

A Comparative Study Between North Bengal and South Bengal: A Comparison of Natural and Ecological Resources in West Bengal, India

Mr. Jimmy Camdir Tok¹, Dr. Ram Krishna Mandal^{2*} 

¹Assistant Professor, Department of History, Dera Natung Government College, Itanagar, Arunachal Pradesh, India.

²Professor & HoD, Department of Economics, Cooch Behar Panchanan Barma University, Cooch Behar, West Bengal, India

*Corresponding Author

Dr. Ram Krishna Mandal

Professor & HoD, Department of Economics, Cooch Behar Panchanan Barma University, Cooch Behar, West Bengal, India

Article History

Received: 13.10.2025

Accepted: 28.11.2025

Published: 07.12.2025

Abstract: *Introduction:* The northern part of West Bengal called North Bengal lies at the foothills of the Eastern Himalayas and is comprised of mountainous terrain, Terai and Dooars (sub-Himalayan regions), rivers in alluvial plains, and other forested areas. Because of their distinctive physical characteristics, these areas are very rich in both terrestrial and freshwater biodiversity, while the highly produced Ganges-Brahmaputra delta in South Bengal has been transformed through tidal actions into the largest contiguous mangrove forest in the world, known as the Sundarbans. *Objective:* To identify the natural and ecological resources of North Bengal with its ecological significance and to assess significant ecological gaps between North Bengal and South Bengal. *Method and Materials:* This descriptive and analytical study describes the regionally Ecological Comparison of West Bengal. The comparative regional analysis framework for a systematic evaluation of North and South Bengal has been developed to contrast their respective natural and Ecological Resources. *Results and Discussion:* The North Bengal region is distinguished from the Eastern Himalayas by a combination of geographical characteristics and its unique forest and wildlife resources with the South Bengal. *Conclusion:* By comparing the Unique Endowments of North Bengal against those of South Bengal this has helped to illustrate the overall intrastate Ecological Diversity as well as support the argument for Differentiated Environmental Governance, which would allow for a more Creative Approach to the Management of West Bengal's Environment. **Keywords:** Terai, Dooars, Ganges-Brahmaputra delta, Sundarbans, Eastern Himalayas, Ecology.

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INTRODUCTION

The profoundly diverse bio-geographical setting of West Bengal has resulted in the extremely diverse ecological resources between the northern and southern regions of West Bengal, as the two have different histories of physiographic, climatic condition and hydrologic regimes. The northern part

of West Bengal, called North Bengal lies at the foothills of the Eastern Himalayas and is comprised of mountainous terrain, Terai and Dooars (sub-Himalayan regions), rivers in alluvial plains, and other forested areas. Because of their distinctive physical characteristics, these areas are very rich in both terrestrial and freshwater biodiversity. Some

Citation: Jimmy Camdir Tok & Ram Krishna Mandal (2025). A Comparative Study Between North Bengal and South Bengal: A Comparison of Natural and Ecological Resources in West Bengal, India; *Glob Acad J Econ Buss*, 7(6), 180-187.

examples of the biodiversity of North Bengal are: Subtropical moist deciduous forests, Grasslands, and rivers and wetlands which provide habitat for many different species and types of plants and animals including endemic and endangered species such as the Greater One-Horned Rhinoceros (*Rhinoceros Unicornis*), the Asian Elephant (*Elephas Maximus*), and the Bengal Tiger (*Panthera Tigris Tigris*) (Das, 2024; Gropedia, n.d.; Wilbengal, 2025). Some of the areas in Northern West Bengal which provide ecological importance are the floodplains of the Dooars and Terai regions, where there is a complex series of rivers and streams and fertile alluvium soil, and where many endemic taxonomic groups exist, which are specialised for unique wetlands and forests (Sen and Mandal, 2018; Dooars, n.d.). The prominent tea gardens of Northern West Bengal, especially in the areas of the Dooars and Jalpaiguri, exemplify anthropogenically sustained ecosystems with their unique economic and ecological dynamics and diverse understory vegetation and Pteridophytes (ResearchGate, 2014).

