

STUDY OF FLOOD VULNERABILITY IN HIMALAYAN REGION: A CASE OF UTTARAKHAND

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Abstract :

India's Himalayan area is well known for its magnificent scenery and abundant wildlife. However, because of its complicated geology, delicate ecosystems, and unpredictable climate, it is also extremely vulnerable to catastrophic calamities. The causes, effects, and mitigation techniques of the common natural catastrophes that affect India's Himalayan region—such as earthquakes, landslides, floods, and glacial lake outburst floods (GLOFs)—are briefly summarised in this summary. Because of the collision of the Indian and Eurasian tectonic plates, earthquakes are one of the most dangerous natural disasters in the Himalayan region. Major seismic events, like the one that struck Nepal in 2015, demonstrate how vulnerable the region's heavily inhabited areas are to devastating destruction and high fatality rates. Effective disaster preparedness and resilient infrastructure are crucial for minimizing casualties and damage.

Another common risk in the Himalayan region is landslides, which can be brought on by unstable slopes, strong rains, and seismic activity. The region's susceptibility is exacerbated by these occurrences, which represent a major threat to natural ecosystems, transportation networks, and towns, particularly during the monsoon season.

In the Himalayan region, floods are a common occurrence that are exacerbated by glacial melt, heavy rainfall, and glacier lake outbursts. Flash floods, like the ones that occurred in Uttarakhand in 2013, highlight the terrible effects on infrastructure, communities, and the environment. Reducing flood risks and increasing resilience requires community-based adaptation strategies, early warning systems, and sustainable land use planning.

A unique hazard in the Himalayan region, glacial lake outburst floods (GLOFs) are caused by the rapid melting of glaciers and the creation of unstable glacial lakes. The communities, infrastructure, and ecosystems downstream are

seriously threatened by these catastrophes, which calls for careful observation and risk assessment techniques.

One of the worst natural catastrophes to have hit the state in recent memory is the flash floods in Uttarakhand. Because of the state's distinctive geography, which is made up of small valleys and steep hills, heavy rainfall events have a greater effect, especially during the monsoon season. 2013's devastating flash floods, brought on by abnormally high rainfall, caused extensive environmental damage, infrastructure ruin, and a great deal of fatalities. The abrupt influx of water, rubble, and silt caused great destruction to isolated communities, tourist attractions, and places of worship, underscoring the precariousness of human habitation in the foothills of the Himalayas. The incident also brought attention to the relationship between unplanned development, environmental deterioration, and the likelihood of disasters, spurring calls for more land use planning, early warning systems, and sustainable development techniques future flash floods in Uttarakhand.

In conclusion, the broad range of natural hazards that the Himalayan area of India faces calls for multifaceted methods to disaster risk reduction and management. In this dynamic and vulnerable setting, scientific research, community participation, and sustainable development practices are critical components of effective resilience-building efforts.

Keywords: Hilly areas natural disaster, flash flood, Glacial lake outburst, flash flood in Uttarakhand

1.Introduction :

Himalaya is Known for its spectacular beauty and ecological significance, the Himalayan region is prone to natural calamities, with floods being one of the most common causes. This essay explores the origins, consequences, and techniques for managing floods in the Himalayan region, with a special emphasis on the most notable zones.

Causes of Floods in the Himalayan Region

The Himalayan region experiences floods as a result of both natural and man-made sources.

1.1. Topographical Features: The Himalayan region's intricate river networks and precipitous slopes make floods more intense and frequent.

1.2. Monsoon Dynamics: Flooding is largely caused by the tremendous rainfall that the Southwest Monsoon, which crosses the Indian subcontinent from June to September, brings to the Himalayan region.

1.3. Glacial Lake Outburst Floods (GLOFs): Glacial lakes are emerging as a result of the Himalayan glaciers melting more quickly due to climate change. These lakes may suddenly burst, which could lead to disastrous GLOFs downstream.

1.4. Deforestation and Land Use Changes: Flood risk is increased by uncontrolled deforestation and changes in land use, which are caused by population pressure and development activities that interfere with the natural hydrological cycle.

2. Impacts of Floods in the Himalayan Region

The ecology and society are both greatly impacted by floods in the Himalayan region.

2.1. Environmental Impacts: Floods cause river courses to shift, erode, and deposit sediment, which destroys habitat and reduces biodiversity. They also have a part in nitrogen depletion and soil erosion.

