Reassessing Environmental Impact Assessments in India: Implications for Species Conservation and Biodiversity Governance

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Short Research Article

ABSTRACT

Environmental Impact Assessment (EIA) serves as a foundational instrument in contemporary development planning, offering a structured approach to integrating environmental considerations at the inception of project design and execution. In the Indian context, EIA acts as a preventive and regulatory framework designed to mitigate ecological degradation by systematically assessing the potential environmental consequences of proposed activities on critical components such as air, water, soil, biodiversity, and public health. While EIA has contributed to advancing sustainable development and enhancing environmental accountability, its application in the realm of wildlife conservation—especially concerning birds and other ecologically sensitive species—remains

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fraught with limitations. A significant proportion of EIAs fail to adequately address the long-term, cumulative, and spatially diffuse impacts on species that navigate both protected and unprotected landscapes. These oversights are aggravated by the limited deployment of scientific tracking tools, insufficient ecological modelling, and a lack of attention to habitat connectivity. Migratory birds and wide-ranging species are particularly vulnerable to such gaps in assessment, often facing habitat fragmentation and ecosystem disruptions. To harmonize developmental objectives with the imperatives of wildlife conservation, it is essential to strengthen the EIA process through the incorporation of advanced ecological methodologies, real-time wildlife tracking, and landscape-level planning. Enhancing stakeholder participation and embedding species-specific conservation strategies within EIA protocols can further ensure that development does not come at the cost of biodiversity loss. Such an integrated and science-informed approach to EIA would support the ethical imperative of safeguarding wildlife, promoting ecological balance, and securing a sustainable future for both human and non-human life. Biodiversity plays a vital role not only in maintaining ecological balance but also in supporting agriculture, livelihoods, and the traditions of indigenous communities. Despite this, increasing human activities such as deforestation, pollution, infrastructure expansion, habitat fragmentation, and climate change are accelerating species extinction at an alarming rate.

1. INTRODUCTION

Environmental Impact Assessment (EIA) is a systematic process used to identify, predict, evaluate, and mitigate the potential environmental effects of proposed projects, plans, or policies (Bhat, 2019). Environmental protection and the pursuit of sustainable development are fundamental goals embedded within India's legal and policy frameworks. EIA serves as a cornerstone of this structure, designed to evaluate the probable environmental outcomes of proposed developmental activities before they are executed. Introduced formally in India in 1994 under the Environment (Protection) Act of 1986, EIA has since evolved through a series of notifications to assess the environmental viability of large-scale projects such as highways, mining, industrial plants, and dams. EIA typically involves several stages: screening to determine whether a proposed activity is likely to have significant environmental impacts; scoping to identify key issues relevant to the EIA; considering alternatives; establishing baseline environmental conditions, conducting EIAs, and taking mitigation measures; developing an environmental management plan; drafting the EIA report; facilitating public participation; finalizing the EIA report; reviewing the EIA report and making decisions; and informing the public of the final decision. Despite its significance, the effectiveness of EIA in India has frequently been undermined by institutional inefficiencies, superficial assessments, insufficient public involvement, political

influences, and lax enforcement mechanisms. This systemic failure has had particularly detrimental consequences for India's wildlife, which is already under immense pressure due to habitat degradation, pollution, anthropogenic encroachment, and climate variability. EIA systematically examines both beneficial and adverse consequences of the project and ensures that these effects are considered during project design. It helps to identify possible environmental effects of the proposed project, proposes measures to mitigate adverse effects and predicts whether there will be significant adverse environmental effects, even after the mitigation is implemented. By considering the environmental effects of the project and their mitigation early in the project planning cycle, environmental assessment has many benefits, such as protection of the environment, optimum utilisation of resources and saving of time and cost of the project. Properly conducted EIA also lessens conflicts by promoting community participation, informing decision makers, and helping lay the base for environmentally sound projects. Benefits of integrating EIA have been observed in all stages of a project, from exploration and planning, through construction, operations, decommissioning, and beyond site closure

India, with just 2.4% of the world's landmass, harbours nearly 8% of global biodiversity. The country is a critical habitat for numerous flagship and endangered species such as the Bengal tiger, Indian elephant, Asiatic lion, and the Great

Indian bustard. However, these biological treasures are increasingly threatened by development projects that either circumvent or manipulate the EIA process. A performance audit conducted by the Comptroller and Auditor General (CAG) revealed that nearly 95% of projects submitted for environmental clearance between 2011 and 2015 received approval, frequently without thorough evaluations or independent reviews, thereby highlighting the pro-development bias within the clearance mechanism (Comptroller and Auditor General of India, 2016).