In comparison, the highly produced Ganges-Brahmaputra delta in southern part of West Bengal (which is called South Bengal) has been transformed through tidal actions into the largest contiguous mangrove forest in the world, known as the Sundarbans. A UNESCO World Heritage Site, this delta environment has resulted in halophytic vegetation with distinct adaptations such as pneumatophores and vivipary. Collectively, these ecosystems comprise an estuarine ecosystem that provides vital ecological services, including coastal protection, carbon sequestration, and nutrient cycling (Ghosh and Mondal 2025, Nature.com 2025, WB Gov 2025). The mangrove biodiversity found within the Sundarbans provides critical habitat area for dominant species like the Royal Bengal tiger (*Panthera tigris tigris*), which exists in an estuarine habitat, unlike the montane and terrestrial fauna of the northern forests (Sundarbans n.d. and WB Gov 2025). The geomorphic processes shaping South Bengal's deltaic wetlands (i.e. sedimentary deposition resulting from major river systems combined with tidal hydrodynamic influence) differ entirely from North Bengal's geomorphic processes that shape northern Tennessee's rivers through orographic rain versus riverine properties from orographic precipitation and runoff (Ghosh et al. 2016; WB Gov 2025). Consequently, while both regions provide significant contributions to West Bengal's total ecological richness, their natural resources differ ecologically, with mountain-derived, riverine, and terrestrial ecosystems derived from North Bengal and tidal, coastal, and mangrove ecosystems derived from South Bengal. Therefore, it is critical to implement region-specific conservation

and sustainable management efforts in each region to ensure the continuity of these invaluable resources.

OBJECTIVES: The aims of this research:

1. To identify the natural and ecological resources of North Bengal, those are unique to North Bengal and their ecological significance of Himalayan river systems and tea plantation landscapes.
2. To assess significant ecological gaps between North Bengal and South Bengal.

METHOD AND MATERIALS

Methodology for the Study:

This descriptive and analytical study describes the regionally Ecological Comparison of West Bengal.

Research Model:

The comparative regional analysis framework for a systematic evaluation of North and South Bengal has been developed to contrast their respective natural and Ecological Resources.

Data Collection:

Secondary Data is used for this study, and is based on published Books; peer-reviewed Research articles; various Governmental Reports; Environmental Assessment Reports; Census-related publications and authenticated databases available on the World Wide Web such as Journals, Government Portal Websites and Institutional Reports.

Physiographical and Ecological Analysis:

Physiographical features such as Terrain; Rivers Systems, Forest Types; Biodiversity Zones; Climate Characteristics etc., have been analysed using current Publications and Literature in Geography and Ecology.

Themes of Data:

The data has been organized by Themes, namely the Themes of the Physiographical; River Systems; Forests/Biodiversity; Wildlife Habitat; Agricultural/Plantation Resources and Ecosystem Service Themes in order to allow a deeper analysis of the Themes.

Comparative Analysis:

