under-recognised systems, but systematic mapping and data coverage remain patchy. Restoration quality, including the effectiveness of degraded land and forest restoration, is another key gap; while methodologies exist in pilot form, consistent measurement, verification, and reporting protocols are still evolving. Likewise, the extent of invasive species was identified as a pressing biodiversity risk indicator, but the absence of a centralised, standardised dataset limits feasibility.

Several indicators focused on socio-ecological dynamics. Population pressure on ecosystems, expressed through encroachment, over-extraction, or land conversion, could provide an important measure of demand-driven stress, yet census and land-use data are not currently integrated into ecological accounting frameworks. Human–wildlife conflict reduction was highlighted as a measure of coexistence and conservation success, but reporting remains fragmented and inconsistent across states. Biodiversity richness or species diversity indices could directly capture ecological integrity and resilience, but at present data is scattered across project-specific surveys and lacks a unified, nationally consistent methodology.

Other aspirational domains include wetlands, mangroves, and blue carbon ecosystems, which play a critical role in carbon storage, fisheries productivity, and coastal protection. Despite their importance, data quality, frequency, and comparability remain uneven across states. Urban ecosystems including green cover, waste flows, and biodiversity corridors were also flagged as priorities for climate-resilient cities, though monitoring frameworks remain nascent and vary widely across municipal contexts.

Organic farming adoption rates represent an emerging indicator of sustainable land use and environmental stewardship. By promoting reduced chemical inputs and improved soil health, organic agriculture contributes directly to ecological integrity and human well-being. However, certification and adoption data under schemes such as PKVY remain fragmented across states, and the absence of a unified national tracking system limits its immediate integration into fiscal frameworks.

Urban air and water pollution serve as critical indicators of environmental health and governance performance. They capture state-level efforts to reduce emissions and improve water quality, central to both ecological sustainability and public health outcomes. Despite regular reporting by CPCB, SPCBs, and AMRUT, gaps in sensor coverage and data standardisation continue to constrain their reliability for use in fiscal devolution models.

Finally, indicators such as the Climate Vulnerability Index (CVI) and the coverage of sacred groves and community reserves reflect broader dimensions of resilience and culturally rooted conservation. While conceptually sound, CVI methodologies differ between institutions and require disaggregation to the state and district level for fiscal use, while sacred groves and community reserves lack systematic national baselines.

Table 4. 4: Aspirational Indicators: Description, Data Status, and Rationale

Indicator	Description	Potential Data Source(s)	Data Status	Rationale
Soil health (SOC, nutrient status)	Captures soil fertility, productivity, and carbon sequestration potential through measures such as (SOC) and nutrient balance.	Soil Health Card Scheme, NBSSLUP, ICAR institutes	Uneven coverage; periodic but inconsistent updates; no standardised national index.	Links agriculture, forestry, and carbon sequestration; essential for integrating agroecological resilience and soil-based carbon sinks into fiscal logic.
Status of water resources (quality and quantity)	Tracks surface water health, watershed condition, and hydrological regulation beyond groundwater.	CGWB, CPCB, State Water Boards, WRIS	Fragmented; datasets exist but lack common baselines and comparability across states.	Complements groundwater data; critical for agriculture, drinking water security, and flood/drought resilience.
Grasslands and agroforestry coverage	Measures extent and quality of grasslands and agroforestry systems as under-recognised ecosystems.	FSI (limited), ICAR, State Agriculture and Forest Departments	Patchy; not systematically mapped or updated.	Expands scope beyond forests; recognises ecosystems with high biodiversity and livelihood co-benefits.
Restoration quality	Evaluates ecological outcomes of forest and degraded land restoration (biodiversity, soil, hydrology).	MoEF&CC (compensatory afforestation reports), State FD reports	Pilot methodologies exist; not standardised nationally.	Captures effectiveness of investments in restoration; critical for assessing long-term ecological resilience.
Invasive species extent	Tracks spread and management of invasive alien species in forests, wetlands, and agroecosystems.	SSI, BSI, State Biodiversity Boards, Forest Department invasive species lists	No systematic, centralised dataset; state- or project-specific surveys.	Essential for biodiversity integrity, habitat restoration, and ecosystem productivity.
Population pressure on ecosystems	Measures demand-driven stresses such as encroachment,	Census of India, NSSO,	Socioeconomic and land-use datasets exist	Highlights human-induced stress on ecosystems; aligns

Indicator	Description	Potential Data Source(s)	Data Status	Rationale
	land conversion, and resource over-extraction.	NRSC, Land Use Statistics	but are not integrated with ecological metrics.	fiscal logic with demand-side pressures.
Human–wildlife conflict reduction	Tracks frequency of conflict incidents, compensation claims, and mitigation effectiveness.	State Forest Departments, NTCA, WII-MEE Report (only done for tiger reserves)	Fragmented, inconsistent across states; often anecdotal or under-reported.	Reflects coexistence and conservation outcomes; addresses socio-ecological dimensions of biodiversity management.
Species / biodiversity richness	Evaluates species diversity and abundance as a measure of ecological integrity.	SSI, BSI, PBRs, IBP	Data scattered; project-specific and irregular; lacks unified national index.	Core indicator for biodiversity; strengthens ecological resilience and ecosystem health assessment.
Status of wetlands, mangroves and blue ecosystems	Tracks extent, health, and productivity of aquatic and coastal ecosystems (wetlands, mangroves, seagrasses, coral reefs).	Wetland Atlas, State Wetland Authorities, SSI, ICAR–CMFRI	Data uneven across states; frequency and standardisation limited.	High carbon storage, biodiversity, and coastal protection value; vital for blue carbon accounting and resilience.
Organic farming adoption rates	Measure of contribute significantly to the environment and also human health	PKVY, State Reports	Certification data fragmented; adoption not fully tracked	Indicator of sustainable practices and reduced inputs
Urban air and water pollution	Composite measure of state efforts for pollution abatement at source	CPCB/SPCB, AMRUT	Regular but Gaps in sensor coverage and standardisation	Central to health and ecological outcomes.
Climate Vulnerability Index (CVI)	Composite measure of exposure, sensitivity, and adaptive capacity of ecosystems and communities to climate hazards.	NITI Aayog (state-level CVI), MoEF&CC, NAPCC-SAPCCs	Methodologies vary; requires standardisation and disaggregation to state/district level.	Aligns fiscal devolution with climate adaptation and risk reduction priorities.
Sacred groves and community reserves	Recognises culturally rooted, community-led conservation landscapes with ecological value.	State Biodiversity Boards, PBRs, academic/civil society documentation	Limited baseline; no systematic coverage across states.	Values community stewardship and cultural heritage; incentivises decentralised conservation practices.

4.4. Suggested Advisory from FC16 to States for Effective Utilisation of FC Transfers for Forestry and Ecology

To ensure that FC transfers lead to measurable ecological outcomes, it may consider issuing the following advisories. Each responds to gaps identified during regional consultations and expert discussions.

Develop ecological databases and monitoring systems: Current ecological data is fragmented across agencies (FSI, CGWB, CPCB, state departments) with limited interoperability, constraining monitoring and evaluation.

- **Establish state-level systems to maintain centralised databases on forests, ToF, wetlands, grasslands, and urban green spaces.**
- **Introduce open-data dashboards and participatory GIS mapping for transparency.**

Institutionalise GBT: Consultations revealed difficulty in distinguishing ecological spending from general development budgets, limiting accountability and targeted planning.

- **Tag and track biodiversity, forestry, and climate-related expenditure in state budgets.**
- **Integrate with national classification frameworks for comparability.**

Earmark and ring-fence funds for ecological priorities: States reported diversion of ecological allocations to other sectors. Ring-fencing ensures funds remain dedicated to environmental purposes.

- **Allocate a defined share of FC transfers to forests, biodiversity conservation, watershed management, and climate resilience.**
- **Classify these allocations as non-lapsable and non-transferable.**

Align fund flows with ecological work cycles: Mismatched fund release cycles have led to low utilisation in forestry and watershed schemes, reducing effectiveness.

- **Release funds in line with seasonal requirements of plantation, watershed, and restoration activities.**

Strengthen institutional and community capacity: Community institutions play a key role in ecological governance but face severe resource and capacity gaps.

- **Invest in the technical and scientific capacity of state forest departments, research institutions, and local bodies.**
- **Provide direct access to funds for JFMCs, Van Panchayats, BMCs, PRIs, and ULBs.**

Incorporate climate transition priorities: Consultations highlighted the fiscal risks of transition in such states, which are not yet reflected in ecological allocations.

- **Identify just transition challenges in coal- and resource-dependent states, and design targeted state schemes accordingly.**

Way Forward

5. Way Forward

The FC16 has the opportunity to position ecological fiscal transfers not only as compensatory instruments but as catalysts for measurable improvements in ecological outcomes. To achieve this, fiscal incentives must be complemented by institutional reforms, robust monitoring systems, and capacity-building measures that ensure funds translate into tangible conservation and resilience benefits.

