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The Effects Of Climate Change On The Manas National Park Ecosystem

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Abstract: A UNESCO World Heritage Site in Assam, India, Manas National Park is well-known for its abundant biodiversity, which includes a number of endangered species like the one-horned rhinoceros, pygmy hog, golden langur, and Bengal tiger. However, the complex effects of climate change are posing a growing threat to this ecologically important region. This study looks at how the park's fragile ecosystem is being impacted by shifting climate patterns, such as rising temperatures, changed rainfall patterns, and an increase in the frequency of extreme weather events. The study examines changes in species behavior and distribution, habitat degradation, flowering and migration patterns, and the spread of invasive species through a combination of field observations, interviews with local communities and forest officials, and analysis of climate data. The study shows that the park's overall ecological balance is being upset in addition to keystone species becoming more vulnerable. Furthermore, the park's wetland ecosystems are further threatened by shifting river flow patterns and sedimentation in the Brahmaputra basin. Socioeconomic resilience and biodiversity conservation are linked because local communities that rely on forest resources for their livelihoods are also experiencing greater hardships. The urgent need for integrated conservation strategies that include community involvement, climate adaptation, and scientific monitoring is emphasized in the study's conclusion. In addition to protecting regional biodiversity, addressing the effects of climate change in Manas is crucial for sustaining ecological services that benefit both local and international populations.

Introduction: Greetings Famous for its rich biodiversity and vital ecological significance, Manas National Park is a designated biosphere reserve and UNESCO World Heritage Site located in the foothills of the Eastern Himalayas in Assam, India. The park's 950 square kilometers are home to a diverse range of plants and animals, including globally endangered species like the Bengal tiger (*Panthera tigris tigris*), pygmy hog (*Porcula salvania*), golden langur (*Trachypithecus geei*), and one-horned rhinoceros (*Rhinoceros unicornis*). Manas National Park, a part of the Brahmaputra River basin, is essential to preserving ecological balance and sustaining local communities' means of subsistence. But the park's delicate ecology faces serious threats from the escalating threat of climate change. In recent decades, the region has witnessed notable climatic shifts, including rising average temperatures, altered monsoon patterns, erratic rainfall, and an increasing frequency of extreme weather events such as floods and droughts. These changes are directly affecting the park's habitats, leading to disruptions in species distribution, reproductive cycles, migration patterns, and vegetation composition. Additionally, changing river dynamics and sedimentation processes in the Brahmaputra basin have intensified the degradation of wetland ecosystems within the park.

The goal of this research paper is to examine the various ways that climate change is affecting Manas National Park's ecosystem. The study aims to draw attention to ecological vulnerabilities and promote adaptive conservation strategies by combining field observations, interviews with park officials and local

communities, and climate data analysis. The study also emphasizes the relationship between local communities' socioeconomic well-being and biodiversity conservation.

Objectives of the Study:

1. To examine the impact of climate change on the biodiversity of Manas National Park.
2. To analyze changes in temperature, rainfall, and extreme weather events affecting the park.
3. To study the effects of climate change on species behavior, migration, and habitats.
4. To assess wetland degradation caused by shifting river flows and sedimentation.
5. To identify the spread of invasive species due to climate variations.

Research Questions

1. How is climate change affecting the biodiversity and wildlife population of Manas National Park?
2. What are the impacts of changing temperature and rainfall patterns on the park's ecosystem?
3. In what ways do extreme weather events influence habitat loss and species migration in the park?
4. How are shifting river flow patterns and sedimentation contributing to wetland degradation in Manas National Park?
5. What are the socioeconomic effects of climate change on the local communities dependent on the park's resources?

Significance of the study: The study's significance With its focus on Manas National Park, a UNESCO World Heritage Site and a vital hotspot for biodiversity in Assam, India, this study is extremely important. Since the park is home to a number of rare and endangered species, its preservation is essential to biodiversity worldwide. But because of rising temperatures, erratic rainfall, floods, and habitat degradation, climate change poses serious threats to its delicate ecosystem. The study is important because it shows how the park's overall ecological balance is being disrupted by climate change, in addition to its effects on wildlife. The study offers crucial information to researchers, conservationists, and policymakers by examining the effects on species behavior, migration patterns, wetland ecosystems, and forest resources. The study also highlights the intimate connection between environmental deterioration and the livelihoods of nearby communities that rely on the park to survive. In order to protect biodiversity and promote human well-being, it emphasizes the necessity of community-based conservation initiatives and climate adaptation plans. The research's conclusions can help direct efficient conservation planning, increase public awareness of the effects of climate change, and support Manas National Park's long-term viability. It will also be a useful resource for upcoming research on biodiversity preservation and climate change in other Indian protected areas and elsewhere.

Literature review: Review of Literature Numerous studies have emphasized how severely and rapidly protected areas are being impacted by climate change, especially in areas with high biodiversity like Assam. Das and Das (2018) investigated how Assam's protected areas were affected by climate change, observing notable changes in temperature and precipitation patterns that have an immediate effect on ecosystem stability and species diversity. The vulnerability of wetland ecosystems in Manas National Park was the subject of Sharma and Deka's (2019) study, which documented sedimentation brought on by frequent floods and riverbank erosion as well as degradation brought on by changes in river flow. Their results highlight the value of wetlands as a buffer against climate shocks and for the preservation of biodiversity. A more comprehensive view of the effects of climate change was offered by Parmesan and Yohe (2003), who noted recurring trends

in species migration, changes in reproductive cycles, and habitat modifications in a variety of ecosystems around the world. Their study reveals comparable patterns that apply to Manas National Park, where species are reacting to environmental stressors.