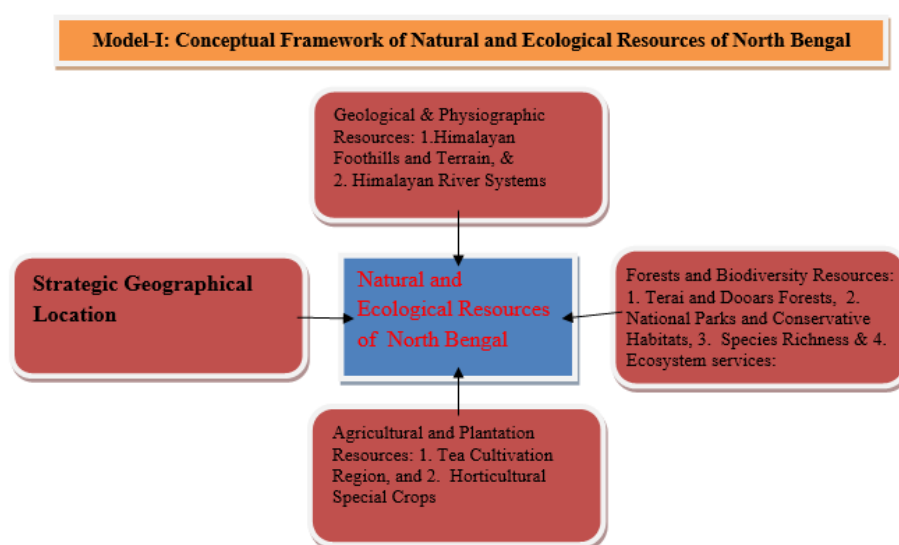
A Region-wise Comparison was performed to assist in identifying Ecological Uniqueness, Resource Concentration and Functional Differences between North and South Bengal.

Interpretive Analysis:

An Interpretive Analysis of the Data has been performed qualitatively; the Interpretative Analysis has been conducted based on Documented Evidence as well as Scholarly interpretations of Ecological

patterns; Ecosystem Services; Conservation Challenges.

RESULTS AND DISCUSSION



Explanation of Model-I:

The Model-I presents conceptual framework that the North Bengal region is distinguished from the Eastern Himalayas by a combination of geographical characteristics and its unique forest and wildlife resources. The extensive moist deciduous, semi-evergreen and subtropical broadleaf forests found in this area provide an environment rich in Floral and faunal diversity; they also provide habitat for such iconic flagship species as the Asian elephant, one-horned rhinoceros, Bengal tiger and red panda. The Buxa Tiger Reserve, Jaldapara National Park and Neora Valley National Park are some of the many component's forming an extensive transboundary biodiversity corridor that connects India, Bhutan and Nepal, thereby maintaining genetic connectivity and facilitating the migration of species along an east-west axis. The rivers of the Himalayas (Teesta, Torsa, Jaldhaka and Sankosh) originate in the higher elevations of the Himalayas and supply constantly flowing rivers that sustain rich riparian ecosystems as well as unique alluvial grasslands found only in North Bengal. These rivers also provide critical support for groundwater recharge, nutrient cycling, and floodplain fertility, which sustains both wildlife habitats and local livelihoods. The floodplain forests and grasslands of North Bengal are some of the last remaining stands of tall grass ecosystems in eastern India, providing vital grazing areas and habitat for wetland-dependent species. Although tea plantation landscapes are a product of human activity, many tea plantations have functioned as semi-natural ecosystems that provide important buffering zones and movement corridors for wildlife between protected forest areas. The resulting mosaic of tea

plantations, neighbouring riverine belts, and patches of forests enhances biological diversity on a landscape scale and supports birds, pollinators and small mammals. In addition, tea plantations influence their local microclimates and hydrological regimes by assisting with the regulation of the moisture content of soils and decreasing the amount of surface water flowing off the land. North Bengal is a unique ecological region defined by both geological and physiographic resources that all contribute to the region's biodiversity conservation, ecological stability, and sustainable development. Now we discuss elaborately one by one below.

I. Geological & Physiographic Resources Specific to North Bengal

1. The Himalayan Foothills and Terrain:

North Bengal consists of a section of the Darjeeling Himalayan Region and the sub-Himalayan Terai, as well as the Dooars; none of which occur in the physiographic outline of South Bengal. These high elevation areas and foothills provide the districts with unique geological formations, soil types, and climatic conditions, all of which compare to the predominantly alluvial and coastal plains found in South Bengal and basically north of the Ganges River (Sikkimexpress, 2025).