It could strengthen ecological fiscal transfers by broadening the scope of indicators beyond forests to encompass other eco-sensitive zones such as wetlands, grasslands, urban green spaces, and PAs. A holistic formula approach which combines stock indicators (forest cover, density, and PA coverage) with flow indicators (changes in forest quality, carbon stock, ToF expansion, fire incidence, groundwater status, and net PA additions), would move the system from compensating historical endowments to rewarding active ecological stewardship. By balancing the recognition of existing ecological assets with incentives for incremental improvements, such a framework would not only enhance equity among states with different ecological profiles but also create a dynamic incentive structure that links fiscal transfers directly to measurable outcomes in conservation, resilience, and ecosystem service delivery.

A critical step towards it is the creation of integrated ecological databases and monitoring systems. At present, data is fragmented across agencies such as the FSI, CGWB, and CPCB, limiting interoperability and weakening evaluation frameworks. States should be supported in establishing “One state, One data system” for forests, trees outside forests, wetlands, grasslands, and urban green spaces. These centralised databases, complemented by open-data dashboards and participatory GIS platforms, would allow interoperability across institutions, enable transparent tracking of ecological outcomes, and provide a reliable foundation for performance-based transfers.

In addition, the Commission may consider setting up a Data Management System equipped with PACIT (Problem identification, Analysis, Choice of policy/action, Implementation and Testing/evaluating) and SWOT (Strengths, Weakness, Opportunities, and Threats) - based analytical frameworks to strengthen evidence-driven ecological planning and fiscal decision-making. Further, the FC may advise states to create Biodiversity Registers at the Gram Panchayat level, to be integrated at the state level by the respective Forest and Environment Departments. These registers would serve as foundational instruments for documenting local biodiversity, tracking ecosystem changes, and linking community-based conservation with fiscal incentives.

Strengthening financial tracking is equally important. Ecological priorities often become subsumed within broader development budgets, making it difficult to assess resource flows. Institutionalising GBT in state budgets will allow clear identification and tracking of biodiversity, forestry, and climate-related expenditures. When harmonised with national classification frameworks, such tagging can significantly improve comparability, accountability, and long-term planning.

To prevent dilution of ecological allocations, Finance Commission transfers must be earmarked and ring-fenced for conservation and climate resilience. Allocating a defined share of funds to

forests, biodiversity, watershed management, and climate priorities, classifying them as non-lapsable and non-transferable, will ensure resources remain dedicated to their intended purpose. Aligning fund flows with ecological work cycles, such as plantation and watershed management seasons, will further enhance utilisation and impact.

Institutional and community capacities require substantial strengthening. Many states lack the resources to systematically collect, analyse, and apply ecological data in planning and implementation. Addressing this gap calls for collaborative partnerships between state agencies and research institutions such as ICFRE, FRI, BSI, ZSI, ICAR, IITs, and IIMs, ensuring that ecological management is informed by cutting-edge science and cross-disciplinary expertise. The utilisation of subject matter specialists, biologists, ecologists, soil conservation experts, economists, and statisticians needs to be mainstreamed within state forest departments. Alongside, a reassessment of human resource requirements is necessary, as forestry agencies face increasingly complex responsibilities arising from climate change, land degradation, and disaster risks.

Capacity building must extend beyond institutions to include field staff and communities. Regular training programmes, joint implementation strategies, and the promotion of collaborative approaches over competitiveness will strengthen collective capabilities. Community institutions such as JFMCs, Van Panchayats, BMCs, PRIs, and

ULBs should be given direct access to funds and technical support to enhance their role in ecological governance. Innovative programmes, such as Madhya Pradesh's ANUBHUTI initiative, can inspire

greater involvement of youth and women in conservation and ecological restoration.

Finally, ecological fiscal transfers must reflect the realities of a just transition.

Several states face fiscal risks due to dependence on coal and other resource-intensive activities. Identifying such vulnerabilities and designing targeted schemes can enable states to diversify their economies while safeguarding ecological and social well-being. More broadly, embedding ecological sustainability into development policies that are consistent with the vision of Lifestyle for Environment (LiFE), will ensure that fiscal reforms are aligned with national priorities for sustainable growth.

Taken together, these measures outline a pathway for the FC16 to move beyond compensation towards incentivising stewardship. By embedding ecological data systems, financial accountability mechanisms, community empowerment, and transition-sensitive approaches, the FC can ensure that fiscal transfers not only recognise states' ecological contributions but also stimulate measurable

improvements in biodiversity conservation, climate resilience, and sustainable development across India.

We urge the FC16 to take forward these recommendations in shaping the next cycle of fiscal devolution, so that ecological stewardship is recognised, rewarded, and integrated into the country's economic fabric. Doing so will create a fiscal architecture that is fair to the states, responsive to the environment, and transformative for India's sustainable future.

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Glossary

Ad hoc grants – One-time or temporary financial transfers made without being part of a permanent or formula-based system.

Article 280 (3)(b) (Constitution of India) – Constitutional provision requiring the Finance Commission to recommend tax devolution between Union and states.

Aspirational indicators (in report context) – Metrics conceptually important for ecological resilience and climate adaptation but not yet feasible for immediate fiscal integration.

AWS-enabled monitoring systems – Automated Weather Station–based systems for collecting real-time environmental and ecological data.

Benefit-sharing – Fair distribution of benefits arising from use or conservation of natural resources.

Biodiversity Management Committees (BMCs) – Local-level statutory bodies under India's Biological Diversity Act responsible for conserving biodiversity and maintaining People's Biodiversity Registers.

Biological sequestration – The capture and storage of carbon dioxide through natural processes such as forests, soils, or algae.

Blue carbon ecosystems – Coastal and marine ecosystems such as mangroves, seagrasses, and salt marshes that capture and store carbon.

Canopy density – The proportion of an area of forest covered by the vertical projection of tree crowns.

Carbon sequestration – The process of capturing and storing atmospheric carbon dioxide in plants, soils, and oceans.

Carbon sinks – Natural systems that absorb more carbon dioxide than they release, such as forests and oceans.

CGWB (Central Ground Water Board) – Indian agency responsible for groundwater surveys, monitoring, and management.

Challenger Fund – A proposed dedicated fiscal pool to reward states retrospectively for ecological achievements and prospectively for future commitments.

Circular economy – An economic system aimed at eliminating waste and promoting the continual use and recycling of resources.

Civil society organisations (CSOs) – Non-governmental groups that represent community interests and advocate for social or environmental issues.

Climate Vulnerability Index (CVI) – A composite metric assessing exposure, sensitivity, and adaptive capacity of regions to climate change impacts.

Community reserves – Protected areas recognised under Indian law where local communities are involved in conservation and management.

Composite Water Management Index (CWMI) – A NITI Aayog-developed tool to assess and compare state-level performance in water management.

Conditional grants – Grants earmarked for specific sectors, often linked to performance or compliance.

CSR (Corporate Social Responsibility) – A business practice where companies allocate funds to social, environmental, and sustainability initiatives.

Customary land tenure – Traditional systems of land ownership and management recognised by local communities rather than formal state law.

Desertification – Land degradation in arid, semi-arid, and dry sub-humid areas caused by climatic variations and human activities.

Devolution (in fiscal federalism) – Transfer of tax revenues from the Union government to states.

Devolution formula (Finance Commission) – Method for allocating tax revenue between central and state governments in India.

Divisible pool – The total pool of central tax revenues that is shared between the Union and state governments.

Earth observation networks – Systems using satellite and ground-based data to monitor Earth's environment.

Ecological economics – An interdisciplinary field studying the relationships between ecosystems and economic systems.

Ecological fiscal transfers (EFTs) – Fiscal transfers from central to state governments based on ecological indicators like forest cover.

Econometric analyses – Statistical methods applied to economic data to test relationships, trends, or policy impacts.

Ecosystem services – Benefits that people obtain from ecosystems, including provisioning, regulating, supporting, and cultural services.

Environmental federalism – Governance approach that distributes environmental management responsibilities across different levels of government.

Externalities (positive/negative) – Indirect benefits or costs of an activity that affect others who are not directly involved.

Fiscal autonomy – The ability of state governments to make independent financial decisions using their own resources.

Fiscal decentralisation – Transfer of financial responsibilities and decision-making from central to subnational governments.

Fiscal disability (of states) – The economic disadvantage states face when conserving forests instead of converting them for revenue-generating uses.

Fiscal federal architecture – The framework governing financial relations between the central and state governments, including transfers and incentives.

Fiscal federalism – System where financial relations and responsibilities are shared between central and state governments.

Flow indicators (in report context) – Metrics that measure changes in an ecological asset or condition relative to a baseline over time.

Flypaper effect – A phenomenon where intergovernmental transfers tend to stick to the sector they are intended for rather than being diverted elsewhere.

Forest ecosystems – Ecological systems dominated by trees that provide habitat, regulate climate, and sustain biodiversity and livelihoods.

General grants – Untied grants from the Union that states can use at their discretion.

Grant-in-aid – Financial transfers from the Union to states, either unconditional or tied to specific needs/sectors.

Green Budget Tagging (GBT) – A process of tracking and labeling budgetary expenditures that contribute to environmental and climate objectives.

Gross Ecosystem Product (GEP) – Measure of the economic value generated by ecosystem services.

High Conservation Value Forest (HCVF) Index – A composite index using ecological, conservation, and socio-economic indicators to assess the relative value of forests.

