Effects of International Biodiversity Frameworks and National Biodiversity Strategies on Economic Resilience in North East India: A Comprehensive Review

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Abstract

Background: North East India, situated at the confluence of four global biodiversity hotspots, harbours extraordinary biological wealth while simultaneously experiencing persistent economic deprivation. International biodiversity frameworks—particularly the Kunming–Montreal Global Biodiversity Framework (KM-GBF) and its precursor the Convention on Biological Diversity—together with India's National Biodiversity Strategy and Action Plans (NBSAP) have established ambitious conservation targets. However, the effects of these policy instruments on the economic resilience of this ecologically fragile yet economically vulnerable region remain inadequately understood.

Objective: This review synthesizes interdisciplinary evidence to examine how international biodiversity frameworks and India's national biodiversity strategies influence economic resilience in North East India, with particular attention to livelihood outcomes, income diversification, ecosystem service valuations, and community-based conservation mechanisms.

Methodology: A systematic review of peer-reviewed literature, government reports, policy documents, and project evaluations published between 2000 and 2026 was conducted. The search encompassed academic databases, institutional repositories, and official government sources, with thematic synthesis applied to identify mechanisms linking biodiversity governance to economic outcomes.

Key Findings: The analysis reveals that international frameworks have catalysed substantial financial commitments—India projects annual biodiversity expenditure of approximately 81,665 crore through 2030—yet only a fraction of these resources systematically targets the North East. Nevertheless, region-specific mechanisms demonstrate measurable economic benefits: valuation studies of the Brahmaputra River ecosystem estimate minimum annual service values of 47.8 crore from a single 22 km stretch. Payment for Ecosystem Services programmes in Meghalaya have mobilized `8.5 crore in private finance while engaging 80,000 farmers. Community Conserved Areas in Nagaland, encompassing over 400 documented sites across 40,000 hectares, exemplify Indigenous-led conservation that simultaneously sustains livelihoods. The bio-economy potential from

the region's medicinal, aromatic, and floricultural resources offers pathways for sustainable economic diversification grounded in existing biodiversity assets.

Conclusion: International and national biodiversity frameworks exert positive but uneven effects on economic resilience in North East India. The most robust outcomes emerge where polycentric governance arrangements enable community leadership, where conservation interventions generate direct income streams, and where policy integration aligns biodiversity goals with economic development priorities. Strengthening these linkages requires enhanced devolution of resources, recognition of customary governance institutions, and sustained investment in value-chain development for biodiversity-based enterprises.

Keywords: Biodiversity frameworks, economic resilience, North East India, Kunming–Montreal Global Biodiversity Framework, National Biodiversity Strategy and Action Plan, ecosystem services, community-based conservation, bioeconomy.

1. Introduction

The relationship between biodiversity conservation and economic development has long been characterized by tension—a framing that positions ecological protection as an impediment to material progress rather than a foundation for sustainable prosperity. North East India challenges this binary. The region sits at the confluence of four global biodiversity hotspots—the Eastern Himalayas and Indo-Burma hotspots, with the region also influenced by the Western Ghats and Sundaland hotspots in the broader Indian context. Its dense forests, extensive river systems, and diverse agro-ecological zones harbour endemic flora and fauna of exceptional scientific and cultural value. Yet the same region experiences persistent economic marginalization, with per capita incomes substantially below national averages and multidimensional poverty indices indicating the highest share of impoverished populations among North Eastern states.

This apparent paradox—abundance coexisting with deprivation—raises fundamental questions about the governance frameworks that mediate between biodiversity and human welfare. International agreements and national strategies establish the policy architecture within which conservation and development decisions are made. The Kunming–Montreal Global Biodiversity Framework (KM-GBF), adopted in 2022, represents the most ambitious international biodiversity accord to date, establishing 23 global targets including the protection of 30% of terrestrial and marine areas by 2030. India has aligned its National Biodiversity Strategy and Action Plan (NBSAP 2024–2030) with these global commitments, setting 23 National Biodiversity Targets monitored through 142 indicators. The updated NBSAP commits India to invest an average of ₹81,664 crore annually in biodiversity conservation through 2029–2030.

