



Mains Practice Question

Q. Discuss the factors contributing to the increasing frequency of landslides in the Himalayan region and their implications. Suggest sustainable mitigation strategies that can be implemented to address this growing concern. (250 Words)

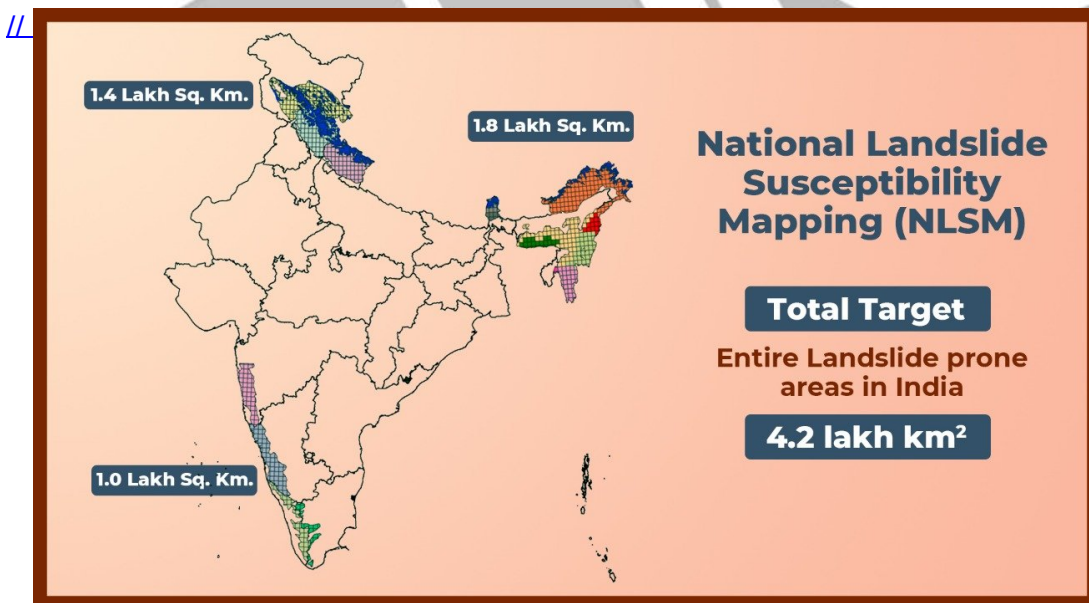
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Approach:

- Start your answer with defining Landslide in the Himalayan Region.
- Discuss the reasons behind landslides in the Himalayan region and their implications.
- Suggest some sustainable mitigation strategies.
- Conclude with a forward looking approach.

Introduction

Landslides are the downward movement of masses of soil, rock, or debris under the influence of gravity. They are a common natural hazard in the Himalayan region, which is geologically young, tectonically active, and climatically diverse. The factors contributing to the increasing frequency of landslides in the Himalayas can be classified into two categories: natural and anthropogenic.



Body

Some of the reasons behind landslides in the Himalayan region:

- **Fragile Ecosystem:** Tectonic or neo-tectonic activities, associated with numerous subsurface processes like rock deformation, exhumation and reworking of rocks and surface processes such as

erosion, weathering and rain/snow precipitation make the ecosystem inherently fragile.