Himalayan ecosystems – Ecological systems in the Himalayan region that regulate water flows, biodiversity, and climate stability.

Horizontal formula (Finance Commission) – The method used to allocate tax revenues among Indian states based on weighted criteria.

ICMS Ecológico (ICMS-E) – Brazil's ecological value-added tax revenue-sharing scheme that allocates a portion of state tax revenue to municipalities based on ecological indicators.

Indian Institute of Forest Management (IIFM) – An autonomous institute under MoEF&CC specialising in education, research, and consultancy in forest and environment management.

Invasive species – Non-native species that spread rapidly and disrupt local ecosystems, biodiversity, and services.

IREDA (Indian Renewable Energy Development Agency) – A government agency providing financial support for renewable energy and energy efficiency projects.

ISFR (India State of Forest Report) – Biennial report published by the Forest Survey of India providing forest cover and related data.

Jhum cultivation – A traditional shifting cultivation practice in North-East India involving rotation of crops and fallows.

Joint Forest Management Committees (JFMCs) – Community-based institutions formed to manage forests collaboratively with state forest departments.

Just transition (climate policy) – A framework ensuring that the shift to a low-carbon economy is equitable and supports workers and communities dependent on fossil fuel sectors.

Kunming-Montreal Global Biodiversity Framework (GBF) – 2022 agreement setting targets for biodiversity conservation, including 30 percent protected area by 2030.

Leakage (in conservation) – When environmental damage is displaced from one area to another due to conservation action.

Marine Protected Areas (MPAs) – Designated marine zones with restricted human activity to conserve biodiversity and ecosystem services.

Moderately dense forest (MDF) – Forest with canopy density between 40 and 70 percent, as classified by the Forest Survey of India.

MoEF&CC (Ministry of Environment, Forest and Climate Change) – The central government ministry responsible for environmental and forestry policy in India.

MRV (Measurement, Reporting, and Verification) – Processes used to track, document, and validate climate and environmental outcomes.

NABARD (National Bank for Agriculture and Rural Development) – An apex development bank in India supporting agriculture and rural infrastructure financing.

National Action Plan on Climate Change (NAPCC) – India's umbrella climate policy framework launched in 2008.

National Biodiversity Action Plan (NBAP) – India's strategy and action plan for biodiversity conservation.

National Disaster Response Fund (NDRF) – A central government fund for

providing emergency relief in the aftermath of disasters.

National Forest Policy (1988) – India's policy aiming to maintain one-third of land under forest cover.

National Key Ecological Function Areas (NKEFA) – China's fiscal transfer program that allocates funds to counties based on ecological functions such as biodiversity and water regulation.

Natura 2000 sites – A network of protected areas across the European Union aimed at conserving biodiversity and habitats.

Natural climate solutions (NCS) – Conservation, restoration, and sustainable land-use actions that reduce greenhouse gas emissions and enhance carbon storage.

Nature-based solutions (NbS) – Actions that use ecosystems to address societal challenges while providing biodiversity and climate benefits.

NDC (Nationally Determined Contribution) – Climate action plans submitted by countries under the Paris Agreement to reduce emissions and adapt to climate impacts.

Non-lapsable funds – Budget allocations that do not expire at the end of the financial year and can be carried forward.

Non-timber forest products (NTFPs) – Forest products other than timber, such as fruits, resins, and medicinal plants.

One Health – Integrative approach recognising interconnections between human, animal, and ecosystem health.

One State, One Data model (in report context) – A proposed system to unify ecological data protocols within a state for consistency and efficiency.

Operational indicators (in report context) – Metrics designed for immediate, practical application and monitoring.

Payment for ecosystem services (PES) – Financial or other incentives provided to landowners, communities, or individuals to manage their land or natural resources sustainably to benefit others who rely on the resulting ecological services.

Peatland – Wetland ecosystem with carbon-rich soils formed from accumulated plant material.

People's Biodiversity Registers (PBRs) – Community-prepared records documenting local biodiversity and traditional knowledge.

Prospective grants – Fiscal transfers tied to future ecological commitments, disbursed against milestones.

Protected Areas (PAs) – Geographically defined areas designated and managed for long-term biodiversity conservation.

Ramsar commitments – Obligations under the Ramsar Convention (1971) to conserve and sustainably use wetlands of international importance.

REDD+ – Mechanism under UNFCCC to reduce emissions from deforestation and forest degradation while enhancing carbon stocks.

Retrospective grants – Fiscal transfers recognising and rewarding past ecological performance.

Right to Life (Article 21, India) – Constitutional right interpreted by courts to include the right to a healthy environment.

Sacred groves – Culturally protected forest patches maintained by communities for spiritual and conservation purposes.

Scientific and Technical Advisory Committee (STAC) – A body of experts convened to provide scientific oversight and technical advice for a study.

Soil Organic Carbon (SOC) – Carbon stored in the organic component of soil,

critical for fertility and carbon sequestration.

Sovereign green bonds – Government-issued bonds specifically earmarked to finance environmentally sustainable projects.

Stock indicators (in report context) – Metrics that measure the current level of an ecological asset or condition at a given point in time.

TAPE (Transfer Anggaran Provinsi berbasis Ekologi) – Indonesia's ecological fiscal transfer scheme piloted in North Kalimantan, linking provincial budgets to ecological indicators.

Tinbergen Rule – Principle stating that each policy objective should be matched with its own distinct policy instrument.

Trees Outside Forests (ToF) – Tree cover located outside recorded forest areas, including agroforestry, plantations, and urban trees.

Van Panchayats – Community-managed forest institutions in Uttarakhand with legal authority over local forest use and conservation.

Vertical share (Finance Commission) – The proportion of central tax revenue devolved to all states collectively.

Very dense forest (VDF) – Forest with canopy density of 70 percent or more, as classified by the Forest Survey of India.

Wetland Health Card – A monitoring tool proposed to assess wetland conditions based on parameters like area, governance, and ecological quality.

WII–ENVIS – Environment Information System hosted by the Wildlife Institute of India that provides data on Protected Areas.

Annexures

Annexure 1: Details of STAC Members

Name	Designation	Role in STAC
Dr. Siraj Hussain	IAS (Retired), former Secretary, Ministry of Agriculture & Farmers Welfare, GoI, New Delhi	Chairman
Dr. Leena Srivastava	Ex-Deputy Director General – Science, IIASA, Austria	Member
Dr. Ruchi Badola	Dean and Senior Professor, Wildlife Institute of India, Dehradun	Member
Dr. Anil Gupta	Chief Executive Officer, ICARS, GNEC - IIT – Roorkee	Member
Dr. Rajesh Kumar	Former Deputy Director, Forest Survey of India, Dehradun	Member
Dr. Somnath Baidya Roy	Head of Centre and Professor, Centre of Atmospheric Sciences, IIT, Delhi	Member

Annexure 2: Details of Regional Consultations

Region	States	**Location and dates**
North Eastern and Eastern	Jharkhand, West Bengal, Sikkim, Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Tripura, Nagaland	Guwahati, 26th June 2025
North, North Western, Western and Central	Jammu and Kashmir, Ladakh, Himachal Pradesh, Punjab, Haryana, Uttarakhand, Uttar Pradesh, Delhi, Bihar, Madhya Pradesh, Rajasthan, Gujarat	Delhi, 23rd July 2025
Southern and Central	Maharashtra, Chhattisgarh, Odisha, Goa, Telangana, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Andaman and Nicobar Island	Hyderabad, 6th August 2025

Annexure 3: Details of Expert Consultations

Name	Position	Consultation date
Dr. M. Govinda Rao	Former Director and Chief Executive, NIPFP	22nd May 2025
Dr. Siddhanta Das, IFS	Chairman, Central Empowered Committee (Member of the Delegation to the FC15 for the study conducted for MoEF&CC by Dr. Madhu Verma and Swapan Mehra)	26th May 20225
Dr. Aman Srivastava	Founder, Sustainable Futures Collaborative	28th May 2025
Mr. Praveen Garg, IAS	President, Mobius Foundation, Former SS and FA, MoEF&CC (Member of the Delegation to the FC15 for the study conducted for MoEF&CC by Dr. Madhu Verma and Swapan Mehra)	3rd July 2025
Dr. Rathin Roy	Former Director and Chief Executive, NIPFP, Ex JS. FC13	11th July 2025
Dr Rajiv Kumar	Ex-Vice Chairman of NITI Aayog and Chairman- Pahle India Foundation	10th July 2025
Mr. Kunal Sharma	Program Lead, Climate Policy and Intelligence, NITI Aayog	8th August 2025
Mr. Subhashish Kapoor	Consultant, NITI Aayog	8th August 2025
Mr. C. K. Mishra	Ex-Secretary, MoEF&CC; Board Member, ITC; CEP of P4I; Delegation lead for FC15	14th August 2025
Shri. Ajit Kesari	(IAS Retd.) Additional Chief Secretary to Government of Madhya Pradesh	18th September 2025
Dr. Pushpam Kumar	Senior Economic Advisor and Chief Environmental Economist, UNEP	17th October 2025