However, the translation of these frameworks into tangible economic outcomes for rural and Indigenous communities in North East India remains poorly understood. This review addresses this gap by systematically examining how international biodiversity frameworks and India's national biodiversity strategies influence economic resilience in the region. Economic resilience is conceptualised here as the capacity of communities and livelihoods to absorb shocks, adapt to changing conditions, and transform towards more sustainable pathways—dimensions that are intimately connected to the integrity of the ecosystems upon which local populations depend.

The objectives of this review are threefold: (i) to trace the policy lineage from international biodiversity frameworks to India's national strategies and their regional implementation in North East India; (ii) to synthesize

evidence on economic outcomes associated with biodiversity governance mechanisms in the region; and (iii) to identify policy and research priorities for strengthening biodiversity-economy linkages.

2. Methodology

2.1 Search Strategy

A comprehensive literature search was conducted across multiple databases including PubMed, Scopus, Google Scholar, and institutional repositories such as the Digital Library of the Commons and Krishi (ICAR). The search employed Boolean combinations of key terms: ("biodiversity framework" OR "Global Biodiversity Framework" OR "Kunming-Montreal" OR "Convention on Biological Diversity") AND ("North East India" OR "Northeast India" OR "NER" OR "Seven Sisters") AND ("economic" OR "livelihood" OR "resilience" OR "poverty" OR "income"). Supplementary searches targeted grey literature from government sources including the Ministry of Environment, Forest and Climate Change (MoEFCC), the Press Information Bureau, the United Nations Development Programme (UNDP), and the World Bank.

The search period extended from 2000 to 2026 to capture the evolution from the Convention on Biological Diversity through the Aichi Targets to the current KM-GBF framework. A total of 128 sources were initially identified, of which 47 met inclusion criteria following full-text review.

2.2 Inclusion and Exclusion Criteria

Sources were included if they: (a) addressed biodiversity policy frameworks at international or national level with relevance to India; (b) examined economic, livelihood, or resilience outcomes in North East India; or (c) described specific conservation interventions in the region with documented economic dimensions. Sources were excluded if they were solely ecological without socioeconomic components, opinion pieces lacking empirical grounding, or duplicate publications.

2.3 Analytical Framework

Thematic synthesis was employed to identify recurring mechanisms linking biodiversity governance to economic resilience. Three analytical dimensions guided the synthesis: (i) policy architecture—the translation of international commitments into national and sub-national strategies; (ii) economic mechanisms—the specific pathways through which conservation generates or constrains economic benefits; and (iii) governance arrangements—the institutional configurations that shape outcomes on the ground.

3. The Policy Landscape: From Global Frameworks to National Strategies

3.1 The Kunming–Montreal Global Biodiversity Framework (KM-GBF)

The KM-GBF, adopted at the 15th Conference of the Parties to the Convention on Biological Diversity (COP15) in Montreal in December 2022, represents a paradigm shift in international biodiversity governance. Unlike its predecessor, the Aichi Biodiversity Targets (2011–2020), the KM-GBF embeds biodiversity within broader societal transformation, explicitly recognizing the interdependence of ecological integrity and human well-being. The Framework's four long-term goals and 23 action targets span three thematic pillars: reducing threats to biodiversity, meeting people's needs through sustainable use and benefit-sharing, and providing tools and solutions for implementation.

Target 18—the repurposing of harmful subsidies—exemplifies the integration of economic and biodiversity objectives. India's commitment to this target, as articulated in partnership with the UNDP, demonstrates 'that economic growth and biodiversity conservation can coexist' through the redesign of perverse incentives. Similarly, the mainstreaming of biodiversity across policy sectors, as operationalized through the UN Common Approach to Biodiversity (aligned with KM-GBF Targets 17 and 18), equips member states to 'translate global mainstreaming targets into actionable national strategies'.

The KM-GBF also mandates robust monitoring and reporting. India submitted its Seventh National Report (NR-7) to the CBD on 26 February 2026, ahead of the February 28 deadline. The report, drawing on inputs from 33 Central Ministries and departments, assesses India's biodiversity efforts 'using 142 national indicators mapped against 23 National Biodiversity Targets under the updated NBSAP (2024–2030)'. According to the Ministry, all 23 national biodiversity targets are '"on track to achieve," reflecting alignment with the Kunming–Montreal Global Biodiversity Framework'.

