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Beyond the Tigers Fixing the Structural Fractures in India's Biodiversity Conservation Regime

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AN ABSTRACT

India, a global biodiversity powerhouse, harbours four of the world's 36 biodiversity hotspots — the Himalayas, Western Ghats, Indo-Burma, and Sundaland — along with an estimated 45,000 plant species and over 91,000 animal species. Yet this wealth is eroding: South Asia's Living Planet Index shows a steep four-decade decline in vertebrate populations, despite India's ratification of the Convention on Biological Diversity (CBD) and its enactment of the Wildlife (Protection) Act (1972), Forest (Conservation) Act (1980), and Biological Diversity Act (2002). This paper argues that the paradox is best understood not as a series of unrelated failures but as six recurring **structural disconnects** that run through India's conservation architecture: a *jurisdictional disconnect* (mandates split across at least fourteen central ministries, epitomized by governance paralysis at Chilika Lake); a *species-ecosystem disconnect* (a charismatic-species bias, inherited from Project Tiger's success, that leaves wetlands, grasslands and marine habitats under-resourced); a *state-community disconnect* (a fortress-conservation model that has displaced over 600,000 Adivasi families since 1947, even where community-managed landscapes out-perform formal Protected Areas); a *science-policy disconnect* (generalist administration, compromised Environmental Impact Assessments, and the sidelining of the Gadgil Report); an *incentive disconnect* (revenue-based forest metrics and a Rs. 50,000-crore compensatory-afforestation regime whose plantation-heavy implementation has often fallen short of restoring natural forest); and a *temporal disconnect* (static, boundary-bound Protected Areas that cannot track climate-driven range shifts). Read together, these disconnects rather than any single failure explain why India's considerable legal and institutional investment has not translated into commensurate ecological outcomes. The paper is deliberately not a story of uniform failure. Project Tiger's population recovery, the growth of Community and Conservation Reserves, functioning State Biodiversity Boards such as Kerala's, a growing number of notified Biodiversity Heritage Sites, and rare but real Access and Benefit-Sharing successes — notably the Kani tribe–TBGRI arrangement — show that India's architecture can work when incentives, science and community authority are aligned. The paper examines the M.S. Swaminathan Research Foundation's (MSSRF) three-decade programme of operationalizing People's Biodiversity Registers and Biodiversity Management Committees as a case study in bridging these disconnects in practice. It further situates India's governance debate within emerging global themes — Nature Positive commitments, Other Effective Area-based Conservation Measures (OECMs), large-scale ecosystem restoration, biodiversity finance, digital sequence information (DSI) and AI-enabled biodiversity monitoring, and nature-related business disclosure regimes — that are reshaping international expectations of national biodiversity governance. The paper closes with reforms mapped explicitly onto each of the six disconnects: a strengthened National Biodiversity Authority; full Forest Rights Act implementation; faithful enforcement of existing ecological-expertise and EIA safeguards in decision-making bodies; incentive reform in CAMPA implementation and in forest-service metrics; aquatic parity through expanded marine protection and a Wetlands Authority; and climate-adaptive corridor planning. Together, these can forge governance that finally matches India's biological wealth with its institutional capacity.

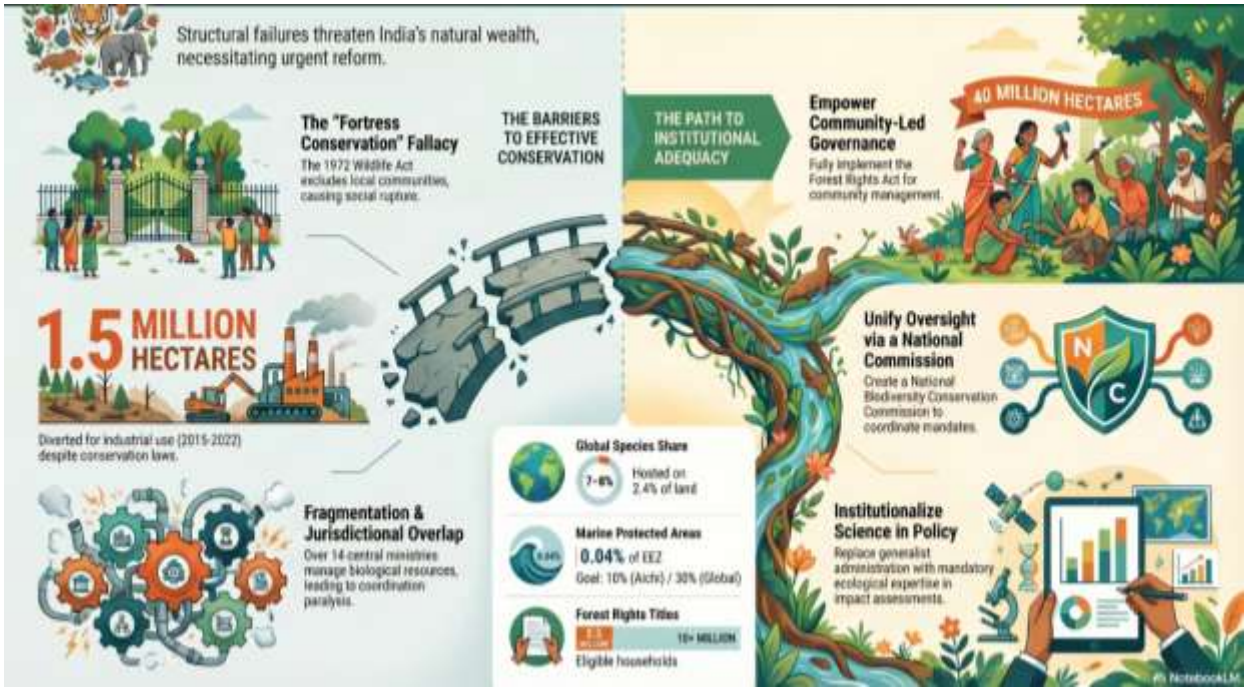
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I-INTRODUCTION

