Sustaining the Himalayan Ecosystem

This editorial is based on " Himalayan tragedy: On avalanches in the Himalayan States " which was published in The Hindu on 08/03/2025. The article brings into picture the vulnerability of India's Himalayan region, which, despite its strategic and resource significance, remains environmentally fragile.

For Prelims: Avalanche, India's Himalayan region, Zoji La Tunnel, Atal Tunnel, Tibetan Buddhism, India's Northeastern states, Hindu Kush Himalayas, Atal Tunnel, Indian monsoon , Sikkim Glacial Lake Outburst Flood, Joshimath land subsidence, Environmental Impact Assessments, Snow leopard

For Mains: Significance of Himalayan Region of India, Key Issues Associated with the Indian Himalayan Region

The recent **avalanche in Uttarakhand** serves as just one example of the **broader vulnerability facing India's Himalayan region**. These majestic mountains, while strategically crucial and resource-rich, **exist in a perpetual state of environmental fragility—prone to avalanches, landslides, flash floods, and seismic activity.** India needs to work harder in developing comprehensive **disaster management systems and ecologically sensitive development approaches** specific to the unique challenges of its **Himalayan frontier.**

What is the Significance of Himalayan Region of India?

- **Strategic and Geopolitical Importance:** The Himalayas form a **natural defense barrier,** crucial for India's security, **especially amid rising border tensions with China.**
  - With increasing **Chinese incursions along the LAC,** India has ramped up military infrastructure in Ladakh and Arunachal Pradesh.
  - The recent **India-China standoff in Eastern Ladakh** led to the expansion of the Border Roads Organisation (BRO) projects, including the strategic **Atal Tunnel and the Zoji La Tunnel.**
    - A 2022 report stated that **India has built 2,088 kilometers** of roads in areas bordering China in the last **5 years.**
- **Water Tower of India (Hydrological Significance):** The Himalayas are the source of major rivers like the **Ganga, Brahmaputra, and Indus**, supporting **agriculture, drinking water, and hydropower.**
  - The **Hindu Kush Himalayas** are called the **water towers of Asia** as they are the source of **10 major rivers** including **Ganges, Indus** and have the largest snow and ice deposits outside the two poles.
  - Approximately **1,20.00,000 million cubic meters of water** flows down the Himalayan rivers annually and nourishes the millions living in the plains.
- **Ecological and Biodiversity Hub:** The Himalayas are one of 36 biodiversity hotspots, with

around 3,160 rare, endemic and sensitive plant varieties that hold special medicinal properties.
    - It is home to rare species like the **snow leopard, red panda, and medicinal plants.**
    - It has a number of climate types and ecological zones, from tropical to alpine ecosystems including ice and rocks in the uppermost zone, enriching the biodiversity of the region.
- **Cultural and Religious Significance:** The Himalaya mountain is a prominent geographical feature revered in various spiritual traditions, including **Tibetan Buddhism and Hinduism.**
    - They are deeply embedded in India's cultural and spiritual traditions, with sacred sites like **Kedarnath, Badrinath, Amarnath, and Hemkund Sahib.**
    - The region attracts millions of pilgrims annually, but unregulated tourism and poor waste management threaten its ecological balance.
- **Economic and Livelihood Significance:** The Himalayas support millions of livelihoods through **tourism, agriculture, and forest-based industries.**
    - **Organic farming, eco-tourism, and renewable energy** are driving sustainable economic growth.
    - In states like **Uttarakhand, West Bengal, Tripura, Assam, and Meghalaya**, the tourism sector has been contributing more than **10% to the GDP.**
    - The Sikkim organic farming model (though, recently facing issues), which made it **India's first organic state**, is a successful example of sustainable agriculture.
    - The **Dark Sky Reserve** will be located at Hanle village in Eastern Ladakh as a part of Changthang Wildlife Sanctuary. It will **boost Astro-tourism in India.**
- **Renewable Energy Potential (Hydropower & Solar Energy Hub):** The Himalayan rivers provide immense hydropower potential, crucial for India's energy security and green transition.
    - **India's Northeastern states**, with their mountainous topography and perennial streams, have the largest hydropower potential in all of India.
        - The **Arunachal Pradesh 13,000 MW hydropower project agreement (2023)** in Lohit Basin aims to boost clean energy.
- **Critical for Monsoon and Climate Regulation:** The Himalayas play a key role in influencing the **Indian monsoon** by acting **as a barrier to cold Central Asian winds and trapping moisture-laden monsoon winds.**
    - Without the Himalayas, **the region would have been a cold desert.** Any disruption in the Himalayan ecosystem, such as **glacial melting or deforestation, affects monsoon patterns**, leading to unpredictable weather and droughts.
    - While monsoon is considered the cleanest season, with relatively low air pollution, experts say air pollution is likely to reduce the southwest monsoon rainfall by **10%-15% for the entire country**

What are the Key Issues Associated with the Indian Himalayan Region?