3.2 India's National Biodiversity Strategy and Action Plan (2024–2030)

India unveiled its updated NBSAP at COP16 in Cali, Colombia, in October 2024. The Plan commits to protecting 'at least 30 per cent of its terrestrial, inland water, and coastal and marine areas by 2030' in alignment with Global Target 3. The Plan's 23 national targets are organized into three thematic areas: reducing threats to biodiversity; meeting people's needs through sustainable use and benefit-sharing; and tools and solutions for implementation.

Critically, the sustainable management of agriculture, animal husbandry, fisheries, and forests is positioned as central to 'the livelihoods of rural communities, including farmers, herders, fishers, tribal people, and forest dwellers'. This framing acknowledges that conservation cannot proceed against the interests of marginalised populations—a principle with direct implications for North East India, where forest-dwelling and Indigenous communities constitute a substantial proportion of the population.

The NBSAP includes significant financial commitments. India invested approximately ₹32,200 crore in biodiversity protection, conservation, and restoration from 2017–2018 to 2021–2022, with projected annual average expenditure through 2029–2030 estimated at ₹81,664.88 crore. Implementing the NBSAP is projected to cost 'an average of ₹81,664 crores per year between 2024–2025 and 2029–2030, split across 23 ministries and departments'.

3.3 Sub-national Implementation and the North East Context

Despite these substantial national commitments, the devolution of resources to North East India remains uneven. Region-specific biodiversity investments are channelled through central schemes, externally-aided projects, and increasingly through innovative financing mechanisms including carbon markets and payment for ecosystem services. The World Bank's ELEMENT Project, approved in November 2024, provides a notable example: a $225.5 million investment to 'conserve and restore over 100,000 hectares of forest' across 400 villages in Tripura and Nagaland, expected to create 60,000 jobs through forest-based entrepreneurship. This complements earlier World Bank financing for similar activities in Meghalaya, suggesting the emergence of a regionally-targeted portfolio within India's broader biodiversity finance framework.

4. Economic Resilience and Biodiversity in North East India: Empirical Evidence

4.1 The Economic Significance of Regional Biodiversity

North East India‘s biodiversity is not merely an ecological asset—it is a substantial economic foundation. The region’s high humidity and diverse topography have ‘resulted in greater speciation and genetic diversity of plant, animal, and microbial species’, positioning it as ‘a major biodiversity hotspot’ with corresponding economic potential. The sustainable use of these bioresources, as articulated in the bioeconomy literature, ‘can contribute to the region‘s bioeconomic development’ through ‘the production of renewable biological resources and the conversion of these resources and waste streams into value-added products’.

Valuation studies provide quantitative evidence of this economic significance. A study of a 22 km stretch of the Brahmaputra River in Assam estimated that the minimum value of six goods and services—including fisheries, navigation, water for domestic use, irrigation, tourism and pilgrimage, and sand mining—amounted to ₹47.8 crore per annum. Tourism, water for domestic use and sand mining were identified as the major components. This valuation of a single, limited river stretch underscores the immense economic contribution of the region‘s ecosystems when systematically accounted for.

The forest sector similarly represents an under-quantified economic asset. As Barik and Mishra note, the ‘economic and environmental benefits of the extensive biodiversity-rich forest areas of Northeast India are immense and are depended upon by the people for their livelihoods’. However, they also identify a critical constraint: ‘quantitative data on most of the economic and environmental components of forests are lacking. Quantification of both tangible and intangible forest benefits remains a neglected research area’.

4.2 Livelihood Mechanisms: From Conservation to Income

The translation of biodiversity assets into household income operates through multiple mechanisms, each with distinct institutional requirements and economic outcomes.