Annexure 4: Implementation Challenges across Ecosystems

Challenge	Forest Ecosystems	Agriculture and Allied Systems	Wetlands	Coastal and Marine Ecosystems	Mountain Ecosystems	Urban Ecosystems
Funding Gaps	Low-density/degraded forests excluded from FC allocations; community/private forests underfunded; restoration and invasive species removal neglected.	Agroecological and climate-smart farming underfunded; subsidies/MSP skewed toward rice and wheat; agroforestry marginalised.	Severely underfunded due to lack of recognition in FC criteria; limited funds for IMPs, restoration, hydrological flow management.	Underfunded despite vulnerability; blue carbon, mangroves, coral reefs not fiscally valued; CRS enforcement weak.	Little fiscal recognition of freshwater protection, scrubs, open forests, or NTFP-based livelihoods.	Neglected in fiscal transfers; no direct ecological funds to ULBs; minimal investment in urban biodiversity and green-blue infrastructure.
Fund Utilisation	Forestry budgets increased nominally but share in state budgets declined; lack of ring-fencing; weak JFMC/BMC capacities.	Weak extension services; PRI bodies under-skilled for climate-smart agriculture; poor cross-departmental convergence.	Departments lack wetland units; weak capacity to implement IMPs; funds poorly absorbed at local levels.	Fragmented jurisdiction between Centre/States; weak enforcement; negligible local absorption mechanisms.	Fragmented schemes; weak Panchayat sub-committees; SHGs face constraints; biodiversity boards underfunded.	ULBs lack mandate/staff; weak enforcement; ecological priorities sidelined by core infrastructure demands.
Data Gaps	FSI captures only forest extent, not quality, carbon, or biodiversity; grasslands, agroforestry, and sacred groves excluded.	Weak data on crop diversification, agroforestry, and soil organic carbon; inconsistent disaster loss reporting.	Wetland mapping incomplete; Wetland Health Cards only piloted; groundwater data fragmented across CGWB, WRIS.	Absence of blue carbon, coral reef, and marine biodiversity datasets; poor marine ecosystem service valuation.	Vulnerability assessments irregular; wildlife monitoring sporadic; tourism–ecology data not integrated.	Poor interoperability between FSI, NRSC, BSI/SSI datasets; outdated pollution and biodiversity data.
Institutional Capacity	Shortages of technical staff; limited GIS/MIS adoption; weak biodiversity integration into forestry planning.	Agriculture departments lack climate/biodiversity expertise; poor convergence with forestry and water.	No dedicated wetland/marine units in most states; limited capacity at ULB level for wetland management.	Very limited technical manpower; weak coordination between fisheries, disaster, and environment departments.	Weak coordination across fragmented schemes; limited mandates for PRIs; SB Boards	Absence of climate/ecology cells in ULBs; weak SPCB enforcement; limited partnerships with

Challenge	Forest Ecosystems	Agriculture and Allied Systems	Wetlands	Coastal and Marine Ecosystems	Mountain Ecosystems	Urban Ecosystems
					lack monitoring funds.	citisen science/PPP models.
Temporal Misalignment	Afforestation funds arrive post-monsoon; fire-prevention funds post-season; CAMPA/NAP inflexible to local calendars.	NA	Wetland funds not aligned with hydrological cycles; mis-timed support undermines floodplain/water recharge.	Pre-monsoon restoration/cyclone resilience funds delayed or fragmented.	Shifting cultivation fallow cycles misaligned with fiscal calendars; dynamic systems seen as “degraded.”	Budget cycles fail to align with seasonal restoration (wetland recharge, invasive removal).

Annexure 5: Revenue allocation and expenditure trend across states

States	Central tax allocated to states (in crore) 2023-24	State's own tax (in crore) 2023-24	Grants received (in crore) 2023-24	Devolution based allocation FC15 under the forestry criteria (in crore)	Total Expenditure (in crore) 2023-24	Forestry expenditure from total allocation (in crore) 2023-24	Percentage use under forestry expenditure in total state expenditure	Percentage use under forestry expenditure in total tax revenue received
Andhra Pradesh	45711	85922	34702	16995	236511	322	0.14	0.19
Arunachal Pradesh	19845	2798	3897	54700	29597	318.47	1.08	1.20
Assam	35330	28178	22123	14004	115672	860.72	0.74	1.01
Bihar	113604	48361	26125	3969	229103	757.66	0.33	0.40
Chhattisgarh	38482	38786	11092	42600	130471	1534	1.18	1.74
Goa	4236	8933	1618	1238	24638	NA	NA	NA
Gujarat	39235.54	134262.44	25557	5753	247632	771.26	0.31	0.39
Haryana	12345.35	72511.12	8355.37	506	133172	426.99	0.32	0.46
Himachal Pradesh	9374.72	11835.29	14942.15	11240	50468	715.87	1.42	1.98
Jharkhand	37352	28005	9146	13271	101537	913.15	0.90	1.23
Karnataka	41193	163505	15528	27771	299207	2093	0.70	0.95
Kerala	21743	74329	12068	12284	159507	659	0.41	0.61

States	Central tax allocated to states (in crore) 2023-24	State's own tax (in crore) 2023-24	Grants received (in crore) 2023-24	Devolution based allocation FC15 under the forestry criteria (in crore)	Total Expenditure (in crore) 2023-24	Forestry expenditure from total allocation (in crore) 2023-24	Percentage use under forestry expenditure in total state expenditure	Percentage use under forestry expenditure in total tax revenue received
Madhya Pradesh	88665	90724	34711	43813	278886	100.9	0.04	0.05
Maharashtra	71262	302431	36045	33991	521898	3373	0.65	0.82
Manipur	8087.14	1223.51	5185.95	7699	24774.07	71.6	0.29	0.49
Meghalaya	8663	3217	5575	10398	21154	234.58	1.11	1.34
Mizoram	5647	1196	3486	9618	13074	104.76	0.80	1.01
Nagaland	6427	1598	7452	6181	17943	123.43	0.69	0.80
Odisha	51144	54427	21012	30582	194895	1053	0.54	0.83
Punjab	20410	47252	14296	859	122346	253.28	0.21	0.31
Rajasthan	68063	94086	22448	4822	269275	925	0.34	0.50
Sikkim	4285	1748	1443	2875	11178	139.54	1.25	1.87
Tamil Nadu	46072	167278	46072	15797	359063	579	0.16	0.22
Telangana	23742	111798	9934	11376	219307	639	0.29	0.44
Tripura	7997	3287	8833	5406	21176	173.72	0.82	0.86

States	Central tax allocated to states (in crore) 2023-24	State's own tax (in crore) 2023-24	Grants received (in crore) 2023-24	Devolution based allocation FC15 under the forestry criteria (in crore)	Total Expenditure (in crore) 2023-24	Forestry expenditure from total allocation (in crore) 2023-24	Percentage use under forestry expenditure in total state expenditure	Percentage use under forestry expenditure in total tax revenue received
Uttar Pradesh	202620	193129	55803	7232	548358	905.26	0.17	0.20
Uttarakhand	12627.75	19244.96	14324.22	19225	58380	NA	NA	NA
West Bengal	84972	89986	22072	7797	255717	NA	NA	NA

Annexure 6: List of all ecosystem-based proposed indicators collated from all consultations for strengthening the FC Forestry and Ecology formula

Ecosystem	Indicator	Dataset / Source	Frequency of Update	Rationale	Data Gaps
Forest	Forest Cover (density class-wise)	FSI – ISFR	Biennial	Direct measure of forest extent; critical for ecological fiscal transfers and carbon sink functions.	Does not capture ecological quality, species diversity, or degradation, limiting its accuracy for ecological service valuation.
	Tree Cover Outside Forest (ToF)	FSI – ToF module	Biennial	Captures trees in agroforestry and urban landscapes, supporting climate, livelihood, and biodiversity outcomes.	Does not capture ecological quality, species diversity, or degradation, limiting its accuracy for ecological service valuation.
	Grassland extent	FSI (pilot), NRSC, local FDs	Under development	Important for biodiversity and carbon storage; often neglected in policy allocations.	Grasslands remain unclassified or merged under various categories; consistent mapping missing.
	Agroforestry Area	FSI, state records	Irregular	Agroforestry supports livelihoods, carbon sinks, and climate resilience.	No standardised or regular dataset across states; estimates fragmented.
	Carbon Stock	FSI – ISFR Carbon Stock estimates	Biennial	Proxy for climate regulation services and mitigation contributions.	Biomass estimates robust but soil carbon and ecosystem service valuation underrepresented.
	Species/Biodiversity Richness	SSI, BSI, PBRs, IUCN, Wildlife Plans	Irregular/Project	Essential for conservation prioritisation and ecological service valuation.	No unified biodiversity index at national level; state/case-specific reporting only.
	Wetlands extent and quality	National Wetland Authority, FSI, ISRO	Sparse	Wetlands provide water purification, flood control, and biodiversity services.	Lacks ecological health metrics; extent is tracked but condition not assessed consistently.
	Urban tree density	FSI urban data, ULB/municipality records	Nascent	Relevant for urban ecosystem services (air quality, cooling).	Data not standardised; tree density rarely linked to urban population or heat stress.
	Population pressure (on forests)	Census of India	Decadal	Proxy for anthropogenic stress on ecosystems, useful for equity-based allocation.	Data outdated between census rounds; not integrated into ecological finance formulas.
	Forest Fire frequency/severity	FSI Fire Alert, MODIS/NASA	Annual/Realtime	Fires degrade ecosystems and carbon stocks; important risk factor for finance.	Data available but under-utilised in fiscal planning; lacks integration with fund allocation.