India's conservation story has long centred on charismatic megafauna, epitomized by Project Tiger's success in rescuing the tiger from extinction. Yet this triumph often obscures the silent degradation of less-visible ecosystems—wetlands, grasslands, corridors, and coasts—overwhelmed by population growth, climate change, and rapid development. To safeguard India's rich biodiversity, we must move beyond single-species successes and address deep structural flaws in the conservation regime. Although laws and institutions are extensive, ecological outcomes remain poor. This paper argues that the gap stems not from isolated failures but from recurring structural disconnects—jurisdictional, species-ecosystem, state-community, science-policy, incentive, and temporal—that separate mandate from execution, science from policy, and communities from ecosystems. Using a six-part framework, it interprets legislative gaps, institutional fragmentation, community exclusion, and climate deficits as interconnected symptoms of a single underlying pattern.



Beyond the Tiger infographic summarizing the paper's core argument

India stands as a global biodiversity powerhouse, encompassing four of the world's 36 hotspots — the Himalayas, Western Ghats, Indo-Burma, and Sundaland — and harbouring around 45,000 plant species and over 91,000 animal species (Myers et al., 2000; MoEFCC, 2020). Yet it grapples with severe species loss and habitat degradation: South Asia's Living Planet Index reveals a steep drop in vertebrate populations over four decades (WWF, 2022), and India's State of Environment reports confirm accelerating biodiversity erosion (CSE, 2021). This persists despite ratification of the CBD and the enactment of the Wildlife (Protection) Act (1972), Forest (Conservation) Act (1980), and Biological Diversity Act (2002). As Kohli (2004) puts it, this reflects a "crisis of governability" — the chronic failure of state institutions to convert policy into results. The paper offers an institutional critique built around the six-disconnect framework, and — in the spirit of a balanced assessment — also documents where India's governance has worked, examines MSSRF as a case study in bridging these gaps, situates the discussion within emerging global biodiversity themes, and closes with reforms addressed to each disconnect in turn.

II-INDIA'S BIODIVERSITY: CONTEXT AND STAKES

India's biodiversity is not merely of national significance; it is an irreplaceable component of global biological heritage. The Western Ghats alone contain over 5,000 flowering plant species, 508 bird species, 179 amphibians, and 288 freshwater fish, with endemism exceeding 50% for many taxa (Nair & Daniel, 1986; Molur et al., 2011). The north-eastern Indo-Burma hotspot holds some of the planet's last intact subtropical broadleaf forests and species such as the Hoolock gibbon and the clouded leopard. Marine biodiversity is equally significant and equally imperilled: India's 2.2-million-sq-km Exclusive Economic Zone contains coral reefs in the Gulf of Mannar and the Andaman and Nicobar Islands that rival the Indo-Pacific in richness, yet Marine Protected Areas cover less than 0.04% of it — far below both the 10% Aichi target and the 30% Kunming-Montreal Global Biodiversity Framework goal (CBD, 2022; MoEFCC, 2021). Agricultural biodiversity is in comparable crisis: India was historically a primary centre of origin for crops such as rice, mango, and various legumes, but Green Revolution monocultures have displaced thousands of traditional landraces — the National Bureau of Plant Genetic Resources estimates that over 3,000 rice varieties grown a century ago have been lost (NBPGR, 2018), with direct implications for food security and climate resilience that fall largely outside conventional conservation governance.



III-A FRAMEWORK FOR ANALYSIS: SIX STRUCTURAL DISCONNECTS

The chapters that follow document a wide range of specific failures. Read individually, each can appear as a discrete policy or enforcement lapse. Read together, they recur in a pattern that this paper treats as the paper's central conceptual contribution: India's biodiversity governance is undermined by six structural disconnects that reinforce one another.

1. ***The Jurisdictional Disconnect*** — biodiversity mandates are split across at least fourteen central ministries and a concurrent-list constitutional arrangement with the states, producing coordination failure rather than coordination (Section V).
2. ***The Species-Ecosystem Disconnect*** — conservation attention and funding gravitate toward a small number of charismatic species, particularly the tiger, at the expense of the ecosystems — wetlands, grasslands, mangroves, marine habitats — in which all species, charismatic or not, are embedded (Sections IV.1 and VIII).
3. ***The State-Community Disconnect*** — a colonial-inherited "fortress conservation" model treats local and indigenous communities as threats to be excluded rather than as custodians whose knowledge and practices generate biodiversity outcomes (Section VI).
4. ***The Science-Policy Disconnect*** — ecological expertise is structurally marginal to decision-making, from generalist administration to conflicted Environmental Impact Assessments to the political overriding of expert panels (Section VII).
5. ***The Incentive Disconnect*** — the metrics by which officials, agencies and offset schemes are evaluated reward outputs (revenue, plantation area, procedural clearance) that are frequently at odds with biodiversity outcomes (Section IX).
6. ***The Temporal Disconnect*** — a governance architecture built around static, boundary-bound Protected Areas is poorly equipped for a climate-altered future in which species ranges, hydrology and disturbance regimes are all shifting (Section X).