2. Himalayan River Systems:

There are several major rivers of Himalayan origin in North Bengal; they are the Teesta, Torsa, Kaljani, and Jaldhaka. All of the above river systems are perennial; provided by the melting of snow from the Himalayas, and are responsible for the irrigation and deposition of alluvial soils, as well as the

maintenance of unique floodplain ecosystems found within North Bengal. (Wikipedia, Cooch Behar).

II. Forests and Biodiversity Resources

1. Terai and Dooars Forests:

The Terai and Dooars regions in North Bengal have large areas of dense and tropical/subtropical forests with high biodiversity (including elephant corridors, leopards, etc.) (e.g., Chilapata Forests, based on connectivity of Jaldapara and Buxa Tiger Reserve protected areas). Terai & Dooars Forests are not present in South Bengal (Wikipedia: Chilapata Forest & Wikipedia).

2. National Parks and Conservative Habitats:

Gorumara and Singalila National Park- a. Gorumara National Park (Dooars) has a mixed habitat area (grasses & forest), which supports both populations of Indian rhinoceros and several species not found in the landscape of South Bengal (Wikipedia). b. Singalila National Park (Darjeeling) has a high altitude(2300m) forest ecosystem, with rich floristic zones. The top spot for trekking to Sandakphu, this ecosystem does not exist in South Bengal (Wikipedia).

3. Species Richness:

It has been reported that North Bengal's forest areas, especially moist Shorea forests, have greater plant diversity than many of West Bengal's dry forest areas because there are many species from other ecological assemblages that do not exist in South Bengal's predominantly alluvial plain forests (Kushwaha and Nandy, 2012). (Mangroves of the Sundarbans are distinct but separate from this.) (WMM Medical Media, 2012). (@WalshMedical).

4. Ecosystem services:

Studies of North Bengal's biodiversity provide evidence of its major contribution to carbon

sequestration, soil stabilization, and ecosystem services, due to both its high level of forest cover and high species diversity. These factors are in contrast to South Bengal's unique environment of mangroves and deltaic systems (Das, 2021).

III. Agricultural and Plantation Resources

1. Tea Cultivation Region:

North Bengal is home to the internationally recognized Darjeeling tea growing region and the large tea growing areas of Dooars–Terai. North Bengal tea is considered among the best in the world, particularly the Darjeeling tea that has been awarded a Geographical Indication status, while the Dooars–Terai tea regions contribute significantly to tea production in India (Narajoleraj College Agriculture Department, 2021; Dooars-Terai tea regions)

2. Horticultural Special Crops:

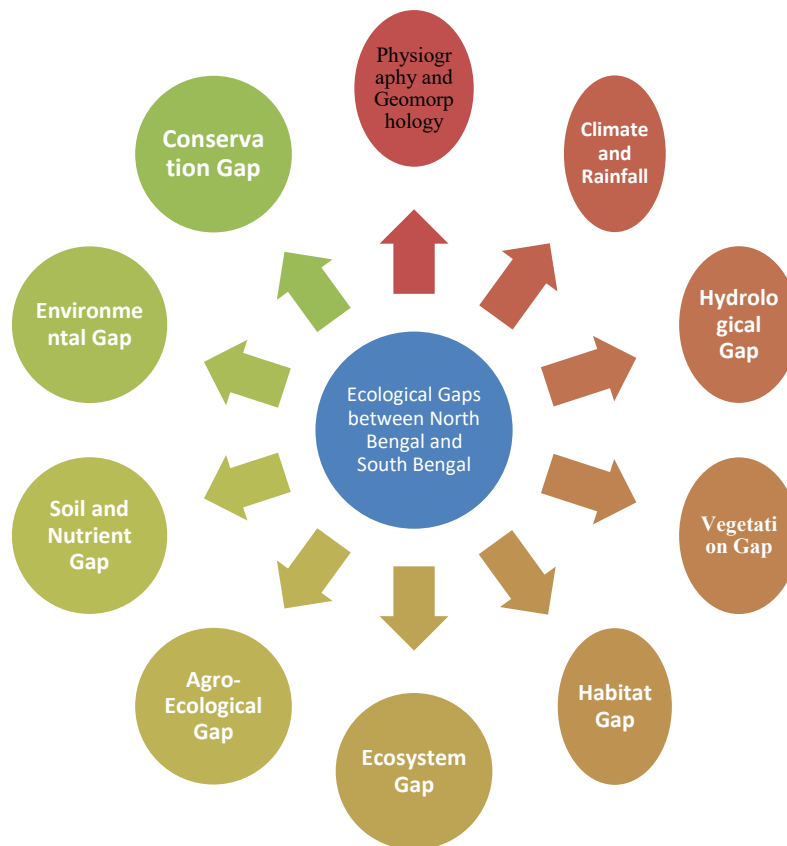
The fertile alluvial plains of North Bengal allow for diverse horticultural production, potentially due to this region's growing pineapple and ginger. Both of these crops are also produced in the Jalpaiguri district, yet due to the soil and hydrographic nature of South Bengal, are much less common and successfully produced in this portion of West Bengal (Jalpaiguri district data).