Ecosystem	Indicator	Dataset / Source	Frequency of Update	Rationale	Data Gaps
	Invasive species spread	State FDs, MoEF&CC reports, research	Irregular	Major threat to native biodiversity and ecosystem services.	No standardised, centralised or spatially consistent dataset.
	Restoration/degraded area	CAMPA, state FD records	Variable	Indicates ecological opportunity and restoration finance needs.	Coverage inconsistent; grasslands and non-forest degraded lands often excluded.
	Performance in management	State action plans, CAMPA audits	Irregular	Tracks governance effectiveness in ecosystem service delivery.	Audit reports not standardised or linked to fiscal transfers.
	Groundwater + springsheds	CWC, State FWD, ISRO	Variable	Forest–water nexus critical for resilience; springsheds sustain mountain communities.	Not currently linked to forest-sector data; integration missing in current incentive structures.
	Landuse change / encroachment	NRSC/Bhuvan, LULC datasets	Annual/some layers	Tracks deforestation and encroachment pressures directly affecting ecosystem health.	Not systematically tied to finance or ecological outcome metrics.
	Community governance	MoTA (FRA claims), JFM notifications	Irregular	Reflects local stewardship and rights-based conservation effectiveness.	Poorly reported and limited nationwide institutional recognition; lacks integration with finance allocation data.
Agriculture	Soil Organic Carbon (SOC)	Soil Health Cards, MoAandFW	2–3 years	Key soil fertility and climate mitigation indicator.	Patchy resolution; state-wise aggregation hinders comparability.
	Crop Diversity Index	Agroforestry Surveys, Agri Dept.	Occasional	Promotes resilience and sustainable cropping systems.	Not tracked regularly; diversity indices missing at district scale.
	Area under Rainfed Farming	Crop pattern data, DACandFW	Annual	Proxy for climate vulnerability and adaptation need.	National statistics exist but rarely linked to climate finance allocation.
	Extent of Agroforestry Coverage	ISRO/NRSC, state records	1–2 years	Captures sustainable land use, integrating carbon and livelihood benefits.	Mapping uneven; fragmented between states and missions.
	Fertiliser Runoff Estimates	State Disaster Management Assessments	Event-based	Indicator of soil/water pollution linked to agricultural practices.	No continuous or systematic dataset; only post-disaster estimates.
	Climate Vulnerability Index (CVI)	NATCOM, DST-CVI reports	Irregular	Composite measure linking exposure, sensitivity, and adaptive capacity.	Outdated; not disaggregated sufficiently for state/district finance use.
	GHG emissions from agriculture/livestock	National GHG Inventories, ICAR	Irregular	Captures agriculture's mitigation burden.	Not granular; improved remote sensing/field data needed.

Ecosystem	Indicator	Dataset / Source	Frequency of Update	Rationale	Data Gaps
	Soil Health Indicators	SHC, NBSSandLUP, IISS	Annual	Key to monitoring restoration and productivity.	Indicators exist but poorly integrated into fiscal systems.
	Out-migration from agriculture	Census, NSSO, CMIE	Census/Annual	Proxy for ecological and economic stress.	No climate/ecological attribution; not linked to fiscal flows.
	Farmers adopting nature-positive agriculture	State agri depts, certification boards	Variable	Shows uptake of climate-friendly practices.	No centralised tracking; scattered across programs.
	Crop diversification index/score	DACFW, Agri Census	Annual	Encourages less water-intensive crops like millets.	Index not standardised across states.
	Organic farming adoption rates	PKVY, State Reports	Annual/project-based	Indicator of sustainable practices and reduced inputs.	Certification data fragmented; adoption not fully tracked.
Wetlands and Water	Water Pollution Levels	CPCB, SPCB	Monthly/Quarterly	Essential for ecosystem and health outcomes.	Basin-level data exists but not integrated with biodiversity/ecosystem metrics.
	Groundwater Recharge and Monitoring	CGWB, SGWB, WRIS	Seasonal/Annual	Tracks sustainability of aquifers, linked to ecosystems.	Poorly linked with vegetation/land-use datasets.
	Biodiversity Near Water Bodies	Indian Biodiversity Portal	Continuous	Reflects aquatic–terrestrial linkages.	Citisen-science data unverified; lacks spatial standardisation.
	Ramsar-Equivalent Wetland Mapping	WRIS, Wetland Portal	Irregular	Identifies priority wetlands for conservation.	No uniform conservation status tagging.
	Watershed Health (multi-metric)	DSS (proposed)	Proposed	Composite resilience and hydrological regulation index.	Institutional mechanisms and methods not developed yet.
	Rainwater Harvesting Assessment	State agencies	Not available	Important for recharge and resilience.	No systematic dataset across states.
	percent wetlands notified under Wetland Rules	MoEF&CC, State Wetland Authorities	Irregular	Legal recognition strengthens protection.	Reporting fragmented across states.
	Wetland Health Cards	MoEF&CC, state agencies	Sporadic	Simple tool for ecological quality assessment.	Pilots exist but not scaled nationwide.
	Extent of invasive species in wetlands/forests	FSI, State FDs	Biennial/Irregular	Direct impact on biodiversity and ecosystem health.	No detailed wetland-specific invasive data.
	Groundwater/aquifer quality	CGWB, SGWB, Bhuvan	Annual/Seasonal	Links water quality to human/ecosystem health.	Low resolution; aquifer–ecosystem nexus poorly captured.
	Coastal ecosystem status	MoEF&CC, State agencies, SAC	2–5 years	Tracks mangroves, seagrass, coral—critical blue carbon.	No unified platform; coral mapping sparse.

Ecosystem	Indicator	Dataset / Source	Frequency of Update	Rationale	Data Gaps
	CSMP Status	MoEF&CC, State CSMAs	One-time/cycle	Planning tool for coastal regulation and protection.	Updates delayed; ecological indicators not integrated.
	Wetland LULC change	Bhuvan, NRSC	Every 5 years	Tracks encroachment and land-use change pressures.	Not tied to health/quality indicators.
	Trends in ecosystem services	Site-specific studies	Rare	Captures service delivery of wetlands.	No national/state database; limited to pilots.
Coastal and Marine	Coastal Vulnerability Index	INCOIS CVI Atlas	Periodic	Identifies exposure of coasts to hasards and SLR.	Updates irregular; coarse granularity.
	Extent of mangroves/coral reefs	FSI, MoEF&CC, SSI	Biennial/Periodic	Critical ecosystems with carbon and biodiversity roles.	Coral data sparse; mangroves better mapped.
	Marine Protected Areas (status)	MoEF&CC, WII	Annual	Legal/institutional conservation indicator.	Ecological outcome monitoring weak.
	Inland waterway cargo volume	IWAI, MoPSW	Annual	Proxy for economic–ecological trade-offs.	Impact indicators not integrated.
	Fisherfolk livelihood dependency	DoF, CMFRI, Census	Census/Surveys	Captures socio-ecological dependence on coasts.	Informal sector poorly covered; data outdated.
	Blue carbon sequestration potential	NIOT, NCSCM, ICAR, research	Ad hoc	Captures climate role of coastal ecosystems.	No standardised inventory or monitoring.
Urban	Rate of Urbanisation	Census, NRSC	Census/irregular	Driver of ecological stress and land-use change.	Not linked to ecological planning databases.
	Urban Green Cover	FSI, satellite imagery	Infrequent	Proxy for urban resilience and ecosystem services.	Updates infrequent; not standardised across cities.
	Area under Water Bodies	Urban portals, NRSC	Incomplete	Key for cooling, recharge, biodiversity.	Lack of granularity in urban-specific mapping.
	Biodiversity Index	BSI, SSI, PBRs	Irregular	Reflects ecological quality in cities.	Fragmented; no central scoring system.
	Wetland notification by ULBs	State Wetland Authorities	Irregular	Reflects local climate/ecological governance.	Reporting inconsistent; not linked nationally.
	Carbon intensity of urban activities	Inventories, AMRUT	Periodic	Measures mitigation burden of cities.	Data inconsistent; coverage uneven.
	Waste treatment and segregation rates	ULBs, CPCB, Swachh Bharat	Regular	Tracks circular economy and pollution control.	Reliable but not linked to fiscal incentives.
	Urban air and water pollution	CPCB/SPCB, AMRUT	Regular	Central to health and ecological outcomes.	Gaps in sensor coverage and standardisation.