These disconnects are mutually reinforcing rather than independent: jurisdictional fragmentation (1) makes it easier for agencies to externalize ecological costs (5); the marginalization of science (4) makes it harder to correct the species bias (2); and the exclusion of communities (3) removes exactly the distributed, adaptive monitoring capacity that climate governance (6) most needs. The remainder of the paper uses this framework as its organizing spine, returns to it explicitly in the discussion of emerging global themes (Section XI) and MSSRF (Section XII), and structures its reform proposals (Section XIII) disconnect by disconnect.

IV-LEGISLATIVE ARCHITECTURE AND ITS CONTRADICTIONS

4.1 The Wildlife (Protection) Act, 1972: Colonial Legacies and Exclusionary Design

The WPA, 1972, remains the foundational statute for wildlife conservation in India. Modelled substantially on colonial-era forest governance that treated forests as state property and local inhabitants as encroachers rather than stewards (Guha, 1989), it established a system of Protected Areas — National Parks, Wildlife Sanctuaries, Conservation Reserves, and Community Reserves — on a fortress-conservation logic that prioritised excluding human activity over integrating human livelihoods with ecological management. Approximately 5.06% of India's geographical area is under Protected Area coverage (Wildlife Institute of India, 2022). While this figure appears reasonable, protection quality is deeply uneven and the social cost has been severe: Pathak Broome (2009) documents over 600,000 families evicted or subjected to rights curtailment in the name of wildlife protection since 1947 — the state-community disconnect described in Section III.

The 2006 amendment brought Project Tiger and Project Elephant more robustly into the legislative framework, and it is worth stating plainly what that programme has achieved: India's tiger population rose from an estimated 1,411 in 2006 to 3,682 by the 2022 All India Tiger Estimation, and Project Tiger is credited internationally as one of the more successful large-carnivore recovery programmes anywhere (NTCA, 2022). The institutional lesson, however, cuts two ways. The same intensity of political attention, ring-fenced funding, and dedicated enforcement capacity that produced this recovery has not been extended to non-charismatic ecosystems — what Rangarajan (2001) calls the "tiger obsession" is best read not as evidence that flagship-species conservation fails, but as evidence of the species-ecosystem disconnect: a demonstrated model of institutional success has not been replicated for wetlands, grasslands or marine habitats. Encouragingly, the Community and Conservation Reserves categories introduced by the 2002/2006 amendments — co-managed, less exclusionary PA categories — have grown steadily in number since, offering a partial institutional template for reconciling protection with local livelihoods, even though their extent still remains small relative to the wider PA estate.

4.2 The Forest (Conservation) Act, 1980: Bureaucratic Centralisation and Diversion Regime

The FCA, 1980, requires central government approval for diverting forest land to non-forest purposes, and it has prevented substantial deforestation since enactment. Implementation, however, has two critical failures. First, the Act has proven permeable to powerful economic interests: over 1.5 million hectares of forest were diverted for industrial, mining, and infrastructure projects between 2015 and 2022 (MoEFCC, 2022), often in ecologically sensitive Protected Area buffer zones with inadequate scrutiny of cumulative impacts (Negi, 2019), and the Forest Advisory Committee has been criticised for approving diversions under political and economic pressure (CSE, 2021). Second, the Forest (Conservation) Amendment Act, 2023, has been widely critiqued for diluting these protections — exempting categories such as national security installations, border roads and linear infrastructure from FCA



requirements, and redefining "forest" in ways that could exclude a significant share of India's forest cover from statutory protection (Krishnaswamy, 2023). The Empowered Committee on Forests estimated that this reclassification could place approximately 2.8 million additional hectares outside the Act's ambit (Gadgil, 2023).

4.3 The Biological Diversity Act, 2002: Promise, Implementation Deficit, and Pockets of Success

The BDA, 2002, was India's legislative response to the CBD and represented a genuine conceptual advance: a three-tier architecture of the National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs) and local Biodiversity Management Committees (BMCs), together with People's Biodiversity Registers (PBRs) for documenting local biological knowledge. Implementation has nonetheless been described as a "grand failure" (Bhutani& Kothari, 2017): as of 2022, fewer than half of states had fully functional SBBs and less than 30% of mandated BMCs had been formed (NBA Annual Report, 2022). Access and Benefit-Sharing (ABS) under the Nagoya Protocol, ratified in 2012, has been particularly poorly enforced, and biopiracy — most visibly in the neem and turmeric patent disputes, eventually reversed after sustained advocacy — illustrates the systemic vulnerability of India's biological commons (Shiva, 1997).