One of the most visible consequences of flawed EIA implementation is habitat fragmentation caused by linear infrastructure such as roads, railways, and transmission lines. These developments intersect natural habitats and wildlife corridors, leading to increased wildlife mortality and disruption of movement patterns. The case of Rajaji Tiger Reserve in Uttarakhand exemplifies this issue, where a railway line traversing the reserve has resulted in numerous elephant deaths due to collisions, underscoring the failure of EIAs to incorporate mitigation structures like overpasses or underpasses in sensitive zones (Hindustan Times, 2020). Another major concern lies in the manipulation or misrepresentation of baseline environmental data in EIA reports. In many cases, environmental consultants, often hired by project proponents, conduct superficial assessments that omit or undervalue the ecological significance of an area. For instance, the EIA report prepared in 2020 for coal mining activities in the Dehing Patkai rainforest of Assam significantly downplayed the ecological value of the area, despite its status as a critical habitat for species like the hoolock gibbon and clouded leopard. Only after strong opposition from civil society and environmental activists was the project reconsidered, highlighting the inherent dangers of poor-quality assessments (Environmental Justice Atlas, n.d.).

The weakening of regulatory provisions within the EIA framework has also compounded threats to biodiversity. Notably, the draft EIA Notification of 2020 proposed legalizing post-facto clearances and diluting public consultation requirements. These changes would effectively permit projects to proceed without adequate environmental scrutiny or stakeholder engagement, potentially leading to unchecked degradation of ecologically sensitive areas. Critics argue that these proposed amendments violate the precautionary principle and public

trust doctrine, both of which are integral to Indian environmental jurisprudence (Down to Earth, 2020). Cumulative environmental impact assessments are another vital yet often ignored aspect of the EIA process. While individual projects may appear sustainable when evaluated in isolation, their combined ecological impact can be profound. This issue is particularly evident in the Western Ghats, a global biodiversity hotspot and a UNESCO World Heritage Site. The proliferation of hydroelectric, mining, and construction projects in the region has significantly reduced forest cover and impeded species migration. The Western Ghats Ecology Expert Panel, led by Prof. Madhav Gadgil, emphasized in its 2011 report the necessity of cumulative assessments and recommended stringent regulatory controls. However, resistance from political stakeholders led to the rejection of the panel's recommendations, thereby side-lining scientific guidance in favour of development agendas (Western Ghats Ecology Expert Panel, 2011). The absence of transparency and genuine public participation further erodes the integrity of the EIA process. Public hearings are frequently conducted in a perfunctory fashion, often with limited community awareness, short notification periods, and restricted access to assessment documents. In many instances, local opposition is either ignored or actively suppressed, undermining both the democratic ethos and ecological insights that local populations could provide. The exclusion of Indigenous and forest-dwelling communities, who are often the de facto stewards of biodiversity, significantly weakens the EIA process's capacity to safeguard wildlife.

Judicial interventions have occasionally corrected administrative lapses in EIA implementation. The Supreme Court and the National Green Tribunal (NGT) have annulled environmental clearances in cases where procedural irregularities or ecological oversights were evident. A notable example is the 2014 Goa Foundation v. Union of India case, where the Supreme Court quashed several mining leases in Goa that had been renewed without comprehensive environmental assessments. The Court emphasized the necessity for stringent scrutiny to uphold sustainable development principles (SCC Online, 2018). Similarly, the NGT has intervened in numerous cases to halt or reassess projects that threaten ecologically sensitive zones, although such interventions often occur only after substantial ecological damage has occurred.

The poor enforcement of EIA norms also exacerbates human-wildlife conflicts. As development projects increasingly encroach on forested areas and wildlife corridors, displaced animals often venture into human settlements, leading to conflict situations. These encounters result in crop loss, human fatalities, and retaliatory killings of wildlife. Ministry of Environment data reveals that, annually, over 500 human deaths and around 100 elephant deaths occur due to such conflicts, illustrating the failure of the EIA mechanism to anticipate and mitigate these impacts (Google Scholar, n.d.). An effective and scientifically grounded EIA system could prevent such outcomes by ensuring that wildlife corridors and buffer zones remain intact and functional.