IV. Strategic Geographical Location

International Border and Chicken Neck Corridor: Unique to North Bengal is its geography, bordering four countries, namely Nepal, Bhutan, Bangladesh, and an only short distance away from Tibet (Chumbi Valley) in China. Notably, it also has the narrow Siliguri Corridor (Chicken Neck) that connects the entire Northeast part of India to India; whereas South Bengal does not have any significant strategic geographical resource such as this (Sikkimexpress, 2025).

Main Ecological Gaps between North Bengal and South Bengal

Model-II: Conceptual Framework for Ecological Gaps between North Bengal and South Bengal



Explanation of Model-II:

The second model (Model- II) is a framework that illustrates ecological gaps between the north and south of West Bengal (WB) in West Bengal based on differences in ecology, physical environment, and human impacts on the environment. This model highlights that the north has a more robust representation of the Himalayan/sub-Himalayan Eco-region as well as an abundance of dense forests, diverse flora and fauna, many major rivers, and a series of wildlife corridors. Conversely, the south is primarily composed of deltaic plains, mangrove ecosystems, saltist coastal environments, and therefore has increased vulnerability to cyclones, sea-level rise, and human activity. The model illustrates how the characteristics of a region such as topography, climate, soil type, and hydrology result in the specific ecological strengths and vulnerabilities of the region. The model also identifies land use, population pressure, and economic activity as contributing factors to the widening ecological divide. Additionally, the model illustrates the links between ecological resources and livelihoods, including forest-based economies in the north and the reliance upon agriculture in the south. The environmental stressors of deforestation, riverbank

erosion, flooding, and climate change are also unevenly distributed between the north and south. In conclusion, this model can be used as a holistic way to understand the spatial distribution of ecological imbalance across WB, and it will also serve as the basis for developing site-specific conservation strategies and sustainable development plans. Now we discuss in detail below.

1. Physiography and Geomorphology: North Bengal's geography has been determined by the Eastern Himalayas, Sub-Himalayan foothills, and Terai-Dooars plains. In terms of topography, this area contains many altitude levels and a variety of different landforms. The way these landforms were created affects how soils form and the types of drainage patterns and ecosystems found within the area. In comparison, South Bengal is almost entirely coastal or delta sedimentary in origin as a result of the deposition of sediments from the Ganges-Brahmaputra River system. South Bengal's seaward position and extensive flatland (Chakraborty, 2016; Roy, 2023) provides a much different physical environment than that of North Bengal creating a major difference in their ecology.

2. Climate and Rainfall Regime: North Bengal's climate is characterized by high amounts of precipitation combined with considerable annual variation due to the effect of the eastern Himalayas. This creates a humid and moist climate, ideal for supporting dense, lush forest and perennial flow rivers. Like North Bengal, South Bengal receives monsoon precipitation. However, the southern region also has coastal climatic effects from cyclonic systems raging through south-east India (Government of West Bengal, 2021; Yadav & Dash, 2023). The divergence in climate between North and South Bengal has resulted in the development of two distinct ecological systems creating a divide between the two regions' ecologies.