This picture of implementation deficit should not obscure genuine successes that show the architecture can function. Kerala's State Biodiversity Board is widely regarded as among the more effective in the country, with comparatively high rates of BMC formation and PBR completion, and offers a template that other states have been slow to adopt. The NBA has, over time, notified a growing number of Biodiversity Heritage Sites under Section 37 of the Act, recognising locally significant biodiversity landscapes with a degree of community involvement in their management. And the arrangement between the Kani tribal community of Kerala and the Tropical Botanical Garden and Research Institute (TBGRI) over the anti-fatigue drug developed from the *arogyapacha* plant — predating the BDA but frequently cited as its conceptual forerunner — remains one of the few documented instances anywhere in the developing world of a benefit-sharing arrangement that delivered sustained returns to an indigenous community (Anuradha, 1998). These cases matter because they demonstrate that the BDA's institutional design is not inherently unworkable; the disconnect lies in the inconsistency of political will and resourcing behind it.

V-INSTITUTIONAL FRAGMENTATION AND JURISDICTIONAL OVERLAP

The jurisdictional disconnect introduced in Section III is starkly visible in practice. At least fourteen central ministries and departments exercise authority over some aspect of biological resource management (Kothari et al., 2014): MoEFCC nominally leads conservation, but the Ministry of Agriculture controls agrobiodiversity, the Ministry of Fisheries, Animal Husbandry and Dairying governs marine and inland fisheries, the Ministry of Tribal Affairs manages forest rights, the Ministry of Jal Shakti controls freshwater ecosystems, and the Ministry of Earth Sciences oversees marine research. Chilika Lake, one of Asia's largest brackish-water lagoons and a Ramsar site, illustrates the resulting paralysis: its ecological integrity is simultaneously subject to the WPA, the Coastal Regulation Zone notification, the Inland Fisheries Act, the Forest Rights Act, and the EIA notification, with no single institution coordinating across them — a gap that actors seeking to circumvent regulation routinely exploit (Mohanty& Dash, 2018).The judiciary has increasingly filled this executive vacuum. The National Green Tribunal, established in 2010, has become a de facto conservation authority across matters from biodiversity assessment to pollution control; while its interventions have produced real protections, the reliance on courts to substitute for absent executive coordination is itself a symptom of institutional dysfunction rather than a durable solution (Gill, 2016). The concurrent-list status of forests compounds the problem at the state level: states with powerful extractive-industry lobbies — Odisha, Jharkhand, Chhattisgarh — have consistently pressed for weaker standards, and the federal structure gives the Union limited leverage to enforce nationally consistent biodiversity standards against recalcitrant state governments (Kohli, 2014).

VI-EXCLUSION OF LOCAL AND INDIGENOUS COMMUNITIES

The state-community disconnect is, arguably, the most consequential of the six. The empirical evidence is unambiguous: ecosystems managed by indigenous communities often carry higher biodiversity than formally protected areas (Fa et al., 2020; Garnett et al., 2018), because practices such as controlled burning, seasonal hunting, rotational cultivation, and sacred-grove maintenance are themselves biodiversity-generating activities refined over millennia. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 — the Forest Rights Act (FRA) — was a significant attempt to correct this, recognising both individual land rights and community forest resource (CFR) rights that could, if fully implemented, bring an estimated 40 million hectares under community-led governance (Springate-Baginski et al., 2021).

Implementation has been deeply flawed. As of 2023, only about 2.3 million individual forest rights titles had been distributed against an eligible population estimated above 10 million households (MoTA, 2023), and CFR recognition covers only around 4 million hectares of its potential (Campaign for Survival and Dignity, 2022) — state governments and forest departments, whose institutional identity depends on retaining control of forest land, have systematically obstructed claims. The long-running Godavarman case before the Supreme Court, generating over 1,600 orders since 1995, captures the resulting jurisprudential contradiction: many orders have been environmentally protective, yet others have prioritised Forest Department authority over FRA rights, at times justifying eviction (Menon & Kohli, 2009).



Where CFR rights have been genuinely realised, the results support the case for community governance. The village of Mendha-Lekha in Maharashtra, among the first gram sabhas to secure full community forest rights, has managed its forest with a degree of ecological rigour and self-governance that is frequently cited as a model for what CFR implementation could achieve nationally (Springate-Baginski et al., 2021). Sacred groves (*devavans* or *orans*) maintained by tribal communities across India likewise contain measurably higher tree-species diversity than adjacent state forest areas (Bhagwat &Rutte, 2006), underscoring that the progressive dismantling of customary governance — without adequate formal replacement — has accelerated the degradation of these biologically rich landscapes.

VII-FAILURES OF SCIENTIFIC INTEGRATION IN POLICY

The science-policy disconnect runs through decision-making at every level. Within MoEFCC, state forest departments, and the EIA process, authority remains largely with generalist administrators without formal training in ecology or conservation biology (Shankar Raman &Madhusudan, 2017). The EIA process, mandated under the Environment (Protection) Act, 1986, is theoretically designed to weigh ecological costs before project approval; in practice it has become largely procedural, since EIA reports are typically prepared by consultants financially dependent on the project proponent, creating a structural conflict of interest that generates systematically optimistic assessments (Narain, 2014). The proposed EIA Notification, 2020, drew wide criticism for allowing post-facto regularisation of unauthorised projects, reducing public consultation periods, and exempting large project categories from scrutiny (Ritwick Dutta, 2020; Baskaran et al., 2021); although it was not issued in its original form after legal challenge, successive administrative directives have achieved many of the same dilutions.