Ecosystem	Indicator	Dataset / Source	Frequency of Update	Rationale	Data Gaps
	EV adoption and emissions reduction	MoHUA, MNRE	Annual/state-specific	Proxy for decarbonisation in transport sector.	Data fragmented across states.
	Solid waste management	Municipal records	Regular	Indicator of sustainability of urban metabolism.	No central collation; uneven reporting.
Mountains	State vulnerability mapping	State agencies	Irregular	Critical for adaptation finance in fragile sones.	No uniform methodology; updates irregular.
	Forest fires	FD records, satellite	Seasonal/Annual	High-risk in mountain ecosystems; carbon and biodiversity impacts.	Data uneven across states; limited early warning.
	Water monitoring data	CWC, SGWB, WRIS	Seasonal/Annual	Vital for springs, glaciers, and catchment resilience.	Poor granularity; links to ecosystem data missing.
	Apex mountainous species	NTCA, State Wildlife Boards	Irregular	Proxy for ecological health in high-altitude habitats.	Sparse and species-limited data.
	NE-specific NTCA data	NTCA	Irregular	Captures unique ecology of NE states.	Not integrated into finance frameworks.
	Wildlife monitoring in hilly states	State Forest Departments	Variable	Tracks biodiversity in fragile landscapes.	Depends on state capacity; not harmonised.
	Lean and peak seasons (tourism/livelihoods)	Tourism/livelihood surveys	Varies	Captures seasonality of ecological services and dependence.	No standardised ecological–economic linkage.

Bihar	Assam	Arunachal Pradesh	Andhra Pradesh	State/UT		
56.47	43.63	4.04	0.1	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
-32.03	-134.32	-167.28	-118.56	MDF		
24.44	-90.69	-163.24	-118.46	Change in DF (sq. km.)		
0.008739	-0.00806	-0.00351	-0.00816	Proportional change		
-146.38	2.74	-6.64	37.47	Change in Extent of TOF (sq. km.)		
-0.0282	0.0003	-0.0007	0.0033	Proportional TOF extent		
-0.748	-0.023	3.036	0.258	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
-0.527	-0.395	0.801	0.617	Protected Area (sq. Km.)		
-0.678	0.038	-0.190	0.144	Extent of TOF (sq. km.) 2023		
0.400	-0.504	-0.259	-0.510	Proportional Change in DF		Z score Flow
-1.460	-0.224	-0.267	-0.094	Proportional Change in TOF		
-0.719	-0.054	2.490	0.283	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
-0.530	-0.364	-0.263	-0.302	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
0.280	0.946	3.490	1.282	Positive Z Score Stock		
0.607	0.773	0.874	0.835	Positive Z Scores Flow		
0.313	0.929	3.228	1.238	Weighted combined Z score (90:10)		
0.009	0.033	0.130	0.040	Proportion of DF FC15 Annexure table of FC		
0.0110	0.0327	0.1138	0.0436	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
31749044423	112029837225	437598139282	135960986142	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
9312158672	27620537848	96013868778	36811680733	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
4106	13965	53361	17277	Final Allocation in INR crores		

Haryana	Gujarat	Goa	Chhattisgarh	State/UT		
0	35.08	14.42	346.64	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
-0.31	-13.31	14.46	-289.71	MDF		
-0.31	21.77	28.88	56.93	Change in DF (sq. km.)		
-0.0011	0.005032	0.034216	0.001789	Proportional change		
129.98	225.3	-3.62	697.03	Change in Extent of TOF (sq. km.)		
0.0531	0.0187	-0.0028	0.0362	Proportional TOF extent		
-0.969	-0.616	-0.918	1.778	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
-1.255	2.489	-1.166	0.087	Protected Area (sq. Km.)		
-0.988	0.233	-1.150	1.201	Extent of TOF (sq. km.) 2023		
-0.129	0.200	1.771	0.026	Proportional Change in DF		Z score Flow
2.067	0.577	-0.356	1.337	Proportional Change in TOF		
-1.000	-0.220	-0.966	1.551	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
0.969	0.389	0.708	0.681	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
0.000	0.779	0.034	2.551	Positive Z Score Stock		
2.106	1.526	1.845	1.818	Positive Z Scores Flow		
0.211	0.854	0.215	2.478	Weighted combined Z score (90:10)		
0.001	0.014	0.003	0.101	Proportion of DF FC15 Annexure table of FC		
0.0074	0.0301	0.0076	0.0873	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
4050344425	46024487023	9901139807	340801177414	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
6264557883	25402619823	6390849921	736982776 22	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
1031	7143	1629	41450	Final Allocation in INR crores		

Kerala	Karnataka	Jharkhand	Himachal Pradesh	State/UT		
-1.34	2.72	2.58	-44.11	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
-9.53	-8.59	0.17	36.09	MDF		
-10.87	-5.87	2.75	-8.02	Change in DF (sq. km.)		
-0.00149	-0.00035	0.00041	-0.00097	Proportional change		
-24.47	-552.5	234.24	61.38	Change in Extent of TOF (sq. km.)		
-0.0016	-0.0225	0.0160	0.0108	Proportional TOF extent		
-0.359	0.451	-0.410	-0.279	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
-0.764	1.090	-0.880	0.428	Protected Area (sq. Km.)		
0.584	1.716	0.566	-0.591	Extent of TOF (sq. km.) 2023		
-0.150	-0.089	-0.048	-0.123	Proportional Change in DF		Z score Flow
-0.306	-1.210	0.458	0.235	Proportional Change in TOF		
-0.305	0.642	-0.360	-0.239	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
-0.228	-0.650	0.205	0.056	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
0.694	1.641	0.640	0.761	Positive Z Score Stock		
0.909	0.487	1.342	1.193	Positive Z Scores Flow		
0.716	1.526	0.710	0.804	Weighted combined Z score (90:10)		
0.029	0.066	0.031	0.027	Proportion of DF FC15 Annexure table of FC		
0.0252	0.0538	0.0250	0.0283	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
98268438550	222166083299	106167193926	89922143249	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
212900313007	45384034540	21123069815	23907526789	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
11956	26755	12729	11383	Final Allocation in INR crores		

Meghalaya	Manipur	Maharashtra	Madhya Pradesh	State/UT		
39.04	-0.35	1041.21	417.47	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
-97.61	-31.5	723.66	-309.78	MDF		
-58.57	-31.85	1764.87	107.69	Change in DF (sq. km.)		
-0.00722	-0.00477	0.074778	0.002823	Proportional change		
-51.26	-14.73	70.14	-585.64	Change in Extent of TOF (sq. km.)		
-0.0166	-0.0073	0.0024	-0.0316	Proportional TOF extent		
-0.294	-0.416	1.212	2.333	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
0.215	-1.138	1.048	1.109	Protected Area (sq. Km.)		
-0.931	-1.061	2.379	0.951	Extent of TOF (sq. km.) 2023		
-0.459	-0.327	3.954	0.082	Proportional Change in DF		Z score Flow
-0.955	-0.552	-0.131	-1.605	Proportional Change in TOF		
-0.306	-0.553	1.312	2.072	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
-0.707	-0.439	1.911	-0.762	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
0.693	0.447	2.312	3.072	Positive Z Score Stock		
0.430	0.698	3.048	0.375	Positive Z Scores Flow		
0.667	0.472	2.386	2.802	Weighted combined Z score (90:10)		
0.025	0.018	0.081	0.104	Proportion of DF FC15 Annexure table of FC		
0.0235	0.0166	0.0841	0.0988	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
83183186508	61588412203	271926209861	350507648163	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
19833771754	14031311304	70962122019	83353830556	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
10302	7562	34289	43386	Final Allocation in INR crores		

Punjab	Odisha	Nagaland	Mizoram	State/UT		
-0.48	3.09	-2.88	66.1	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
-0.36	34.42	-4.43	-210.11	MDF		
-0.84	37.51	-7.31	-144.01	Change in DF (sq. km.)		
-0.00183	0.001829	-0.00169	-0.01629	Proportional change		
159.81	440.4	-94.3	-14.59	Change in Extent of TOF (sq. km.)		
0.0670	0.0175	-0.0225	-0.0155	Proportional TOF extent		
-0.954	0.793	-0.618	-0.237	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
-1.240	0.868	-1.065	-1.163	Protected Area (sq. Km.)		
-0.993	1.910	-0.797	-1.197	Extent of TOF (sq. km.) 2023		
-0.169	0.028	-0.161	-0.947	Proportional Change in DF		Z score Flow
2.670	0.525	-1.211	-0.906	Proportional Change in TOF		
-0.986	0.912	-0.680	-0.426	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
1.251	0.277	-0.686	-0.926	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
0.013	1.912	0.319	0.574	Positive Z Score Stock		
2.388	1.414	0.451	0.211	Positive Z Scores Flow		
0.251	1.862	0.332	0.538	Weighted combined Z score (90:10)		
0.002	0.072	0.015	0.023	Proportion of DF FC15 Annexure table of FC		
0.0088	0.0656	0.0117	0.0189	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
6869456789	244654899681	49451561836	76944696153	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
7458359056	55381820306	9888443181	15988319003	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
1433	30004	5934	9293	Final Allocation in INR crores		