- **Earthquakes:** The convergence of the Indian plate with the Eurasian plate in the Himalayan region has created subterranean stresses that get released in the form of earthquakes which, in turn, cause fractures and loosen the litho-structures near the mountain surface. This increases the possibilities of rock movement along the slope.
 - Debris flow and underground water make a slope weak and landmass can slip down it.
- **Climate Induced Excessive Events:** Climate-induced excessive events like freezing/thawing and heavy rain/snow precipitation lead to avalanches, landslides, debris flow, glacial lakes outburst floods, landslide lakes outburst floods and flash floods. They add to the precariousness of the mountain system. The Himalaya is further stressed by anthropogenic activities.
 - Climate change has adverse impacts on glaciers, riverine systems, geomorphology and biodiversity, which, in turn, have increased the vulnerability of people in the mountainous states.
 - Land degradation aggravates the problem.
- **Geological Composition:** Some of the Himalayan rocks are made of limestone, which is more prone to water and landslides than other types of rocks because it can dissolve in weakly acidic rainwater or groundwater. This process creates caves, sinkholes, and other karst features that weaken the stability of the slopes.
- **Westerly Disturbance & Monsoon:** Confluence of Westerly Disturbance — a low-pressure system, originating from the Mediterranean Sea, moving eastward across central Asia and northern India — and the South West Indian Summer Monsoon cause excessive and concentrated rainfall in parts of J&K, Himachal Pradesh and Uttarakhand leading to landslides and flash floods.
- **Anthropogenic Factors:** Human activities such as road construction, tunneling, mining, quarrying, deforestation, urbanization, agriculture, excessive tourism and hydroelectric projects can also cause or worsen landslides in the Himalayas. These activities can disturb the natural balance of the slopes by removing vegetation cover, altering drainage patterns, increasing soil erosion, creating artificial cuts and fills, blasting rocks, and generating vibrations.
 - These activities can also increase the exposure and risk of human settlements and infrastructure to landslides.
 - The 2013 Kedarnath Tragedy was also influenced by the unplanned development and construction activities in the area that had altered the natural drainage system and increased the soil erosion.

Some of the measures that can be taken as mitigation strategy:

- **Resilience Building:** To address these challenges, it's important to develop resilience against geo-hazards caused by natural processes, environmental degradation, and human activities. This involves implementing a network of sensors for real-time monitoring and data collection.
- **Leveraging Technology for Effective Monitoring:**
 - **Web-based sensors such as rain gauges, piezometers, inclinometers, extensometers, InSAR (Interferometric Synthetic Aperture Radar),** and total stations can help monitor vulnerable areas. Monitoring should be prioritized in densely populated and built-up zones.
 - **Integrated Early Warning System (EWS):** The development of an integrated Early Warning System (EWS) using AI and Machine Learning (ML) algorithms is crucial. Such a system could help predict and alert communities about impending hazards, giving them valuable time to take preventive measures.
- **Formation of Himalayan States Council:** Establishing a collaborative platform that brings together the disaster management authorities from different states in the Himalayan region is a strategic move. This centralized council would enable the sharing of knowledge, experiences, and resources to effectively assess and manage the impacts of various stressors on the region.
- **Sustainable Socio Economic Development:** Recognizing the valuable natural resources present in the region, such as glaciers, springs, minerals, energy sources, and medicinal plants, offers the potential for sustainable socio economic development. However, it's crucial to strike a balance between resource exploitation and ecological preservation to ensure long-term viability.
- **Environmental Considerations:** Proper town planning that accounts for the unique characteristics of mountainous terrain is vital. Restricting heavy construction, implementing effective drainage systems, scientifically managing slope cutting, and using retaining walls are

important aspects of environmentally conscious development.

- Retaining walls are relatively rigid walls used for supporting soil laterally so that it can be retained at different levels on the two sides.
- **Sustainable Tourism:** Sustainable tourism can reduce landslides by promoting environmental awareness, conservation and protection of natural resources, and respect for biodiversity and ecosystems.
 - It can also provide economic incentives and social benefits for local communities, which can enhance their resilience and adaptive capacity to cope with natural hazards.
- **Building Sustainable Govt Projects:** To ensure responsible development in the Himalayan region, key measures include conducting environmental assessments, using eco-friendly technologies, involving local communities, increasing stakeholder awareness, and promoting coordination among governmental sectors.

Conclusion

The increasing frequency of landslides in the Himalayan region is a complex issue with multifaceted causes and significant implications. Sustainable mitigation strategies must encompass a holistic approach that combines geological understanding, climate adaptation, land-use planning, and community engagement to safeguard both the environment and the well-being of the people living in this vulnerable region.

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