3. Hydrological Gap, Distance Between River Systems: River systems in North Bengal, including the Teesta, Torsa, Jaldhaka, Kaljani, originate from the Himalayas or sub-Himalayan drainage basins; these rivers are perennial and continuously flow over fertile floodplains and support freshwater habitats. The hydrology of South Bengal consists mainly of the deltaic systems formed by the Ganga River and the extensive tidal creek systems that have limited periods of freshwater; in most cases, these rivers contain significant amounts of saline due to the intrusion of tidal surges. As a result, there is a clear separation of freshwater systems in North Bengal and the brackish and estuarine systems in the south (Ghosh *et al.*, 2016; Chakraborty, 2016).

4. Vegetation Gap by Type of Forest: In North Bengal, there is a broad diversity of forests including tropical moist deciduous, subtropical, temperate montane, and sal forests. These forests have a wide range of biodiversity and complex structural arrangements (Manoj *et al.*, 2013; Singh *et al.* 2021). In South Bengal, the natural vegetation is primarily represented by the mangrove trees of the Sundarbans. The mangrove trees are generally halophytic, which are acclimatized to saline waterlogged conditions and, as a result, separated from the freshwater forests of North Bengal (Yadav & Dash, 2023).

5. Biodiversity and Wildlife Habitat Gap: Biodiversity reveals an ecological gap in terrestrial forests; as stated by Manoj *et al.* (2013) North Bengal supports terrestrial forests that provide wildlife habitat with species such as elephants, rhinoceroses, gaurs, leopards, and a variety of birds; the source of North Bengal's biodiversity includes forest corridors linking India with Bhutan and Nepal. As described by Ghosh & Mondal (2025), South Bengal is home to biodiversity adapted for estuarine ecosystems. The estuary has specific animals dependent on mangroves; among these species are the following: estuarine crocodiles, mudskippers, and tigers that

are adaptable to both terrestrial and aquatic conditions. These examples indicate there is a significant ecological gap in wildlife species composition and habitat structures between North and South Bengal.

6. Ecosystem Services Gap: Ecosystem services differ greatly between North and South Bengal; North Bengal provides freshwater filtration, soil conservation, slope stabilization, carbon storage within forest systems, and opportunities for ecotourism (Das, 2021), and in contrast, the ecosystem service provided by South Bengal is coastal protection against hurricanes, storing blue carbon, fish nursery habitats, and managing tidal flooding within the mangrove systems (Ghosh & Mondal, 2025; Yadav & Dash, 2023). The differences in ecological service functions between North and South Bengal represent an important ecological service gap.

7. Agro-Ecological Gap: The agricultural systems and associated agro-ecology of North and South Bengal are quite distinct from one another. North Bengal has its own signature agro-ecological systems associated with tea plantations located in Darjeeling and the Dooars, as well as with horticulture growing under humid and well-drained conditions; both types of agricultural production create human-ecological systems that do not exist in South Bengal (C. Chatterjee, 2017; Narajole Raj College of Agriculture; Dept. of Agriculture, 2021). Conversely, South Bengal's primary agricultural products are rice, fish, and brackish aquaculture, and these activities relate to the deltas and coastal systems of South Bengal (Roy, 2023).

8. Soil and Nutrient Regime Gap: There is a significant gap in soil and nutrient regimes between the two regions. The soils in North Bengal differ from forested loams and hilly soils to highly fertile alluvial soils created by Himalayan Rivers, which all support various uses of the land, whereas, most of South Bengal, particularly the Coastal and Sundarbans areas, comprises primarily deltaic, clay, and salinity-adverse soils; therefore, the types of agriculture grown and types of vegetation present differ significantly (Chakraborty, 2016; Government of West Bengal, 2021). The disparity in soils between the two regions has also caused a level of ecological differentiation.