Tamil Nadu	Sikkim	Rajasthan	State/UT		
-2.35	-0.73	141.96	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
-8.37	-1.01	-128.38	MDF		
-10.72	-1.74	13.58	Change in DF (sq. km.)		
-0.00089	-0.00102	0.003315	Proportional change		
7.03	-0.04	367.61	Change in Extent of TOF (sq. km.)		
0.0005	0.0000	0.0257	Proportional TOF extent		
0.052	-0.845	-0.636	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
0.732	-0.880	1.789	Protected Area (sq. Km.)		
0.463	-1.144	0.539	Extent of TOF (sq. km.) 2023		
-0.118	-0.125	0.108	Proportional Change in DF		Z score Flow
-0.214	-0.236	0.879	Proportional Change in TOF		
0.161	-0.878	-0.276	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
-0.166	-0.181	0.493	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
1.161	0.121	0.723	Positive Z Score Stock		
0.971	0.956	1.630	Positive Z Scores Flow		
1.142	0.205	0.814	Weighted combined Z score (90:10)		
0.037	0.007	0.011	Proportion of DF FC15 Annexure table of FC		
0.0402	0.0072	0.0287	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
126376886213	22997066071	38575866007	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
33963625900	6091795374	24211708285	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
16034	2909	6279	Final Allocation in INR crores		

Uttar Pradesh	Tripura	Telangana	State/UT		
33.25	-14.54	-3.66	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
-7.87	-165.31	-111.62	MDF		
25.38	-179.85	-115.28	Change in DF (sq. km.)		
0.00457	-0.04189	-0.01132	Proportional change		
520.03	16.2	44.21	Change in Extent of TOF (sq. km.)		
0.0368	0.0066	0.0071	Proportional TOF extent		
-0.509	-0.636	-0.118	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
0.012	-1.205	-0.122	Protected Area (sq. Km.)		
0.535	-1.001	-0.526	Extent of TOF (sq. km.) 2023		
0.176	-2.324	-0.680	Proportional Change in DF		Z score Flow
1.360	0.050	0.074	Proportional Change in TOF		
-0.352	-0.729	-0.160	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
0.768	-1.137	-0.303	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
0.648	0.270	0.840	Positive Z Score Stock		
1.905	0.000	0.834	Positive Z Scores Flow		
0.773	0.243	0.839	Weighted combined Z score (90:10)		
0.017	0.013	0.027	Proportion of DF FC15 Annexure table of FC		
0.0273	0.0086	0.0296	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
57857096722	43248615232	91006011439	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
23000078825	7234499220	24970698363	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
8086	5048	11598	Final Allocation in INR crores		

Total	West Bengal	Uttarakhand	State/UT		
	17.52	206.73	VDF	Forest Cover Inside RFA/GW	Change from 2021-23 (Flow)
	31.07	-198.07	MDF		
	48.59	8.66	Change in DF (sq. km.)		
	0.00902	0.000636	Proportional change		
	-39.06	21.01	Change in Extent of TOF (sq. km.)		
	-0.0032	0.0024	Proportional TOF extent		
	-0.521	0.192	Forest Cover Inside RFA/GW 2023		Z score Stock (2023)
	0.188	0.337	Protected Area (sq. Km.)		
	0.210	-0.224	Extent of TOF (sq. km.) 2023		
	0.415	-0.036	Proportional Change in DF		Z score Flow
	-0.375	-0.129	Proportional Change in TOF		
	-0.377	0.165	Avg Z score Stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
	0.020	-0.083	Avg Z Score Flow (Change in FC inside RFA + Change in Extent of TOF)/2		
	0.623	1.164	Positive Z Score Stock		
	1.157	1.054	Positive Z Scores Flow		
	0.676	1.153	Weighted combined Z score (90:10)		
	0.018	0.046	Proportion of DF FC15 Annexure table of FC		
	0.0238	0.0406	Allocation Share of Performance-based bonuses (90:10 :: Stock:Flow)		
	62374352848	153799019510	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
	20110567349	34299835773	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
422000	8248	18810	Final Allocation in INR crores		

Arunachal Pradesh	Himachal Pradesh	Uttarakhand	IHR States (40 percent of the divisible pool allocated)	State/UT		
4.04	-44.11	206.73		VDF	Forest Cover Inside RFA/GW	Change 2021-23 (Flow)
-167.28	36.09	-198.07		MDF		
-163.24	-8.02	8.66		Change in DF (sq. km.)		
-0.00351	-0.00097	0.000636		Proportional change		
-6.64	61.38	21.01		Change in Extent of TOF (in sq. Km.)		
-0.00074	0.010831	0.002439		Proportional TOF extent		
2.900283	-0.20651	0.234166		Forest Cover Inside RFA/GW 2023		Z score stock (2023)
1.526139	1.069553	0.943741		Protected Area (sq. Km.)		
0.865659	0.069431	0.797183		Extent of TOF (in sq. Km.) 2023		
0.25623	0.448671	0.570836		Proportional Change Dense Forest		Z score flow
0.331372	1.454788	0.640338		Proportional Change in TOF		
2.559406	-0.05131	0.361425		Average Z score stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
0.293801	0.951729	0.605587		Average Z score Flow (Change in FC inside RWA + Change in Extent of TOF)/2		
3.324484	0.713766	1.126503		Positive Z Score Stock		
1.199125	1.857053	1.510911		Positive Z Scores Flow		
3.111948	0.828095	1.164944		Weighted combined Z score (90:10)		
0.366763	0.075366	0.128903		Proportion of V+MDF 15th FC Annexure table of FC		
0.363388	0.096698	0.136033		Allocation Share of Performance-based bonuses (90:10 :: Stock: Flow)		
4.95E+11	1.02E+11	1.74E+11		Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
1.23E+11	3.26E+10	4.59E+10		Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
61795.6	13441.97	21999.53		Final Allocation in INR crores		

Mizoram	Meghalaya	Manipur	Sikkim	State/UT		
66.1	39.04	-0.35	-0.73	VDF	Forest Cover Inside RFA/GW	Change 2021-23 (Flow)
-210.11	-97.61	-31.5	-1.01	MDF		
-144.01	-58.57	-31.85	-1.74	Change in DF (sq. km.)		
-0.01629	-0.00722	-0.00477	-0.00102	Proportional change		
-14.59	-51.26	-14.73	-0.04	Change in Extent of TOF (in sq. Km.)		
-0.01547	-0.0166	-0.00729	-3E-05	Proportional TOF extent		
-0.16782	-0.22067	-0.33574	-0.73741	Forest Cover Inside RFA/GW 2023		Z score stock (2023)
-1.11238	0.776865	-1.07764	-0.72393	Protected Area (sq. Km.)		
-1.13207	-0.60442	-0.86277	-1.02758	Extent of TOF (in sq. Km.) 2023		
-0.71316	-0.02548	0.160289	0.445504	Proportional Change Dense Forest		Z score flow
-1.09749	-1.20744	-0.30432	0.400764	Proportional Change in TOF		
-0.3587	-0.15929	-0.46263	-0.76508	Average Z score stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
-0.90532	-0.61646	-0.07202	0.423134	Average Z score Flow (Change in FC inside RWA + Change in Extent of TOF)/2		
0.406376	0.605784	0.302445	0.000001	Positive Z Score Stock		
0.000001	0.288863	0.833307	1.328458	Positive Z Scores Flow		
0.365738	0.574092	0.355531	0.132847	Weighted combined Z score (90:10)		
0.064489	0.069718	0.051619	0.019274	Proportion of V+MDF 15th FC Annexure table of FC		
0.042708	0.067038	0.041516	0.015513	Allocation Share of Performance-based bonuses (90:10 :: Stock: Flow)		
8.71E+10	9.41E+10	6.97E+10	2.6E+10	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
1.44E+10	2.26E+10	1.4E+10	5.24E+09	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
10150.47	11677.92	8372.194	3126.533	Final Allocation in INR crores		

	West Bengal	Assam	Tripura	Nagaland	State/UT		
non-IHR States (60 percent of the divisible pool allocated)	17.52	43.63	-14.54	-2.88	VDF	Forest Cover Inside RFA/GW	Change 2021-23 (Flow)
	31.07	-134.32	-165.31	-4.43	MDF		
	48.59	-90.69	-179.85	-7.31	Change in DF (sq. km.)		
	0.00902	-0.00806	-0.04189	-0.00169	Proportional change		
	-39.06	2.74	16.2	-94.3	Change in Extent of TOF (in sq. Km.)		
	-0.00322	0.000256	0.006586	-0.0225	Proportional TOF extent		
	-0.4338	0.033417	-0.54155	-0.52436	Forest Cover Inside RFA/GW 2023		Z score stock (2023)
	0.740365	-0.06647	-1.16927	-0.97822	Protected Area (sq. Km.)		
	1.65985	1.318506	-0.7447	-0.3391	Extent of TOF (in sq. Km.) 2023		
	1.207018	-0.08865	-2.65582	0.394551	Proportional Change Dense Forest		Z score flow
	0.090905	0.428464	1.042769	-1.78014	Proportional Change in TOF		
	-0.10702	0.151937	-0.62463	-0.55122	Average Z score stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
	0.648961	0.169908	-0.80652	-0.6928	Average Z score Flow (Change in FC inside RWA + Change in Extent of TOF)/2		
	0.658057	0.917015	0.140444	0.213858	Positive Z Score Stock		
	1.554285	1.075232	0.0988	0.212528	Positive Z Scores Flow		
	0.74768	0.932837	0.13628	0.213725	Weighted combined Z score (90:10)		
	0.052278	0.093895	0.036248	0.041447	Proportion of V+MDF 15th FC Annexure table of FC		
	0.087308	0.108929	0.015914	0.024957	Allocation Share of Performance-based bonuses (90:10 :: Stock: Flow)		
	7.06E+10	1.27E+11	4.89E+10	5.6E+10	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
	2.95E+10	3.68E+10	5.37E+09	8.43E+09	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
	10007.08	16357.05	5432.149	6439.507	Final Allocation in INR crores		