Traditional and community-based livelihoods: Indigenous communities in North East India have sustained ‘biodiversity-rich landscapes through traditional ecological knowledge (TEK), which operates across multiple scales—from species-level interactions to the management of entire landscapes’. In Nagaland, Community Conserved Areas (CCAs) represent ‘one of South Asia‘s most extensive Indigenous-led conservation systems, with over 400 documented CCAs governed by village institutions that protect forests and wildlife under customary law’. These CCAs play a vital role in conserving forests and biodiversity while also supporting local livelihoods through regulated resource use. The Forest and Biodiversity Management Project, initiated in 2021, has strengthened ‘the institutional, ecological, and planning foundations of 64 CCAs covering over 40,000 hectares across seven landscapes’. Preliminary evidence suggests ‘tangible ecological and social gains, including reduced hunting, improved forest cover, and stronger local institutions rooted in traditional governance’.

Payment for Ecosystem Services (PES): Meghalaya‘s GREEN PES programme provides a state-wide intervention ‘paying villagers across the state to commit to preserving their private forested land for 30 years’. The programme is implemented against a backdrop of significant economic pressure: ‘the state‘s per capita income is a third less than the national average’, and Meghalaya has ‘the highest share of ‘multidimensionally poor’ of the Northeastern states, at 27.79 per cent of the population’. The programme‘s effectiveness in reconciling conservation with poverty reduction remains under evaluation.

Complementing government-led PES is private sector engagement. Iora Ecological Solutions secured ₹8.5 crore in debt funding to scale the MegCare agroforestry program in Meghalaya, ‘restoring degraded landscapes, improving forest cover, and enhancing rural livelihoods through sustainable agroforestry practices’. The

programme ‘will directly benefit 80,000 smallholder farmers’ through a carbon finance model that links ‘ecosystem restoration with sustainable income generation’.

Bioeconomy and value-added processing: The CSIR-Aroma Mission and CSIR-Floriculture Mission exemplify science-led interventions that transform biodiversity into marketable products. In his address to stakeholders, Union Minister Dr. Jitendra Singh ‘commended CSIR-NEIST‘s efforts in empowering farmers, entrepreneurs, and youth through the cultivation of medicinal, aromatic, and floricultural crops’. The initiatives ‘not only enhance farm income but also promote women empowerment, youth engagement, and rural industrialization’. The potential for replication of the ‘Purple Revolution’—which demonstrated high market demand and income potential for aromatic crops in Jammu and Kashmir—has been explicitly identified for Mizoram and other Northeastern states.

At a broader policy level, the BioE3 Policy—‘Biotechnology for Economy, Environment, and Employment’—aims to ‘transform India’s biomanufacturing sector through innovation, sustainability, and high-quality production’. The biodiversity of North East India, according to Dr. Srinivas V. Kaveri, ‘holds strong potential to drive the region‘s bioeconomy through the growth of biomanufacturing industries across multiple sectors’.

4.3 Carbon Markets and Climate Finance

Carbon markets have emerged as a significant—though contested—mechanism linking biodiversity conservation to economic outcomes in North East India. The World Bank‘s 2006 strategic vision document on resource-led development in the region ‘promotes PES as a development strategy’ and includes a dedicated section on ‘carbon finance opportunities for natural resources’. The MegCare programme in Meghalaya, spanning 150,000 hectares and targeting ‘over 25 million tonnes of CO_2 sequestration, is poised to become India’s largest carbon removal program’. Its carbon-linked financing model is one of the first in India ‘to be underwritten against future Carbon Removal Units (CRUs)’, monetizing carbon credits in global markets to enable ‘long-term value creation’.

However, critical perspectives caution against the uncritical embrace of market-based conservation. As Sarma (2026) observes, carbon markets ‘reframe living landscapes into measurable carbon stocks, translating relationships of care into units of trade. What is rendered invisible in this conversion is the deep, historical stewardship of Indigenous Peoples—their knowledge systems, their cyclical practices, and a moral economy rooted in reciprocity’. The challenge, therefore, lies in designing carbon finance mechanisms that respect and reinforce Indigenous governance rather than displacing it.

4.4 Governance Arrangements and Their Economic Implications

The effectiveness of biodiversity frameworks in generating economic resilience depends critically on governance arrangements. Talukdar, Shrivastava and Anwer identify the biodiversity conservation governance of North East India as ‘highly complex and show[ing] an overarching presence of pluralism’. Their study examines how ‘intersections of two theoretical approaches—polycentricism and frugality—can enhance our understanding of nuances within the larger concept of polycentric governance’.