India also lacks a comprehensive, nationally standardised biodiversity monitoring programme comparable to the UK's Countryside Survey or the US National Ecological Observatory Network. The Wildlife Institute of India and the Zoological Survey of India conduct valuable baseline surveys, but their output remains fragmented and poorly integrated into management planning, making it difficult to assess conservation outcomes or detect early degradation signals (Bhattacharya et al., 2020). The Western Ghats Ecology Expert Panel (the Gadgil Report, 2011) offered an unusually rigorous attempt to bring science into conservation zoning through a tiered Ecologically Sensitive Area classification; facing development-lobby and state pressure, the central government instead commissioned a replacement report (the Kasturirangan Report, 2013) with substantially reduced coverage — a clear instance of the structural tendency to marginalise inconvenient science when it conflicts with economic interests (Ramesh, 2017).

VIII-MARINE AND FRESHWATER CONSERVATION: THE NEGLECTED FRONTIERS

The species-ecosystem disconnect described in Section III is compounded, for marine and freshwater systems, by weak enforcement capacity. Marine Protected Areas are governed under a combination of the WPA, the CRZ Notification, and the Environment (Protection) Act, but enforcement at sea is minimal: the Gulf of Mannar Marine National Park, one of India's oldest and richest MPAs, has seen extensive coral bleaching, illegal trawling and dynamite fishing within its legally protected boundaries (Venkataraman et al., 2011), reflecting fragmented authority between the Coast Guard, state fisheries departments and forest departments, and the near-total absence of fishing-community participation in management.

Freshwater biodiversity fares little better. India harbours roughly 800 freshwater fish species, but hydropower dams, sand mining and urban encroachment have caused severe habitat fragmentation; the Gangetic river dolphin, India's national aquatic animal, is IUCN-listed as Endangered, yet the National Mission for Clean Ganga functions primarily as a water-quality and sewage-treatment programme, with biodiversity conservation an afterthought (Kelkar et al., 2010; NMCG, 2021). Wetland governance shows the same pattern: the Wetlands (Conservation and Management) Rules, 2017, formally recognized wetland biodiversity as a governance concern, but lack effective enforcement,

IX-INCENTIVE STRUCTURES & THE POLITICAL ECONOMY OF CONSERVATION FAILURE

The incentive disconnects shapes behavior at every level of the system. Forest officers are evaluated on revenue generation, plantation targets and boundary maintenance rather than ecological indicators, creating institutional pressure to favour timber production over natural forest conservation and boundary policing over ecosystem management (Bhattacharjee &Behera, 2018); promotion and posting decisions are, in turn, heavily influenced by political patronage, weakening the administrative autonomy needed for independent conservation decisions.

The Compensatory Afforestation Fund Management and Planning Authority (CAMPA) illustrates the disconnect at scale. Developers who divert forest land are required to plant trees elsewhere as compensation, and over Rs. 50,000 crore has accumulated in CAMPA funds from forest diversions between 2010 and 2022 (MoEFCC, 2022). CAMPA's policy framework does not promote monoculture: the Compensatory Afforestation Fund Act, 2016 and its 2018 Rules provide for ring-fenced, non-lapsable funds, and official guidance emphasises native, mixed-species planting and natural regeneration (Government of India, 2016). The disconnect lies in implementation. Area- and target-based reporting favours plantation-heavy delivery, which has often yielded fast-growing, low-diversity stands with poor survival and limited biodiversity value rather than functioning forest, so compensatory plantation



remains, in practice, ecologically inferior to natural forest and risks legitimizing the diversion it is meant to offset (Nagendra, 2007). The remedy is faithful implementation of CAMPA's existing norms, in letter and spirit, rather than new principles. Infrastructure politics compounds the problem: major highways, railways and power lines routinely fragment Protected Area buffer zones and elephant corridors, and infrastructure ministries consistently prevail over wildlife-authority objections in inter-ministerial negotiations (Wikramanayake et al., 2011; MOEF, 2010). International conservation funding adds a further distortion, concentrating on charismatic-species interventions and leaving community-based, landscape-level and non-charismatic conservation chronically under-resourced, even where these approaches are demonstrably more cost-effective (Balmford& Whitten, 2003).

X-CLIMATE CHANGE AND ADAPTIVE GOVERNANCE DEFICITS

India's conservation architecture was designed for a stable climate, and the temporal disconnect this creates is becoming one of the more serious gaps in the system. Species range shifts, altered phenology, extreme weather and ocean acidification are reshaping India's biodiversity in ways that static, boundary-based ProtectedAreas are poorly equipped to manage. Climate vulnerability assessments indicate that species in the Western Ghats, the Himalayas, and the Andaman and Nicobar Islands face particularly severe risks (Krishnaswamy et al., 2014); the Himalayas are warming at roughly twice the global average rate, with glacial retreat threatening the hydrological foundations of biodiversity across multiple river basins (Immerzeel et al., 2010), and species confined to specific altitudinal bands face extinction as isotherms shift upward — a process fixed park boundaries cannot accommodate.