2.2. Socio-Economic Impacts: Floods seriously harm livelihoods, agriculture, and infrastructure. Increased displacement, fatalities, and interruptions to vital services intensify the socio-economic consequences.

2.3. Cultural Impacts: Floods frequently cause loss of cultural identity and historical significance by damaging cultural heritage sites and upsetting customs.

3. Effects of Floods in the Himalayan Region

Floods have significant and wide-ranging impacts on both the ecosystem and human life in the Himalayan region.

3.1. Human Health: Floods contaminate water supplies, increasing the danger of waterborne illnesses including cholera and typhoid. In the course of rescue and relief efforts, they also result in fatalities and injuries.

3.2. Food Security: Flood-prone agricultural areas experience crop losses, endangering local residents' access to food and fueling long-term economic instability.

3.3. Infrastructure Damage: Floods cause damage to buildings, bridges, and roads, interfering with the operation of transportation networks and making it more difficult to receive necessities like healthcare and education.

3.4. Psychological Effects: Flood-related trauma and stress can have enduring psychological impacts on people and communities, presenting as sadness, anxiety, and post-traumatic stress disorder (PTSD).

4. Flood Management Strategies in the Himalayan Region

Floods in the Himalayan region present a variety of issues that call for a multifaceted approach that includes methods for preparedness, mitigation, response, and recovery.

4.1. Early Warning Systems: By putting in place reliable early warning systems with sensors, gauges, and communication networks, at-risk communities can receive timely notifications that allow people to flee to safer areas.

4.2. Development of Infrastructure: Building flood-resistant infrastructure, such as drainage systems, floodwalls, and embankments, can lessen the effects of flooding and shield susceptible areas from flooding.

4.3. Community-Based Adaptation: By including local people in capacity-building programmes, participatory decision-making processes, and awareness campaigns, flood risk management can be improved and sustainable development promoted.

4.4. Adaptation to Climate Change: Adopting ecosystem-based strategies, encouraging sustainable land use planning, and introducing climate-resilient agricultural methods can all help lessen the negative effects of climate change and reduce the vulnerability of the Himalayan region to floods.

5. Case Study: Uttarakhand, India

Uttarakhand, a state in the Indian Himalayas, has a rich river network and rough terrain, making it particularly prone to flooding.

Environmental concerns now have a major impact on extreme environmental disasters. The majority of people affected by natural disasters like landslides, flooding in rivers, rainfall, popular movements, and rainfall have

increased significantly over time. There's a good chance that these tragedies involve extreme weather.

Problem Description A map of disaster-prone areas shows that Uttarakhand is among the states with the highest risk of natural catastrophes, including landslides, flash floods, calamities, and habitat degradation. These catastrophic calamities have damaged property, human lives, and the natural environment. There are many landslides, particularly in the rainy season. Roads, agricultural land, buildings, homes, and other infrastructure are destroyed, and human lives are lost as a result. Since landslides interrupt people's daily lives, they have a variety of effects on the state. This is a result of Uttarakhand's steep terrain and lack of other transit options outside highways. Large-scale landslides occur in the state almost annually, causing several social problems.

The geoclimatic characteristics and varied geography of the area have resulted in an increase in the frequency of landslides in recent times. The main causes of the situation, aside from the state's physical features, are haphazard human activities like extensive deforestation, road construction done without consideration for the fragile nature of the area, the construction of power plants or groundwater, multi-story visitor accommodations, and pseudoscientific natural resources.

The area is strongly impacted by a number of risks. According to historical studies and Hindu sacred texts, the nation is referred to as the Himalayas, which is Sanskrit for "Uttarakhand." Uttarakhand, because of its geographic and geomorphic location, is vulnerable to severe environmental difficulties. Eight developing Asian nations—Pakistan, Afghanistan, India, Bangladesh, Bhutan, China, Myanmar, and Nepal—are surrounded by the vast Himalayan mountain range. India is regarded as a mega range of bio diversity of flora and fauna and one of the ten most notably wooded places in the globe because of the Himalayan range. It makes up only 18% of the total land area of India. Nonetheless, it is home to 40% of India's forests and more than 50% of the nation's biodiversity subcontinent's endemic species. Of all the states, Uttarakhand has the highest risk of disasters. The Garhwal region of Uttarakhand has historically been vulnerable to environmental hazards due to its distinct geoclimatic conditions. Natural disasters include floods, droughts, and cloudbursts. There have previously been landslides, earthquakes, and cyclones. The environment of Garhwal in the Himalayas is often used to illustrate the fragility of hazards and disasters.