- **Increasing Frequency of Climate-Induced Disasters:** The Himalayas are witnessing a surge in disasters like **avalanches, landslides, and flash floods** due to rising temperatures, glacier retreat, and erratic weather patterns.
    - It includes increasing **cloudbursts due to the rising frequency of orographic rainfall.**
    - **Rapid urbanization and deforestation** have further exacerbated the fragility of the region, making local communities highly vulnerable.
    - Between **2004 and 2017**, a total of 3,285 landslides worldwide were triggered by rainfall.
        - **In the Indian Himalayas alone, 580 landslides occurred** during this period, with 477 caused by rainfall, accounting for 14.52% of global landslides.
    - The **2025 Uttarakhand avalanche** and the **2023 Sikkim Glacial Lake Outburst Flood (GLOF)** highlight the rising disaster threats in the region.
- **Unsustainable Infrastructure Development:** Massive infrastructure projects such as **highways, tunnels, and hydropower plants** are being developed without adequate environmental assessments.
    - The **cutting of slopes, deforestation, and blasting for roads** weaken mountain stability, triggering landslides and land subsidence.
        - While strategic connectivity is essential, development must balance ecological sensitivity with infrastructure needs.

    - **Heightened seismic activity** due to **ongoing continental collision (Indus-Tsangpo suture zone)** ties with unsustainable infrastructure development to give result to issues like **The Joshimath land subsidence crisis (2023)** was linked to excessive tunneling and road construction under the **Char Dham Project.**
- **Rapid Glacier Retreat and Water Security Threats:** Himalayan glaciers, crucial for sustaining India's major rivers, are melting at an alarming rate due to global warming.
    - This threatens long-term water availability for millions downstream, increasing risks of **droughts, reduced hydropower generation, and conflicts over water resources.**
    - A 2023 report stated that **glaciers in Asia's Hindu Kush Himalayas** are melting at unprecedented rates and could lose up to **75%** of their volume by century's end if global warming continues at current rates.
- **Biodiversity Loss and Wildlife Habitat Destruction:** Deforestation, human encroachment, and climate change have led to the loss of biodiversity in the Himalayas, home to unique species like the **snow leopard and red panda.**
    - A decline of **902 square kilometres** in forest cover was recorded in hill districts of the country as compared to 2019, found the **State of Forest Report, 2021.**
    - The **expansion of agriculture, tourism, and hydro projects** disrupts ecosystems, leading to human-wildlife conflicts and species extinction.
    - Human-caused climate warming and increasing deforestation have also fuelled an invasion of non-native species.
        - For example, the **crofton weed** poses a real risk to the native Himalayan **pine trees (Pinus roxburghii).**
- **Border Tensions and Security Challenges:** The Himalayan region is the frontline of India's border tensions with China and Pakistan, making it strategically vulnerable.
    - Frequent **skirmishes, encroachments, and militarization** have increased, leading to heavy infrastructure development that disrupts fragile ecosystems.
    - The **India-China clashes in Tawang (2022)** led to accelerated road and airbase construction in border areas.
        - Due to this, **India's defence budget for 2025-26 has been set at Rs 6.8 lakh crore ($79 billion)**, reflecting a critical diversion of resources towards security rather than development.
- **Unregulated and Unsustainable Tourism:** Tourism in the Himalayas has increased exponentially, **leading to overcrowding, waste mismanagement, and ecosystem degradation.**
    - Unplanned hotel construction, road expansion, and pollution have severely impacted fragile zones, triggering land subsidence and biodiversity loss.
    - The Himalayan Clean-Up (2022) waste audit revealed that **92.7% of the trash was plastic**, with **72% consisting of non-recyclable plastic**.

What Measures can India Adopt for Sustainable Development and Resilience of the Himalayan Region?