The National Mission for a Green India, under the National Action Plan on Climate Change, has biodiversity components, but focuses primarily on forest-cover enhancement rather than biodiversity quality, with minimal integration into the Protected Area network. A 2019 review found that climate vulnerability was not systematically incorporated into management plans for any of India's Tiger Reserves or National Parks (Chaitra Sahoo et al., 2019). Connectivity conservation — maintaining or restoring ecological corridors so species can track shifting habitat — has been advocated by scientists for over two decades[3] yet India has made limited formal progress: of the 101 critical elephant corridors identified by Project Elephant (2010), fewer than 30 have received formal legal protection.

XI-EMERGING GLOBAL THEMES AND INDIA'S POSITIONING

Global biodiversity governance has moved substantially since India's core legislative architecture was designed, and several emerging themes deserve explicit attention because they will shape the terms on which India's institutions are judged over the coming decade.

Nature Positive. The post-2020 global goal of halting and reversing biodiversity loss by 2030 — "Nature Positive" — has become the organising ambition of the Kunming-Montreal Global Biodiversity Framework (GBF), adopted at CBD COP15. It reframes conservation from a defensive project (slowing loss) to a restorative one (net gain), a shift that India's largely protection-and-diversion-oriented legal architecture is not yet structured to measure or report against.

Other Effective Area-based Conservation Measures (OECMs). GBF Target 3 commits parties to conserving 30% of land and sea by 2030 through a combination of Protected Areas and OECMs — geographically defined areas, outside formal PAs, that achieve effective long-term biodiversity conservation through other governance forms. India's community reserves, sacred groves, and privately or community-conserved landscapes are natural OECM candidates, but the country currently lacks a formal mechanism to identify, recognise and report such areas towards the 30% target, so that their contribution becomes visible in national accounting.

Ecosystem restoration. The UN Decade on Ecosystem Restoration (2021–2030) and India's own Bonn Challenge pledge to restore 26 million hectares of degraded land give restoration a prominence it did not have when the FCA and WPA were framed. CAMPA's plantation-heavy implementation, discussed in Section IX, sits uneasily with the ecological-integrity standards now expected of restoration commitments internationally.

Biodiversity finance. GBF Target 19 calls for mobilizing at least USD 200 billion annually for biodiversity from all sources, alongside a rapid growth in private-sector instruments — green and biodiversity bonds, biodiversity credits, and blended-finance conservation trusts. India's conservation financing remains dominated by budgetary allocation and the CAMPA offset mechanism; it has yet to develop comparable market-based instruments at scale.

Digital sequence information (DSI) and AI-enabled monitoring. The multilateral mechanism for benefit-sharing from digital sequence information on genetic resources, agreed at CBD COP15/16, extends ABS obligations into genomic data — a domain India's BDA, drafted before genomic databases were a governance concern, does not clearly address. At the same time, AI-enabled tools — camera-trap image recognition, acoustic monitoring, satellite-based habitat change detection, and environmental-DNA analysis — are lowering the cost of the very long-term biodiversity monitoring that Section VII identifies as chronically under-resourced, offering a plausible technological complement to institutional reform rather than a substitute for it.

[3] Paul Beier and Reed F. Noss titled *"Do Habitat Corridors Provide Connectivity?"* (published in *Conservation Biology*, Vol. 12, No. 6, pp. 1241–1252)



Nature-related business disclosures. The Taskforce on Nature-related Financial Disclosures (TNFD), which released its final recommendations in 2023, is beginning to require large corporations to report nature-related risks and dependencies in the way the Task Force on Climate-related Financial Disclosures did for climate. As Indian corporates increasingly face these expectations from investors and export markets, the country's fragmented biodiversity data landscape — a direct consequence of the jurisdictional and science-policy disconnects described above — will make credible corporate disclosure difficult without national-level investment in biodiversity data infrastructure.

None of these themes is China-, EU-, or NGO-specific: each has direct bearing on how India's six structural disconnects will be judged internationally in the coming decade, and each offers a concrete entry point for reform.

XII. BRIDGING GOVERNANCE GAPS IN PRACTICE

The preceding sections diagnose structural disconnects; this section examines an institution that has spent three decades working, deliberately, to close them. The M.S. Swaminathan Research Foundation (MSSRF) offers a case study precisely because its interventions map onto the framework in Section III rather than addressing conservation in the abstract.

Operationalizing the state-community disconnect. Through sustained work on People's Biodiversity Registers (PBRs) and the reconstitution of Biodiversity Management Committees (BMCs) under the BDA, 2002, MSSRF has helped translate statutory provisions that exist on paper in most states into functioning grassroots institutions for documentation, decision-making and benefit-sharing. By building the capacity of tribal and rural communities to record species, land-use patterns and traditional knowledge themselves, the Foundation has strengthened exactly the "local governance layer" that Section VI identifies as chronically weak or absent, narrowing the gap between national biodiversity policy and its implementation on the ground.

Bridging the science-policy disconnect. MSSRF's conservation models — including the M.S. Swaminathan Botanical Garden and a proposed Biodiversity Park in the Western Ghats — combine ex-situ and in-situ conservation with traditional ecological knowledge, treating community expertise as a scientific input rather than an obstacle to be managed around. This stands in direct contrast to the generalist, science-marginal decision-making documented in Section VII.