9. Environmental Vulnerability and Stress Gap: Environmental vulnerability and stress are also a major gap between the two regions. North Bengal's forests are subject to deforestation and further ecological problems such as landslides, riverbank erosion, and the increasing incidence of human/wildlife conflict due to the fragmentation of

forested areas and the growing human population living in those areas (Manoj *et al.*, 2013). On the other hand, South Bengal has a higher vulnerability to sea-level rises, cyclones, salinity intrusion, and degradation of mangroves caused by climate-related impacts than does the upland North Bengal ecosystem, where the majority of these environmental pressures do not exist (Koley *et al.*, 2025; Yadav & Dash, 2023).

10. Conservation and Management Gap:

Finally, differences between the two regions in conservation and management are evident. Conservation efforts in North Bengal focus on protecting terrestrial wildlife, maintaining forest corridors, and preserving biodiversity in protected areas, whereas the focus of conservation in South Bengal is on restoring mangrove habitats, managing large-scale natural disasters, enhancing the coastal ecosystem, and improving the sustainability of fishing communities (Government of West Bengal, 2021; Ghosh & Mondal, 2025). These two regions represent two different ecological systems with different regional approaches, respectively.

LIMITATIONS

1. There is no direct in-field data collection related to ecological conditions; therefore, all information utilized in this analysis has been derived solely from prior published articles.
2. Since the amount and type of secondary data available and how accurate it is does differ greatly by region, this makes it difficult to provide a consistent comparison between all of the regional studies included in the research.
3. Due to a lack of data, quantifying the values associated with both ecosystem services and biodiversity are not possible in this study.
4. Advanced techniques utilizing either remote sensing or geospatial analysis are not utilized in this study and as such, the potential for improved spatial accuracy of the data used is not realised.
5. Seasonal changes and ecological activities occurring at a micro-scale (district) level within North Bengal have not been identified in any detail.
6. The analysis is primarily limited to a few specific features of the ecosystem, while the analysis does not include all of the many other minor ecosystems and habitats located throughout the region.
7. Policy development efforts and conservation results are presented as "conceptually" based, rather than based on empirical values.

CONCLUSION

The Comparison of Ecological Resources clearly demonstrates that North Bengal has an extremely unique collection of resources not

available or only minimally represented in the south. The geographical formation of Himalayan foothills, the various rivers and many other factors, including the climatic influences across international borders that influence the area, create an unusual ecological "mosaic" in North Bengal, which includes thick forests, wet and dry subtropical to temperate zones of biological diversity, large plains created by river sediment replenishment, and unique wildlife habitat, which has global significance. The eastern Himalayan forests, tea growing regions, high-altitude wetlands, and critical wildlife corridors connecting India, Bhutan, and Nepal emphasize the unique and exceptional ecological value of North Bengal as opposed to South Bengal, which is a deltaic and coastal phenomenon. The separate ecological environments of North and South Bengal require that development programs and policies relate specifically to each individual region rather than collectively across West Bengal.

Therefore, understanding the unique ecological character of North Bengal is important in order to create a sustainable regional plan, conserve Biodiversity, and adapt to Climate Change. Evidence from the assessment indicates that Conservation Frameworks should focus on maintaining a balance between conserving Ecological Resources and providing for the Livelihoods of residents within those areas. In particular, this will apply to Forest Dwelling Communities and those residing within the Tea Plantations. This overview highlights the distinct natural resources that North Bengal possesses compared to other areas, especially South Bengal. By comparing the Unique Endowments of North Bengal against those of South Bengal this has helped to illustrate the overall intrastate Ecological Diversity as well as support the argument for Differentiated Environmental Governance, which would allow for a more Creative Approach to the Management of West Bengal's Environment.

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