Goa	Chhattisgarh	Bihar	Andhra Pradesh	State/UT		
14.42	346.64	56.47	0.1	VDF	Forest Cover Inside RFA/GW	Change 2021-23 (Flow)
14.46	-289.71	-32.03	-118.56	MDF		
28.88	56.93	24.44	-118.46	Change in DF (sq. km.)		
0.034216	0.001789	0.008739	-0.00816	Proportional change		
-3.62	697.03	-146.38	37.47	Change in Extent of TOF (in sq. Km.)		
-0.00278	0.036241	-0.02824	0.003253	Proportional TOF extent		
-0.96899	1.765151	-0.79718	0.223584	Forest Cover Inside RFA/GW 2023		Z score stock (2023)
-1.26874	-0.12433	-0.68475	0.35973	Protected Area (sq. Km.)		
-1.49263	0.763644	-1.04002	-0.25037	Extent of TOF (in sq. Km.) 2023		
1.383525	-0.24157	0.106724	-0.74029	Proportional Change Dense Forest		Z score flow
-0.53417	0.913261	-1.47874	-0.31047	Proportional Change in TOF		
-1.05133	1.476052	-0.81022	0.189804	Average Z score stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
0.424675	0.335844	-0.68601	-0.52538	Average Z score Flow (Change in FC inside RWA + Change in Extent of TOF)/2		
0.036251	2.563636	0.277363	1.277388	Positive Z Score Stock		
1.321051	1.23222	0.210368	0.370994	Positive Z Scores Flow		
0.164731	2.430494	0.270663	1.186749	Weighted combined Z score (90:10)		
0.004536	0.156126	0.014545	0.062286	Proportion of V+MDF 15th FC Annexure table of FC		
0.009067	0.133774	0.014897	0.065319	Allocation Share of Performance-based bonuses (90:10 :: Stock: Flow)		
9.19E+09	3.16E+11	2.95E+10	1.26E+11	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
4.59E+09	6.77E+10	7.54E+09	3.31E+10	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
1377.924	38399.16	3700.569	15924.31	Final Allocation in INR crores		

Karnataka	Jharkhand	Haryana	Gujarat	State/UT		
2.72	2.58	0	35.08	VDF	Forest Cover Inside RFA/GW	Change 2021-23 (Flow)
-8.59	0.17	-0.31	-13.31	MDF		
-5.87	2.75	-0.31	21.77	Change in DF (sq. km.)		
-0.00035	0.00041	-0.0011	0.005032	Proportional change		
-552.5	234.24	129.98	225.3	Change in Extent of TOF (in sq. Km.)		
-0.02248	0.015971	0.053088	0.018722	Proportional TOF extent		
0.419363	-0.45432	-1.02104	-0.66247	Forest Cover Inside RFA/GW 2023		Z score stock (2023)
0.796889	-1.02341	-1.36971	2.090228	Protected Area (sq. Km.)		
1.258906	0.154566	-1.33777	-0.16537	Extent of TOF (in sq. Km.) 2023		
-0.34894	-0.31069	-0.38613	-0.07909	Proportional Change Dense Forest		Z score flow
-1.26523	0.161322	1.538214	0.263384	Proportional Change in TOF		
0.54107	-0.45034	-1.08758	-0.33749	Average Z score stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
-0.80708	-0.07468	0.576044	0.092149	Average Z score Flow (Change in FC inside RWA + Change in Extent of TOF)/2		
1.628654	0.637243	0.000001	0.750095	Positive Z Score Stock		
0.089291	0.821691	1.472419	0.988524	Positive Z Scores Flow		
1.474718	0.655688	0.147243	0.773938	Weighted combined Z score (90:10)		
0.101777	0.048637	0.001856	0.021084	Proportion of V+MDF 15th FC Annexure table of FC		
0.081168	0.036089	0.008104	0.042597	Allocation Share of Performance-based bonuses (90:10 :: Stock: Flow)		
2.06E+11	9.85E+10	3.76E+09	4.27E+10	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
4.11E+10	1.83E+10	4.1E+09	2.16E+10	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
24726.39	11679.39	786.2523	6428.005	Final Allocation in INR crores		

Odisha	Maharashtra	Madhya Pradesh	Kerala	State/UT		
3.09	1041.21	417.47	-1.34	VDF	Forest Cover Inside RFA/GW	Change 2021-23 (Flow)
34.42	723.66	-309.78	-9.53	MDF		
37.51	1764.87	107.69	-10.87	Change in DF (sq. km.)		
0.001829	0.074778	0.002823	-0.00149	Proportional change		
440.4	70.14	-585.64	-24.47	Change in Extent of TOF (in sq. Km.)		
0.017535	0.002402	-0.03159	-0.00162	Proportional TOF extent		
0.765863	1.191201	2.32775	-0.40234	Forest Cover Inside RFA/GW 2023		Z score stock (2023)
0.591616	0.757771	0.814586	-0.91664	Protected Area (sq. Km.)		
1.44505	1.895077	0.524218	0.171358	Extent of TOF (in sq. Km.) 2023		
-0.23957	3.41628	-0.18976	-0.40578	Proportional Change Dense Forest		Z score flow
0.219322	-0.34203	-1.60299	-0.49139	Proportional Change in TOF		
0.816357	1.218245	1.99608	-0.3964	Average Z score stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
-0.01013	1.537123	-0.89637	-0.44858	Average Z score Flow (Change in FC inside RWA + Change in Extent of TOF)/2		
1.903941	2.30583	3.083664	0.691184	Positive Z Score Stock		
0.88625	2.433498	0.000001	0.447791	Positive Z Scores Flow		
1.802172	2.318597	2.775298	0.666844	Weighted combined Z score (90:10)		
0.11208	0.124573	0.160572	0.045018	Proportion of V+MDF 15th FC Annexure table of FC		
0.099191	0.127615	0.152752	0.036703	Allocation Share of Performance-based bonuses (90:10 :: Stock: Flow)		
2.27E+11	2.52E+11	3.25E+11	9.12E+10	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
5.02E+10	6.46E+10	7.74E+10	1.86E+10	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
27725.94	31695.99	40260.92	10977.52	Final Allocation in INR crores		

Uttar Pradesh	Telangana	Tamil Nadu	Rajasthan	Punjab	State/UT		
33.25	-3.66	-2.35	141.96	-0.48	VDF	Forest Cover Inside RFA/GW	Change 2021-23 (Flow)
-7.87	-111.62	-8.37	-128.38	-0.36	MDF		
25.38	-115.28	-10.72	13.58	-0.84	Change in DF (sq. km.)		
0.00457	-0.01132	-0.00089	0.003315	-0.00183	Proportional change		
520.03	44.21	7.03	367.61	159.81	Change in Extent of TOF (in sq. Km.)		
0.036783	0.007135	0.000499	0.025679	0.066987	Proportional TOF extent		
-0.55392	-0.15823	0.014626	-0.68353	-1.00551	Forest Cover Inside RFA/GW 2023		Z score stock (2023)
-0.19948	-0.32314	0.46599	1.442588	-1.35632	Protected Area (sq. Km.)		
0.125156	-0.89425	0.055965	0.128211	-1.34175	Extent of TOF (in sq. Km.) 2023		
-0.10223	-0.8987	-0.37588	-0.16509	-0.4228	Proportional Change Dense Forest		Z score flow
0.933341	-0.16646	-0.41261	0.521446	2.05381	Proportional Change in TOF		
-0.45057	-0.24833	0.063896	-0.38975	-1.07421	Average Z score stock (0.8*FC inside RWA + 0.1*PA + 0.1*Extent of TOF)		
0.415556	-0.53258	-0.39424	0.178177	0.815503	Average Z score Flow (Change in FC inside RWA + Change in Extent of TOF)/2		
0.637019	0.839259	1.15148	0.697838	0.013372	Positive Z Score Stock		
1.311932	0.363794	0.502131	1.074552	1.711878	Positive Z Scores Flow		
0.70451	0.791713	1.086545	0.73551	0.183222	Weighted combined Z score (90:10)		
0.026505	0.041691	0.057895	0.017672	0.003147	Proportion of V+MDF 15th FC Annexure table of FC		
0.038776	0.043576	0.059803	0.040482	0.010085	Allocation Share of Performance-based bonuses (90:10 :: Stock: Flow)		
5.37E+10	8.44E+10	1.17E+11	3.58E+10	6.37E+09	Allocation Bucket 1 (80% of 4.22 crore) : As per existing criteria		
1.96E+10	2.21E+10	3.03E+10	2.05E+10	5.11E+09	Allocation Bucket 2 (20% of 4.22 crore): Performance-based bonuses		
7332.507	10651.63	14755.66	5629.698	1148.136	Final Allocation in INR crores		

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