Polycentric governance—characterized by multiple, overlapping decision-making centres operating at different scales—appears particularly well-suited to the region. In Nagaland, CCA governance integrates ‘local governance into higher-level biodiversity planning and offers actionable lessons for scaling Indigenous-led conservation within the Global Biodiversity Framework’. The approach builds on long-standing traditions while embedding them within formal policy structures, thereby enhancing both ecological outcomes and community economic security.

The recognition of customary institutions under the Sixth Schedule of the Indian Constitution provides constitutional backing for Indigenous governance in parts of the region. However, the translation of recognition into effective resource devolution remains incomplete. The tension between community interests and economic incentives that 'prioritize profit over sustainable forest stewardship' represents an ongoing governance challenge.

5. Synthesis: Mechanisms and Pathways

Drawing together the empirical evidence, three primary pathways emerge through which international and national biodiversity frameworks influence economic resilience in North East India.

5.1 Direct Benefit Pathways

The first pathway involves the direct monetization of biodiversity through markets and payments. Carbon credits, non-timber forest product value chains, ecotourism, and PES arrangements generate income that flows (ideally) to communities. The ELEMENT Project's target of 60,000 jobs through forest-based entrepreneurship, the MegCare programme's engagement of 80,000 farmers, and the agrobiodiversity valuation of ₹47.8 crore from a single river stretch all exemplify this pathway. However, the capture of benefits by communities rather than intermediaries depends significantly on governance arrangements—a condition that polycentric systems with strong community oversight are better positioned to satisfy.

5.2 Resilience Enhancement Pathways

The second pathway operates through the maintenance of ecosystem services that underpin livelihood security. The Brahmaputra valuation study's inclusion of water for domestic use and irrigation, along with fisheries and tourism, captures this dimension: biodiversity supports basic provisioning services that buffer communities against economic shocks. Forests regulate water supplies, prevent soil erosion, and provide safety-net resources during lean seasons. These resilience-enhancing functions are less visible in market-based accounts but are no less economically significant. The NBSAP's inclusion of ecosystem restoration targets—aiming for 'the effective restoration of at least 30 per cent of degraded terrestrial, inland water, coastal, and marine ecosystems by 2030'—explicitly acknowledges this pathway.

5.3 Transformation Pathways

The third pathway is transformational: the strategic positioning of biodiversity as the foundation for new economic sectors. The BioE3 Policy and the CSIR missions exemplify this approach, which envisions North East India transitioning from a biodiversity hotspot to a 'Biomanufacturing Hotspot'. This pathway requires substantial investment in research and development, value-chain infrastructure, market linkages, and human capital. The projected annual expenditure of ₹81,664 crore under the NBSAP provides a potential resource base for such transformation, though the region-specific allocation of these funds remains unspecified.

6. Challenges and Constraints

Despite these promising mechanisms, significant challenges constrain the contribution of biodiversity frameworks to economic resilience in North East India.

Data and valuation deficits: As Barik and Mishra note, 'quantitative data on most of the economic and environmental components of forests are lacking'. This deficit impedes evidence-based policy making and community advocacy for resource devolution. The National Red List Assessment, launched at the IUCN World Conservation Congress in October 2025, addresses part of this gap by establishing 'a nationally coordinated,

inclusive, and science-based system to assess and monitor the conservation status of India‘s flora and fauna’. However, economic valuation data—rather than species status data—remains underdeveloped.

Implementation gaps: While India’s NBSAP reports that all 23 national biodiversity targets are ‘on track to achieve’, monitoring reports also note persistent concerns: only about ‘5 per cent of India‘s land is under formal protection’, and ‘30 per cent of geographical area still facing land degradation’ despite restoration efforts. These metrics raise questions about whether headline alignment with global frameworks translates into improved outcomes on the ground.