Climate change adds another dimension of complexity to this relationship. Infrastructure projects that promote deforestation or contribute to greenhouse gas emissions diminish the resilience of ecosystems and species already under stress from changing climatic conditions. Wetlands, which serve as critical habitats for many bird and amphibian species, are frequently targeted for reclamation and development, often with minimal or faulty environmental assessments. The failure of EIAs to account for long-term climate implications further reduces their efficacy as conservation tools. Strengthening the integration of climate projections and adaptation planning within EIA methodologies is essential for safeguarding wildlife in the future.

India's international obligations also demand urgent reform of its EIA processes. As a signatory to multilateral environmental agreements such as the Convention on Biological Diversity (CBD) and the Convention on the Conservation of Migratory Species (CMS), India has committed to protecting its natural heritage. The National Biodiversity Action Plan (NBAP), which operationalizes the CBD within the Indian context, explicitly emphasizes the need for robust EIAs to prevent biodiversity loss. However, the continued degradation of wildlife habitats, facilitated by compromised assessments and regulatory shortcuts, raises concerns about India's ability to meet its global commitments (CEERA, NLSIU, 2024). The disparity between policy commitments and on-ground implementation reflects the systemic weaknesses that undermine wildlife conservation efforts.

2. MATERIALS

Environmental Impact Assessment (EIA) functions as a key environmental governance instrument in India, used to evaluate the ecological implications of proposed development projects before they are implemented. Established under the Environment (Protection) Act, 1986, the EIA procedure was formally organized through the EIA Notification of 2006 issued by the Ministry of Environment, Forest, and Climate Change (MoEFCC). Its primary goal is to prevent environmental degradation by integrating environmental safeguards into developmental planning. However, although this process seems comprehensive in theory, multiple gaps in enforcement and methodology have undermined its effectiveness, especially in terms of safeguarding bird populations and other wildlife.

The EIA process (Fig. 1) begins with screening, wherein a project is classified based on its size and impact. Projects in Category A (typically large-scale or sensitive) require clearance at the central level, while Category B projects undergo evaluation at the state level. Following this, scoping is conducted, wherein Expert Appraisal Committees (EAC or SEAC) draft Terms of Reference (ToR) that define the extent of environmental study required. Once the ToR is finalized, the project proponent hires consultants to prepare the EIA report, detailing baseline environmental data, predicted impacts, and proposed mitigation measures. This report is then subjected to public consultation, during which affected communities can raise objections or express concerns. Subsequently, an appraisal is carried out by the EAC/SEAC, which reviews the documentation and makes recommendations. Based on this, the regulatory authority grants or denies environmental clearance (Climate Connection, n.d.). However, the actual practice of this procedure reveals serious shortcomings. A prominent concern is the credibility and independence of the EIA reports. Most reports are prepared by consultants paid by the project developers, resulting in potential conflicts of interest. These reports often lack site-specific ecological data and fail to provide accurate assessments, thereby obscuring the actual environmental costs (Barrett et al., 2006). Equally problematic is the public hearing stage, which often turns out to be an empty ritual. Notifications are poorly circulated, local languages are not used, and
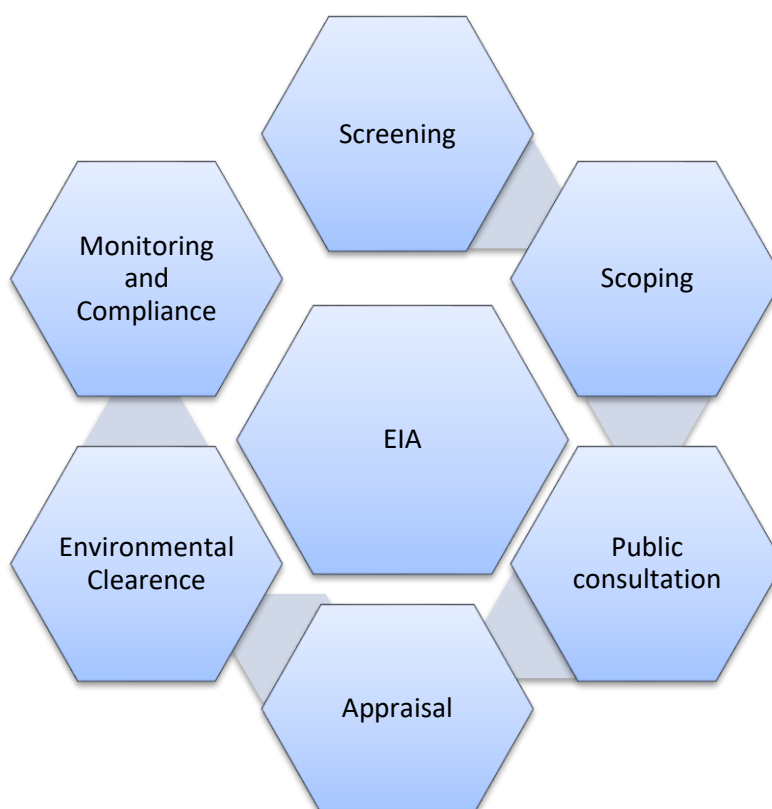
Fig. 1. Functions of environmental impact assessment (EIA)