- **Eco-Sensitive and Climate-Resilient Infrastructure:** Infrastructure development should follow strict **Environmental Impact Assessments (EIA)** and adopt **nature-based solutions** like bio-engineering and climate-resilient road designs.
    - **Zero-emission public transport** and **electric vehicle corridors** should be promoted in high-altitude towns to minimize air and noise pollution.
    - Integrating **disaster-resistant building codes** will enhance the safety of settlements in vulnerable zones.
        - A **scientific carrying capacity analysis** should be conducted before approving large-scale projects.
- **Sustainable Tourism and Waste Management Policies:** Tourism should be regulated through **carrying capacity limits**, eco-tourism models, and responsible visitor behavior frameworks.
    - A **permit-based entry system** in ecologically fragile areas can control overcrowding while promoting high-value, low-impact tourism.
    - **Decentralized waste management systems**, including biodegradable waste processing

and plastic bans, should be strictly enforced in pilgrimage and trekking zones.
    - **Green certifications for hotels and homestays** can incentivize sustainable tourism practices.
        - Local communities should be empowered through **community-managed tourism models** to ensure economic benefits without ecological exploitation.
- **Integrated Water Management and Glacier and Wetland Conservation:** A **Himalayan River Basin Management Authority** should be established to coordinate transboundary river conservation and optimize hydropower usage without disrupting local ecology.
    - **Artificial glacier recharge techniques**, such as **ice stupas and designating more Ramsar sites in himalayan region** should be done to combat water issues and combat seasonal water shortages.
    - **Glacial lake monitoring and early warning systems (EWS)** should be strengthened to prevent Glacial Lake Outburst Floods (GLOFs).
    - River embankment projects should use **bioengineering solutions** instead of excessive concretization.
- **Reforestation and Biodiversity Conservation Strategies:** India needs to promote afforestation with **native species in himalayan region that enhance soil stability and carbon sequestration**.
    - **Eco-sensitive zones (ESZs)** must be strictly implemented around wildlife corridors to prevent habitat destruction.
    - Community-led conservation models, such as **Van Panchayats and eco-task forces**, should be expanded for participatory afforestation.
    - **Agroforestry and medicinal plant cultivation** can be promoted as sustainable livelihood alternatives to reduce pressure on forests.
- **Disaster Risk Reduction and Early Warning Systems:** A **Himalayan Disaster Resilience Framework** should integrate **real-time monitoring of landslides, earthquakes, and avalanches** through satellite-based remote sensing.
    - Local governance should be empowered with **disaster-resilient infrastructure plans and climate adaptation strategies**.
    - Expanding **community-based disaster preparedness programs** will improve response efficiency in remote villages.
    - **Cross-border cooperation with Nepal, Bhutan, and China** on disaster management should be strengthened for coordinated responses.
- **Sustainable Livelihood Promotion and Climate-Adaptive Agriculture:** Promoting **organic farming, permaculture, and high-altitude climate-resilient crops** can enhance food security and reduce soil degradation.
    - **Eco-friendly handicrafts, herbal products, and adventure tourism** should be incentivized to diversify local economies.
    - **Decentralized renewable energy solutions, such as micro-hydro and solar grids**, can provide sustainable energy access to remote villages.
    - **Skill development programs in green jobs** (such as **sustainable tourism, forest conservation, and eco-construction**) should be expanded.

Conclusion:

To ensure the long-term sustainability of India's Himalayan region, a multi-pronged approach integrating **ecological conservation, disaster resilience, and climate-adaptive development is essential.** Strengthening the **National Mission on Himalayan Studies (NMHS)** can play a pivotal role in fostering research-based solutions, promoting sustainable tourism, and enhancing local governance.

Drishti Mains Question:

The Indian Himalayan Region (IHR) is ecologically fragile yet developmentally important. How can infrastructure development in the region be balanced with environmental sustainability? Suggest a strategic roadmap.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims:

Q. Consider the following pairs: (2020)

Peak Mountains

1. Namcha Barwa Garhwal Himalaya
2. Nanda Devi Kumaon Himalaya
3. Nokrek Sikkim Himalaya

Which of the pairs given above is/are correctly matched?

(a) 1 and 2

(b) 2 only

(c) 1 and 3

(d) 3 only

Ans: (b)

Q. If you travel through the Himalayas, you are likely to see which of the following plants naturally growing there? (2014)

1. Oak
2. Rhododendron
3. Sandalwood

Select the correct answer using the code given below:

(a) 1 and 2 only

(b) 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Ans: (a)

Q. When you travel in Himalayas, you will see the following: (2012)

1. Deep gorges
2. U-turn river courses
3. Parallel mountain ranges
4. Steep gradients causing landsliding

Q. Which of the above can be said to be the evidence for Himalayas being young fold mountains?

(a) 1 and 2 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

Ans: (d)

Mains:

Q1. Differentiate the causes of landslides in the Himalayan region and Western Ghats. (2021)

Q2. How will the melting of Himalayan glaciers have a far-reaching impact on the water resources of India? (2020)

Q3. "The Himalayas are highly prone to landslides." Discuss the causes and suggest suitable measures of mitigation. (2016)