The Himalayan and Brahmaputra basin ecosystems are at greater risk, according to the Intergovernmental Panel on Climate Change (IPCC, 2021), which also predicted an increase in the frequency of extreme weather events, which puts biodiversity hotspots like Manas at risk. Singh et al. (2011) also highlighted the Eastern Himalayas' and the surrounding plains' susceptibility to climate change, pointing out the ecological and socioeconomic effects that will follow.

The socioeconomic effects of climate change in Assam's protected areas were examined by Bhattacharjee (2020), who found a complex relationship between livelihood vulnerability and ecological degradation. In Manas, where local communities rely on forest and wetland resources, this is especially pertinent. In order to reduce climate risks in vulnerable regions like Manas, reports from WWF India (2017) and UNESCO (2020) support integrated climate adaptation strategies that combine habitat restoration, community involvement, and scientific monitoring. By connecting community-based adaptation initiatives with biodiversity conservation, these studies collectively highlight the pressing need for climate-resilient management in Manas National Park.

Methodology: A mixed-method approach is used in this study, combining quantitative and qualitative research techniques. Field surveys, in-person observations, and structured interviews with local residents, conservation specialists, and forest officials were used to gather primary data. Systematic field visits and photographic documentation were used to track habitat conditions, species distribution, and wildlife behavior. Government reports, climate records, research articles, and publications from environmental organizations were the sources of secondary data.

Positive Impacts of Climate Change on Manas National Park Ecosystem:

1. **Extended Growing Season:** In some cases, slightly warmer temperatures can extend the growing season for certain plant species, potentially enhancing food availability for herbivores.
2. **New Habitats:** As climate patterns shift, certain areas within the park may become suitable for species that previously did not inhabit the region, potentially increasing species diversity in localized areas.
3. **Increased Awareness and Conservation Efforts:** The visible effects of climate change have led to greater focus on conservation, research, and funding for climate adaptation projects within the park.

Climate Change's Adverse Effects on the Ecosystem of Manas National Park:

1. **Degradation and Loss of Habitat:** Grasslands, wetlands, and forests—essential habitats for animals like the Bengal tiger, pygmy hog, and one-horned rhinoceros—have been destroyed by erratic rainfall, floods, and droughts.
2. **Species Decline and Displacement:** A lot of species are having trouble adjusting to the quick changes in rainfall and temperature, which is causing changes in migratory patterns, decreased breeding success, and population decreases.
3. **Degradation of Wetland Ecosystems:** The Brahmaputra River's frequent flooding and riverbank erosion have weakened wetlands, which has an effect on aquatic life and waterfowl.
4. **Invasive Species:** As a result of climate change, invasive plants and animals have proliferated, outcompeting native species and changing the park's natural vegetation and food chain.

5. More Human-Wildlife Conflict: As a result of habitat loss and food scarcity, wildlife frequently infiltrates neighboring villages, increasing the likelihood of human-wildlife conflicts.

Results The study found that the ecosystem of Manas National Park has been significantly impacted by climate change in multiple ways:

1. **Modified Weather Patterns:** Recent years have seen an increase in temperatures and erratic rainfall patterns, according to climate data analysis. Extreme weather events like droughts and floods have become more common in the area, which has accelerated habitat degradation.
2. **Loss of habitat and degradation of ecosystems:** Floods, sedimentation, and erosion of riverbanks brought on by fluctuating river flow in the Brahmaputra basin have all harmed sizable tracts of grasslands and wetlands within the park.
3. **Shifts in Species Distribution and Behavior:** As a result of habitat loss and decreased food supply, wildlife species like the Bengal tiger and one-horned rhinoceros showed shifts in their movement and behavior. Bird migration patterns were also changed.
4. **Spread of Invasive Species:** Invasive plant species are becoming more prevalent, displacing native vegetation and altering food chains.
5. **Need for Conservation Measures:** Conservationists and forest officials stressed the pressing need for climate-resilient management plans that incorporate community involvement and ecological restoration.

In conclusion, This study emphasizes how climate change is having increasingly complex effects on Manas National Park's delicate ecosystem. The results show that the park's biodiversity and natural habitats are being drastically changed by rising temperatures, unpredictable rainfall patterns, frequent floods, and protracted droughts. Due to habitat degradation, altered migration patterns, and decreased food availability, keystone species like the golden langur, Bengal tiger, pygmy hog, and one-horned rhinoceros are becoming more and more vulnerable. Furthermore, sedimentation and fluctuating river flows from the Brahmaputra River are causing wetland ecosystems to deteriorate, resulting in long-term ecological imbalance. By upsetting food chains and ecological stability, the spread of invasive species puts native plants and animals in even greater danger. Local communities that depend on the park experience increasing economic hardships in addition to ecological effects, such as decreased agricultural productivity and a rise in conflicts between people and wildlife. In order to protect the ecological integrity of Manas National Park and sustain the livelihoods of the local communities, the study strongly suggests integrated conservation strategies that include habitat restoration, climate adaptation, scientific monitoring, and active community participation.

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