Addressing the incentive disconnect. Genetic gardens of bio fortified plants and medicinal-plant bio-valleys link conservation outcomes to livelihood and nutrition benefits for participating communities, offering a working example of the kind of incentive alignment that Section IX finds largely absent from mainstream forest and biodiversity administration.

Outcomes and limits. MSSRF's PBR and BMC work has informed national and state-level discussions on linking agriculture, nutrition and biodiversity, and its record over successive annual reporting cycles shows a model that is participatory, evidence-based, and consistent with India's commitments under global biodiversity frameworks. It would, however, be a mistake to read a single institution's programme as a substitute for national reform: MSSRF's reach, however sustained, is necessarily limited relative to the scale of the BMC deficit documented in Section IV.3. Its value lies less in the areal coverage it has achieved than in demonstrating, at working scale, that the BDA's institutional design can function when paired with patient capacity-building and a science-community partnership — evidence that should inform, rather than substitute for, the structural reforms proposed in Section XIII.

XIII-REFORM PATHWAYS: TOWARDS INSTITUTIONAL ADEQUACY

India's biodiversity conservation crisis is, this paper has argued, fundamentally institutional in character. Addressing it requires structural reform of the architecture of conservation governance, together with effective implementation and enforcement, in letter and spirit, of the many safeguards that already exist in law and regulation; neither more resources nor new statutes alone will suffice. The reforms below are organized against the six disconnects set out in Section III.

Against the jurisdictional disconnect: The existing National Biodiversity Authority (NBA), constituted under the BDA, 2002, must be strengthened with cross-ministerial authority, a permanent scientific advisory body, and mandatory coordination mechanisms with state governments, so that it can reduce the governance vacuum at the centre of the system. The National Disaster Management Authority, which coordinates across sectoral agencies, offers a partial institutional analogue (Kothari et al., 2014).

Against the state-community disconnect: full implementation of the Forest Rights Act, proper recognition of Community Forest Resource rights, and integration of indigenous governance systems into formal Protected Area management would address equity deficits and improve ecological outcomes together — as legally recognised indigenous territories have done in Bolivia, Ecuador and parts of Brazil (Schleicher et al., 2017), and as Mendha-Lekha demonstrates is achievable within India's own legal framework.

Against the science-policy disconnect: many of the required safeguards — ecological expertise on appraisal bodies, accreditation of EIA consultants, and monitoring of clearance conditions — already exist in policy and regulatory mandates, so the priority is their effective implementation and enforcement, in letter and spirit. In practice this means ecological expertise that carries real weight in decision-making bodies, genuinely independent and audited EIA consultancy, mandatory and publicly reported post-project monitoring, rigorous biodiversity baselines, and reconsideration of the Western Ghats ESA classification.



Against the incentive disconnect: CAMPA implementation should prioritise natural forest restoration and assisted regeneration over compensatory plantation, in keeping with its own norms, using ecologically validated offset criteria and independent monitoring of survival and biodiversity outcomes; forest-officer performance metrics should incorporate biodiversity indicators; and anti-corruption measures should reduce the political patronage that undermines administrative autonomy.

Against the species-ecosystem disconnect: marine and freshwater biodiversity governance need parity with terrestrial conservation — rapid expansion of effective Marine Protected Areas toward the Kunming-Montreal 30% target, genuine co-management with fishing communities, dedicated marine enforcement capacity, and a National Wetlands Authority with real regulatory teeth.

Against the temporal disconnect: climate vulnerability assessments and adaptive strategies should be mainstreamed into every Protected Area management plan, and formal legal protection for priority wildlife corridors — starting with all 101 identified elephant corridors — should be treated as a national conservation priority.

Finally, engaging seriously with the emerging themes in Section XI — recognising OECMs formally, developing biodiversity finance instruments, investing in AI-enabled monitoring infrastructure, and preparing for DSI and nature-related disclosure obligations — would help India's institutions catch up with, rather than continue to lag, the direction of international biodiversity governance.

XIV-CONCLUSION

1. *Biodiversity paradox*: India's four global hotspots and 130,000+ species face steep declines despite CBD ratification and strong legislation, reflecting a "crisis of governability" driven by structural disconnects rather than any single institutional flaw.
2. *A framework, not a list of failures*: six recurring disconnects — jurisdictional, species-ecosystem, state-community, science-policy, incentive, and temporal — explain why legal and institutional investment has not converted into ecological outcomes, and why the same failure patterns recur across otherwise distinct domains.
3. *Success is real, and instructive*: Project Tiger's population recovery, Kerala's SBB, a growing number of Biodiversity Heritage Sites, the Kani-TBGRI ABS case, and Mendha-Lekha's community forest governance show that India's architecture works when incentives, science and community authority align — the task is to generalize these conditions, not merely replicate the individual programmes.
4. *MSSRF as case study*: three decades of PBR and BMC work show that the BDA's institutional design can function at working scale when paired with sustained capacity-building — evidence for, rather than a substitute for, wider reform.
5. *A changing international context*: Nature Positive commitments, OECMs, ecosystem restoration, biodiversity finance, DSI, AI-enabled monitoring, and nature-related disclosure regimes are raising the bar against which India's institutions will be judged, and largely presuppose exactly the coordination capacity the jurisdictional disconnect currently denies.
6. *Reform is architectural, not incremental*: bridging these gaps requires an institutional overhaul — integrating mandates, empowering communities, institutionalising science, correcting incentives, achieving aquatic parity, and mainstreaming climate adaptation — rather than piecemeal fixes to individual statutes.