hearings are scheduled with little community awareness. This marginalizes the voices of Indigenous people and local stakeholders, who may have valuable insights into the local ecology and biodiversity (Centre for Science and Environment, n.d.).

Another major flaw is the failure to assess cumulative impacts. Indian EIA procedures largely evaluate projects in isolation, disregarding the aggregated impact of multiple interventions in a region. For example, successive infrastructure and mining projects in biodiversity-rich zones like the Western Ghats or Aravalli ranges have caused serious habitat degradation, but individual EIAs do not account for these broader effects (Academia.edu, n.d.).

These systemic weaknesses in EIA implementation have had profound effects on India's wildlife, particularly birds. Birds are especially vulnerable to disturbances in their habitat, changes in wetland ecosystems, and collisions with man-made structures. One of the most significant threats comes from wind turbines and overhead power lines. Installed in high-density bird areas such as Gujarat and

Rajasthan, these structures have led to fatal collisions involving the critically endangered Great Indian Bustard (GIB), whose population has declined to less than 200 in the wild. This has occurred despite conservation warnings, mainly because EIA reports failed to consider the species' flight patterns and habitats during planning (The Hindu, 2021).

The loss and pollution of wetlands due to poorly reviewed urban and industrial developments have also led to a decline in migratory and resident waterbird populations. Many EIA reports overlook hydrological changes, resulting in habitat degradation. The Pallikaranai marshland near Chennai is a stark example, where construction, waste dumping, and water diversion have adversely affected species such as egrets, pelicans, and storks (Fischer & Young, 2007). Additionally, infrastructure such as highways and railway lines often dissect forested or ecologically sensitive landscapes. In protected areas like Kaziranga National Park in Assam, numerous wild animals and birds are killed each year while crossing roads and rail tracks. EIAs for these projects frequently fail to recommend or enforce mitigation structures like underpasses or

eco-bridges, highlighting a significant oversight in wildlife protection (Assam Tribune, 2024). Mining and quarrying present further dangers to bird species, particularly cavity-nesting birds such as hornbills and owls. The felling of mature trees and the blasting involved in mining destroy nesting and feeding habitats. Areas like the Eastern Ghats and forested zones of Chhattisgarh have seen notable declines in avian populations due to these practices, yet EIA reports often underrepresent the biodiversity of these regions (Armitage et al., 2012).

Furthermore, while renewable energy projects are generally considered eco-friendly, solar and wind energy installations can disrupt fragile ecosystems when not planned carefully. Solar farms and wind parks are frequently developed on open scrublands and grasslands—habitats that support endangered birds like the Lesser Florican and Indian Courser. These habitats, often undervalued in ecological assessments, are rapidly vanishing, putting these species at risk (Visseren-Hamakers et al., 2012).

The disconnect between India's biodiversity policies and its EIA practices exacerbates the problem. National programs such as the Wildlife Action Plan and State Biodiversity Registers are seldom referenced during EIA preparation. As a result, Important Bird Areas (IBAs) and eco-sensitive zones continue to face encroachments, endangering species that require undisturbed territories to thrive—particularly raptors and large waterbirds (Times of India, 2023).

