

From Crisis to Conservation: Protecting the Nanda Devi Biosphere Reserve

Debaleena Chatterjee, Nitesh Goswami & B.S. Adhikari

The Nanda Devi Biosphere Reserve, a UNESCO World Heritage site known for its attractive landscapes, abundant wildlife, and vibrant cultural history, resides deeply concealed in the Indian Himalayan System. The reserve encompasses areas surrounding the magnificent Nanda Devi National Park and Valley of Flowers National Park, is home to rare alpine plants and animals, including several endangered species like the Himalayan musk deer and the snow leopard. The entrance to the reserve as well as the starting point for both the trekkers and devotees is Joshimath - a historic town and point of pilgrimage. However, the combined effects of climate change, unplanned urbanization and massive infrastructure projects have resulted in frequent landslides and other environmental hazards in this ecologically delicate place, making the area more sensitive and vulnerable than ever.

The area is experiencing noticeable changes in weather patterns. One of the most apparent modifications in recent years has been the warming of the environment. Joshimath, similar to other mountainous regions around the world, is experiencing rising temperatures, including an increase in extreme heat events. Which in turn is affecting the timing and distribution of precipitation, influencing the hydrological cycle of the region and water supply. Some areas may receive more rainfall and flash floods, while others face extended dry spells and water scarcity, posing challenges for agriculture and water management. Glacier retreat and snowmelt are major factors influencing the hydrology and biodiversity of the region. The glaciers are receding at an alarming rate as temperatures rise, resulting in faster snowmelt and changes in river flows. In the previous few decades, there have been reports of less snowfall as well. Temperature and precipitation regime shifts influence the suitability of habitat for flora and fauna, resulting in changes in species suitability, phenology, and ecosystem dynamics.

Hence, these catastrophic occurrences endanger the biodiversity of the reserve by destroying vital habitats and threatening species that are already under stress from the environment.



Landslide in Joshimath taluka, Nanda Devi Biosphere Reserve

Discussions with residents of nearby villages indicate growing concern about the increasing frequency and severity of floods and landslides. The disturbances in the fragile ecosystems within the reserve are putting residents' safety in peril. Furthermore, agriculture is increasingly affected by climate fluctuations, leading to reduced production and more frequent pest outbreaks. The unpredictability of the rainfall is making issues worse by substantially disrupting agricultural cycles, especially staple crops like potatoes and tomatoes. As a result, local farmers are exposed to greater risks, including decreased agricultural reliability and increasing economic strain, which contributes to food insecurity across the place. Extreme climate impacts and unregulated developmental activities also pose an existential threat to the delicate zone. Climate change has increased the frequency and intensity of natural disasters, including flash floods, unpredictable rainfall, and glacial melting, destabilizing regional geology and heightening the risk of landslides. Due to the

area's steep terrain and a rapid rate of glacier melting and weak soil composition, Joshimath is particularly vulnerable to landslides.

Tourism pressure in Joshimath presents a complex interplay between the region's natural beauty and the challenges of sustainable development and environmental conservation. As the place acts as a gateway to several well-known pilgrimage sites and hiking attractions, like Niti Valley, Badrinath, the Valley of Flowers, and Hemkund Sahib, the rush of adventurers has put an additional burden on the ecosystem and local infrastructure. The calm landscapes, clean rivers, and the rich flora and fauna are under threat from unregulated tourism activities. Deforestation, pollution, and habitat degradation are some of the impacts of increased traffic in the area. Trekkers frequently abandon waste along the trails, damaging biodiversity and reducing the aesthetic value of the area. Furthermore, unplanned construction of resorts, guesthouses, and roads affect the surrounding natural habitats and change the topography, resulting in soil erosion and landslides, particularly during the monsoon season. The construction of these hotels, housing developments, and commercial establishments frequently occur, often without proper planning, permission and concern for the fragile ecology of the area. Large-scale road projects also require a lot of excavation, blasting, and widening. Tourism pressures are also putting strain on the cultural fabric of the local communities. Traditional practices are gradually disappearing. There is pressure on resources such as water and power, as locals compete with the growing tourist population for access. Infrastructure fails to keep up with the number of visitors, particularly during the peak pilgrimage season. Roads are crowded, lodging facilities are overburdened, and basic services like healthcare and sanitation are insufficient to meet the demands of both residents and tourists. The economic benefits of tourism are apparent, with many residents finding work in the hospitality, transportation, and guiding industries. However, because of its reliance on tourism, the area is vulnerable to fluctuations in the number of visitors brought on by the emergence of natural disasters like earthquakes, regular rock falls, and building cracks. These instances are becoming more prevalent, as evidenced by the current news of ground subsidence occurring at Joshimath.

A multifaceted, sustainable strategy that strikes a balance between the requirements of locals and tourists and the natural conditions is needed to address these issues and improve the ecological health of the region. For restricting unauthorized construction in the surrounding areas, strict laws must be implemented. In order to minimize strain and to prevent additional ground subsidence, building permits must include a geological stability evaluation. Strict environmental regulations must be followed while constructing roadways and other infrastructural projects. Every project must also undergo thorough environmental impact assessments, with an emphasis on the long-term effects on local populations and wildlife. Early warning systems for floods and landslides can provide evacuations with vital notice in time. Local inhabitants should be trained to actively participate in disaster response teams. Creating awareness, encouraging ecotourism and providing tourists with clear guidelines might reduce the adverse impacts of anthropogenic activities on the ecosystem and boost the local economy.



Rockfall in Urgam Valley, Nanda Devi Biosphere Reserve

Lastly, landslide risks might be decreased, carbon sequestration could be facilitated and local biodiversity can be enhanced by afforestation projects that use native vegetation and soil stabilizing measures along susceptible slopes to prevent erosion. In high-altitude regions, sustainable water resource management can be facilitated by the promotion of climate-resilient crops like millets, utilization of integrated pest management solutions, crop rotation techniques and rainwater harvesting.

Therefore, it is possible to reduce the anticipated threats, protect this delicate landscape for future generations and guarantee the resilience and sustainability of Indian Himalayan regions by implementing sustainable construction practices, involving local communities in disaster management, encouraging ecotourism, agroforestry, and funding environmental restoration.

About the Authors:

Debaleena Chatterjee works as a Project Associate under the project “An Integrated Approach to Biodiversity Conservation in Nanda Devi Biosphere Reserve, Uttarakhand”. She is a GIS enthusiast and has particular interests in landscape dynamics and ecosystem processes.

Email id- chatterjeedebaleena222@gmail.com

Nitesh Goswami joined the Wildlife Institute of India in 2022. He has a keen interest in the Himalayan ecosystem.

Email id- niteshgoswami194@gmail.com

B. S. Adhikari is a Scientist-G at the Wildlife Institute of India. He has been working in the Himalayan ecosystem for over 35 years and has interests in the fields of vegetation ecology, habitat ecology, forest dynamics, rangeland ecology, and medicinal and aromatic plant conservation.

Email id- adhikaribs@wii.gov.in



Landslide restoration along Badrinath Road,
Nanda Devi Biosphere Reserve