XV-RECOMMENDATIONS

1. *Strengthen the National Biodiversity Authority*: the NBA already exists under the BDA, 2002; strengthen it with cross-ministerial authority, a permanent scientific advisory body and mandatory coordination mechanisms with state governments (Section XIII), drawing on the NDMA model, to close the jurisdictional disconnect.
2. *Fully implement the FRA*: accelerate individual titles and CFR recognition toward the full 40 million hectares, empowering gram sabhas and integrating indigenous governance into PA management, drawing on the Mendha-Lekha and Bolivia/Ecuador precedents.
3. *Reform CAMPA incentives*: ensure that compensatory afforestation follows CAMPA's native-species and natural-regeneration norms in practice, with validated ecological-offset criteria and independent survival monitoring; tie forest-officer performance metrics to biodiversity indicators.
4. *Expand marine protection*: scale MPAs toward the Kunming-Montreal 30% target, with dedicated enforcement, Coast Guard integration, and genuine fishing-community co-management.
5. *Scale up ecosystem-level conservation already in place*: the Community and Conservation Reserve categories, the Wetlands Rules, 2017 and mangrove and river-dolphin initiatives already provide a legal and programmatic base; extend the institutional model behind Project Tiger's success — dedicated funding, coordinated enforcement, political attention — so that wetlands, grasslands and mangroves receive comparable, sustained priority in implementation, and expand co-managed Community and Conservation Reserves.
6. *Strengthen FCA scrutiny*: reverse the 2023 dilutions; enforce cumulative-impact assessment and FAC independence from political and economic pressure.



7. *Operationalise the BDA and ABS fully*: bring all SBBs and BMCs to full functionality, drawing on Kerala's model; enforce Nagoya ABS obligations; expand Biodiversity Heritage Site notification; strengthen anti-biopiracy monitoring.
8. *Build a national monitoring network*: develop standardised, long-term biodiversity surveys comparable to the US NEON, integrating WII and ZSI data into PA planning, and pilot AI-enabled monitoring tools (camera-trap analytics, eDNA, satellite change detection) to close the science-policy disconnect at lower cost.
9. *Mainstream climate adaptation*: embed vulnerability assessments and corridor protections — including all 101 identified elephant corridors — in every PA management plan.
10. *Engage emerging global frameworks*: formally recognize OECMs, develop biodiversity-finance instruments consistent with GBF Target 19, prepare institutional capacity for DSI benefit-sharing obligations, and support nature-related disclosure readiness among Indian corporates.
11. *Curb political patronage*: enact anti-corruption measures for forest services and equalize funding for non-charismatic-species and community-led projects to counter prevailing global funding biases.

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XVII-ETHICAL CONSIDERATIONS

This research exclusively utilizes publicly accessible secondary data sources, ensuring strict adherence to ethical standards throughout the process. References are cited to maintain intellectual honesty and academic integrity, taking advantage of the positive aspects of AI tools where used. This approach not only upholds ethical research practice but also reinforces the credibility and transparency of the study's findings.

XVIII-LIST OF ACRONYMS

1. ABS — Access and Benefit-Sharing
2. BDA — Biological Diversity Act, 2002
3. BMCs — Biodiversity Management Committees
4. CBD — Convention on Biological Diversity
5. CAMPA — Compensatory Afforestation Fund Management and Planning Authority
6. CFR — Community Forest Resource(s)/Rights
7. CRZ — Coastal Regulation Zone
8. CSE — Centre for Science and Environment
9. DSI — Digital Sequence Information
10. EIA — Environmental Impact Assessment
11. EEZ — Exclusive Economic Zone
12. ESA — Ecologically Sensitive Area
13. FAC — Forest Advisory Committee
14. FCA — Forest (Conservation) Act, 1980
15. FRA — Forest Rights Act, 2006
16. GBF — (Kunming-Montreal) Global Biodiversity Framework
17. GIM — National Mission for a Green India
18. MoEFCC — Ministry of Environment, Forest and Climate Change
19. MoEF — Ministry of Environment and Forests
20. MoTA — Ministry of Tribal Affairs
21. MPAs — Marine Protected Areas
22. NBPGR — National Bureau of Plant Genetic Resources
23. NAPCC — National Action Plan on Climate Change
24. NBA — National Biodiversity Authority
25. NGT — National Green Tribunal
26. NTCA — National Tiger Conservation Authority
27. OECMs — Other Effective Area-based Conservation Measures
28. PAs — Protected Areas
29. PBRs — People's Biodiversity Registers
30. SBBs — State Biodiversity Boards
31. TNFD — Taskforce on Nature-related Financial Disclosures
32. WPA — Wildlife (Protection) Act, 1972



33. WII — Wildlife Institute of India
34. ZSI — Zoological Survey of India

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