3. RESULTS & DISCUSSION

India is renowned globally for its rich biodiversity, encompassing nearly 8% of the world's documented species, including more than 90,000 animal species and 45,000 plant species. This biodiversity plays a vital role not only in maintaining ecological balance but also in supporting agriculture, livelihoods, and the traditions of indigenous communities. Despite this, increasing human activities such as deforestation, pollution, infrastructure expansion, habitat fragmentation, and climate change are accelerating species extinction at an alarming rate. Iconic species like the Bengal tiger, Asiatic lion, and Great Indian Bustard face significant threats, while many lesser-known species remain neglected by conservation efforts (Petersson & Stoett, 2022).

Conservation in India goes beyond the boundaries of protected areas such as national parks and wildlife sanctuaries. It involves strategic landscape-level planning, establishing wildlife corridors, involving local communities, and enforcing regulations to prevent disturbances in ecologically sensitive zones. However, to achieve successful conservation outcomes, effective tools are needed to foresee and minimize environmental damage. Among these, Environmental Impact Assessment (EIA) plays a crucial role.

3.1 Environmental Impact Assessment Mechanism in India

The Environmental Impact Assessment (EIA) system in India operates as a legal mandate under the Environment (Protection) Act of 1986. Its primary objective is to evaluate potential environmental impacts before the start of developmental projects and propose mitigation measures. The foundation of this system is the EIA Notification of 2006 issued by the Ministry of Environment, Forest and Climate Change (MoEFCC), which details a multi-step process: screening, scoping, preparation of the EIA report, public consultation, and expert appraisal (Ministry of Environment, Forest and Climate Change, n.d.).

Projects are classified as Category A or Category B depending on their scale and likely environmental effects. Category A projects require clearance from central authorities, while Category B projects are overseen by state-level agencies. The process includes identifying environmental concerns, analyzing alternatives, forecasting impacts, and suggesting mitigation methods. Public consultation is intended to give affected populations a platform to express concerns, though in practice, this participation has often been limited or superficial (Petersson & Stoett, 2022). In spite of its structured framework, the EIA process faces several challenges, including delays, substandard baseline data, lack of independent monitoring, and weak public involvement. These deficiencies frequently lead to the approval of projects that adversely affect biodiversity and critical habitats.

3.2 The Conflict between Industrial Development and Environmental Sustainability

India's quest for rapid industrialization, urban expansion, and infrastructure growth often leads to a clash between development goals and

ecological preservation. While economic progress is vital for poverty reduction and improved living standards, many projects proceed without adequately considering environmental costs. Scientific and industrial progress, though essential, can have unintended negative consequences for the environment. For example, renewable energy developments such as wind and solar farms—despite being environmentally cleaner alternatives—have led to the degradation of grasslands that support unique wildlife but are often overlooked in EIAs. Similarly, transportation infrastructure such as highways and railways, when poorly planned, results in wildlife deaths and habitat fragmentation (Down to Earth, 2024). This conflict manifests in administrative decisions, legislative rollbacks, and legal disputes. The controversial draft EIA Notification of 2020 was criticized widely for diluting environmental safeguards, allowing retroactive clearances, and limiting public scrutiny (Bhat, 2019).

3.3 Relevant Environmental Legislation in India

India has established a comprehensive set of environmental laws aimed at protecting natural resources and conserving biodiversity. Among the most important are:

- **Environment (Protection) Act, 1986** – Grants the central government authority to regulate environmental pollution and enforce conservation.
- **Wildlife (Protection) Act, 1972** – Provides legal protection to endangered species and allows for the creation of protected areas.
- **Forest (Conservation) Act, 1980** – Regulates the diversion of forest land for non-forest purposes, requiring central government approval.
- **Biological Diversity Act, 2002** – Seeks to conserve biodiversity, promote sustainable use, and ensure fair sharing of benefits arising from biological resources.
- **Indian Forest Act, 1927** – Controls Forest management and protection, albeit being a colonial-era statute.

While the legal framework is robust on paper, enforcement often falters due to political pressures, understaffing, overlapping jurisdictions, and competing developmental priorities (The Analysis, n.d.).

3.4 Case Study

1. **Ken-Betwa River Linking Project:** The Ken-Betwa River Linking Project, intended to alleviate water scarcity by transferring water between two river basins in Madhya Pradesh and Uttar Pradesh, was granted environmental clearance (Rethinking the Future, n.d.) despite submerging parts of the Panna Tiger Reserve. The EIA underestimated the ecological impacts and gave precedence to water resource management over biodiversity protection. Conservationists argue that this clearance exemplifies development priorities overshadowing environmental concerns.