5.1. Uttarakhand Flood Causes: The state has become more vulnerable to floods due to rapid urbanisation, unchecked development, and deforestation. This increases the likelihood of natural disasters such high rainfall and glacier lake outburst floods.

5.2. Effects of Floods in Uttarakhand: The severe floods of 2013, which were brought on by intense rain and cloudbursts, caused a great deal of property damage and fatalities in Uttarakhand, underscoring the pressing need for efficient flood control measures.

5.3. Flood control Initiatives: Check dam building, river training projects, and afforestation programmes are just a few of the flood control measures Uttarakhand has implemented in the wake of the 2013 floods with the goal of minimising the effects of flooding and minimising soil erosion.

The process of adapting to floods involved two steps: first, one had to believe that a flood was happening, and then one had to take action to mitigate and adapt to the flood's varied effects. Farmers employed a range of flood preparedness and adaptation strategies to lessen the effects of flooding, depending on how severe they perceived the floods to be. Farmers have implemented a variety of flood protection strategies.

In order to meet the need for fodder during the projected flood, approximately 91% of farmers preferred to store crop residue and gather forage from forest areas. Floods mostly harmed crops and cattle feed. When it comes to flood management techniques, the majority of respondents (89%) said they watch television, listen to the radio, and read newspapers. The district level disaster management agencies in Uttarakhand are run by the state government, and according to 58% of the respondents, they maintain contracts with government officials for any emergency in order to lessen unanticipated circumstances in the area. It is noteworthy that 46% of the participants assembled a disaster management kit with essential items recommended by several development agencies.

Other noteworthy adaptation and mitigation measures included planting perennial grasses and fodder trees, helping farmers explore job opportunities through migration, destocking and crop rotation, and livestock insurance, which was only embraced by 9% of the respondents. Depending on the farmers' degree of education, a notable variation in adaptation was noted. It was discovered that farmers with higher levels of education were more aware of these flood preparation measures. Various autonomous adaptation measures were implemented by farmers to lessen the impact of floods on their livelihoods, based on their perception of the severity of the damages.

5.4 Mitigation strategies include Structural and Non-structural measure, which may include-

Embankments, Channel improvement, Anti- erosion works, Watershed Management, Risk based land use planning , Flood hazard zoning and vulnerability mapping ,

Development regulations for the development under high risk zones should be reformed and revised.

(i)-Parameters for **flood hazard mapping** –

Precipitation , Drainage density , Soil moisture , slope

(ii)-Parameters for **flood Vulnerability mapping** –

Population density, Settlement and structures, Road networks

6. Conclusion

The Himalayan region is seriously threatened by flooding, which has an effect on civilization and the ecology. Floods require a comprehensive approach that incorporates scientific understanding, community involvement, and sustainable development principles to address their origins, consequences, effects, and management. Effective flood control techniques can improve the Himalayan region's resilience, reduce hazards, and give its people a more secure future.

The Himalayan region experiences flooding that ruins livelihoods, hinders development, and has varying effects on animal husbandry and agriculture. The majority of respondents (84%) worked in agriculture and animal husbandry. Approximately 79.6% of farmers reported having experienced flooding in the previous year. Ninety-one percent of farmers preferred to store crop residue and forage from forest areas to meet the demand for fodder during the anticipated flood. The majority of respondents (59%) said that the government did not do enough to communicate that flooding was likely, which they believed was the reason for the devastating impacts. Forty-one percent said that the communications from government agencies were adequate. 89% of the majority of the respondents watching television, listing to radio and reading newspaper for flood management practices as mitigation of flood disaster.

It highlights the importance of effective communication for disaster risk mitigation since with such poor communication, the number of victims and level of damage were increased and it minimises any aftermath relief or compensation arrangements. In the survey communities, households rarely have financial adjustment systems like insurance. More so than a lack of understanding of the insurance process, the cost of insurance is a result of income disparities. Households therefore use their savings, sell assets, or obtain money from unofficial sources to make adjustments. The study's final conclusions suggest that inadequate institutional assistance, poor communication, and household-based adjustment worsen the effects of floods in rural communities, and that a

comprehensive national flood disaster action plan with specific in agriculture and animal husbandry.

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