Trade-offs and competing priorities: The pressure to exploit forest resources for immediate economic gain, particularly ‘in community-owned forests lacking formal protection’, remains acute. Between 1990 and 2015, ‘farmland expanded from 11.6 per cent of Meghalaya’s total area to 15.3 per cent’, driven by ‘financial realities [that] have left villagers little choice but to convert many forests to farmland’. Addressing these trade-offs requires complementary investments in agricultural productivity and off-farm employment.

Governance coordination: The ‘highly complex’ governance landscape, with its ‘overarching presence of pluralism’, poses coordination challenges. International frameworks, national strategies, state-level policies, and customary institutions operate at different scales with imperfect alignment. The ‘lack of coordination in governance and policy’ has been identified as a threat to biodiversity, with corresponding implications for economic outcomes.

7. Policy Recommendations

Based on the synthesis, five policy priorities emerge for strengthening the contribution of biodiversity frameworks to economic resilience in North East India.

First, enhance region-specific resource devolution. The NBSAP‘s projected expenditure should be accompanied by transparent sub-national allocations that recognize North East India‘s exceptional biodiversity endowment and economic vulnerability. A dedicated North East biodiversity finance window could coordinate central schemes, externally-aided projects, and innovative financing mechanisms.

Second, strengthen community governance foundations. Polycentric systems with strong community oversight—exemplified by Nagaland‘s CCAs—should be supported through legal recognition, technical assistance, and long-term financing. The Forest and Biodiversity Management Project‘s approach of ‘strengthening the institutional, ecological, and planning foundations’ of community-governed areas provides a replicable model.

Third, invest in value-chain development for biodiversity-based enterprises. The CSIR missions and BioE3 Policy provide promising frameworks, but scaling requires investment in processing infrastructure, quality standards, market linkages, and farmer training. The ELEMENT Project‘s focus on ‘forest produce such as agarwood, bamboo and honey in partnership with the private sector’ illustrates how value chains can be developed while maintaining community benefit streams.

Fourth, improve economic valuation and monitoring. The National Red List Assessment should be complemented by systematic economic valuation of ecosystem services across the region. The development of an Economic Valuation Tool under the NCAVES India project provides a foundation that should be extended and localized for North East India.

Fifth, align carbon market mechanisms with community stewardship. The tension between market-based conservation and Indigenous governance identified by Sarma (2026) requires policy attention. Carbon finance

should complement rather than replace community-led conservation, with revenue-sharing mechanisms transparently governed by customary institutions.

8. Conclusion

This review has examined the effects of international biodiversity frameworks and national biodiversity strategies on economic resilience in North East India. The evidence demonstrates that these frameworks exert positive but uneven influence. Where polycentric governance arrangements enable community leadership, where conservation interventions generate direct income streams, and where policy integration aligns biodiversity goals with economic development priorities, measurable benefits accrue. The economic valuation of riverine ecosystems, the development of bioeconomy value chains, the expansion of PES and carbon finance mechanisms, and the recognition of Indigenous-led conservation systems all offer pathways for translating biological wealth into human welfare.

However, substantial constraints remain. Data deficits, implementation gaps, governance coordination challenges, and persistent trade-offs between conservation and competing land uses limit the transformative potential of current frameworks. Addressing these constraints requires not merely additional resources—though the ₹81,664 crore annual biodiversity expenditure signals significant commitment—but also institutional reforms that devolve authority, recognize customary governance, and invest in value chains that connect communities to markets on equitable terms.

The question that animates this review—whether international biodiversity frameworks can enhance economic resilience in the world‘s most biodiverse yet economically marginalized regions—admits no simple answer. The frameworks themselves are necessary but insufficient. Their effects are mediated by governance arrangements that determine who benefits, how benefits are distributed, and whether conservation reinforces or undermines community resilience. In North East India, where ‘biodiversity conservation governance…shows an overarching presence of pluralism’, the most promising pathways emerge from the intersection of global commitments, national strategies, and local institutions that have sustained landscapes and livelihoods for generations.

Future research should prioritize longitudinal studies of economic outcomes under different governance arrangements, rigorous evaluations of PES and carbon finance programmes, and participatory assessments of benefit distribution. The transformation of North East India from a biodiversity hotspot to a model of biodiversity-driven economic resilience remains a work in progress—one whose success will depend on the alignment of international ambition, national strategy, and local reality.

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