2. **Mumbai Coastal Road Project:** This ambitious infrastructure project aimed at easing traffic congestion in Mumbai has faced significant opposition due to its environmental impact. Coastal reclamation has threatened intertidal habitats essential for marine biodiversity and migratory birds, as well as local fishing communities. Although public protests and legal actions ensued, the project continued under conditional clearances. Critics highlight the EIA's failure to capture seasonal ecological variability and the cumulative effects on coastal ecosystems (Land Conflict Watch, n.d.).

3. **Dibang Valley Hydropower Project:** The Dibang Multipurpose Hydropower Project (Dialogue Earth, 2024) in Arunachal Pradesh represents one of India's largest hydropower initiatives but poses serious risks to the fragile Himalayan ecosystem and endemic species. Initially, the Forest Advisory Committee (FAC) rejected forest clearance due to biodiversity concerns. However, political, and administrative pressures later led to its approval. The EIA failed to fully analyze long-term ecological impacts, including downstream effects on riverine habitats and local communities.

4. **Etalin Hydropower Project:** Also situated in Arunachal Pradesh, the Etalin hydropower project (Press Information Bureau, n.d.) proposed the felling of over 270,000 trees in a biodiversity hotspot, threatening rare species such as the clouded leopard and Mishmi takin. Despite expert concerns and recommendations against clearance, the project progressed in the appraisal stages. Intense public and scientific scrutiny eventually forced reassessment, demonstrating the potential

to challenge flawed EIA through sustained activism.

4. CONCLUSION

India's resolute commitment to wildlife conservation, under the astute leadership of Prime Minister Shri Narendra Modi, is evidenced by a series of progressive initiatives that harmoniously integrate traditional conservation values with advanced technological innovations. Through the reinforcement of flagship programs such as Project Tiger and Project Elephant, coupled with targeted conservation efforts for critically endangered species including the gharial and the Great Indian Bustard, the Government has embraced a comprehensive and science-based approach to biodiversity preservation. The application of cutting-edge technologies—such as artificial intelligence, geospatial mapping, and community-driven conservation models—has significantly enhanced the monitoring and protection of wildlife, establishing India as a global exemplar in environmental stewardship.

Central to the success of these conservation endeavours is the critical function of Environmental Impact Assessment (EIA) as a regulatory tool that ensures developmental activities proceed without compromising ecological integrity or the survival of endangered species. EIAs systematically evaluate potential environmental consequences before project implementation, thereby enabling the integration of mitigation strategies that protect vital habitats and maintain ecosystem balance. The infusion of technological advancements within the EIA framework facilitates precise impact assessments and real-time environmental monitoring, thereby enhancing the efficacy and responsiveness of conservation interventions.

Moreover, India's strengthened legal frameworks and active engagement with international conservation bodies reflect a steadfast dedication to achieving sustainable development that harmonizes economic growth with ecological preservation. The interplay between rigorous EIA processes and species conservation fosters a balanced paradigm wherein development objectives are aligned with environmental sustainability, thereby safeguarding natural heritage for future generations.

To further consolidate this integration and advance sustainable development goals, the following measures are imperative:

1. **Augmentation of Public Participation:** Institutionalizing comprehensive stakeholder engagement in the EIA process ensures incorporation of indigenous knowledge and local conservation priorities, promoting transparency and inclusiveness.
2. **Implementation of Adaptive Management:** Embedding dynamic monitoring and feedback mechanisms within EIA protocols allows for continuous evaluation and refinement of mitigation measures, thereby enhancing the resilience of conservation efforts.
3. **Capacity Enhancement and Training:** Strengthening the expertise of EIA professionals, regulatory authorities, and community representatives through targeted training programs ensures the rigorous assessment and effective management of environmental impacts.
4. **Reinforcement of Legal Compliance:** Ensuring stringent enforcement of EIA recommendations through independent oversight and robust legal frameworks is essential to prevent environmental degradation and uphold conservation mandates.

By embedding these principles within the EIA system, India can effectively reconcile developmental imperatives with biodiversity conservation. As the nation observes World Wildlife Day 2025, this integrated approach underscores its enduring commitment to ecological restoration, fostering coexistence between human progress and wildlife preservation, and securing a sustainable and resilient environment for posterity.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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