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GENERAL ARTICLE

Uttarakhand Disaster: Consequences of Human Interference beyond Nature's Line of Defense

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Abstract

Uttarakhand, a state in the northern region of India, lies to the close proximity of young folded Himalayas. The state has immense religious and tourist importance as it reveals a vast array of nature covering within itself abundant greenery, wildlife and the mighty Himalayan Mountains. However, people, in recent times, have approached the state in huge numbers thereby disturbing its geo-ecological balance. Moreover, climatic change and anthropogenic forces have led to several unwanted consequences in the form of landslides, soil erosion, etc that has affected a large portion of population in June 2013. The present article aims to highlight certain viewpoints to curb the scenario.

Keywords

Fluvial, Geomorphological, *Glaciations*, Orogeny, Seismo-tectonic, Subduction

Introduction

Uttarakhand extends between 28°4′ to 31°27′ north latitude and 77°34′ to 81°2′ east longitude with the total geographical area of 53,484 square kilometers and population of 1,01,16,752 people. The region is known for its scenic beauty and fragile ecosystem and shrines, such as, Chardham and Prayags are its major attractions. The state is also considered as seismo-tectonically active zone due to the subduction of south Asian plate under the main Asian plate, which in turn causes the Himalayas to rise and thus make the region seismically active (Singh, 2006). Besides, the region is also known for its river system, biodiversity and cultural landscapes. Head water region of river Ganga in the area is dotted by a number of tributaries including Bhagirathi river from Gangotari glacier and Alakhnanda from Bhagirath Kerag glacier which in turn form Bhagirathi and Alakhnanda Basins. These two rivers meet at Dev Prayag to form river Ganga. Mandakani river is an important tributary of Alakhnanda river which joins the latter at Rudraprayag.

The area, that holds immense cultural importance housing the sacred rivers, is also dominated by scrubs and sparse coniferous forest. On the climate front, Uttarakhand falls within the sub tropical zone, dominated by the Asian monsoon system where south easterly monsoon provides most of the precipitation in the months of July and August. During this season, cloud bursts, landslides, mass moments and flash floods are common phenomenon, whereas, winter months are characterized by lower precipitation with a maximum of 54.8mm in January. Thus, it can be concluded that Uttarakhand is unique as it possesses a varied range of physiographical, topographical and climatic diversity.

Reasons Responsible for Uttarakhand Flood

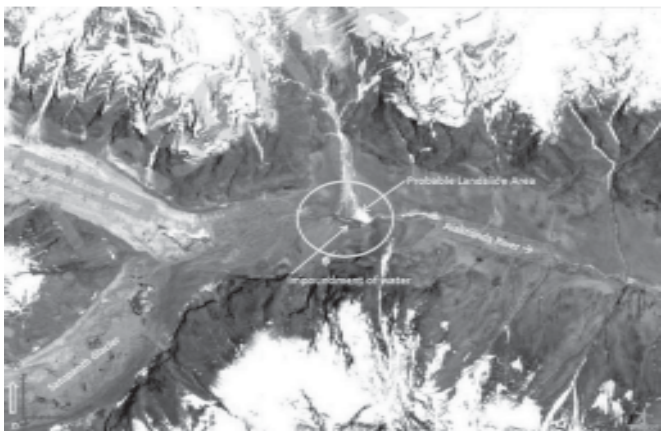

Fig.1. Showing Impounded water along the river basin

Source: www.dailymail.co.uk/indiahome/indianews/article

Geogenic Causes

Uttarakhand receives heavy rains between the months of July and September every year but in the year 2013, monsoon set in early June. Heavy rains continued for three

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days i.e. from June 16 to June 18, 2013 wreaking havoc in the region. The region received heavy rainfall of 154.5mm to 244.4mm in this period. Traditionally, Uttarakhand has always been prone to floods and landslides owing to fragile nature and poor soil stability in the steep slope of Himalayan ranges. The Bhagirathi and Alakhnanda have always been susceptible flood prone rivers.

Subtropical easterly jet stream passed along the Calcutta-Bangalore axis and further descended over the Bay of Bengal and formed high pressure area over the oceanic surface. The winds from high pressure oceanic surface started blowing towards the thermally induced low pressure land areas developed over the north-western part of the Indian subcontinent. The clouds were formed over eastern Rajasthan and New Delhi but they further moved upward towards lesser Himalayas in Uttarakhand.

The snout of Mandakani River received heavy rainfall. Heavy precipitation, both in the form of snow and rain, led to large amount of water flowing down the slope. This brought down debris lying on the path to Kedarnath settlements. The precipitation released enough water for a new stream to form in the area. At the same time, a small lake, Chorabari was formed in the north-western part of the Kedar valley. Due to an increase in the rate at which ice and snow melted, the accumulation of water in lakes started increasing. Sudden discharge of large volumes of water with debris from the lake potentially caused glacial lake outburst floods (GLOFs) in valleys downstream (Jain *et al*, 2012). The debris from the landslide and water from the lake travelled down the slope, channelled into the glacier and came down to Kedarnath town causing flash flood. The main area flooded by heavy rains was Kedarnath while they further extended to Uttrakashi, Rambada, Joshi Math, Chamoli, Rudraprayag and Guptkashi. These areas lie in the catchment areas of Alakhnanda and Bhagirathi basin. Due to morphological setting of the area, the region consists of unconsolidated and loose glacial, fluvio-glacial, or fluvial materials. The river had high sinuosity and therefore caused high level of erosion which resulted in flash floods. Flash floods are a type of landslide that consist of a spatially continuous movement of a saturated mass of earth materials, such as, debris and mud mainly controlled by gravity and whose movement mechanics resemble that of a viscous liquid (Cruden and Varnes, 1996).

Anthropogenic Sources

Human encroachments, change in the land use, deforestation and overgrazing are some intensifying factors which have induced unprecedented scale of devastation. Mountain ranges are being indiscriminately dynamited in the name of development. The Alakhananda and Bhagirathi rivers are important pilgrimage centers and attract high tourist's inflow during the months of March to October. In India after independence, democratization of leisure, educational awareness, social mobility, paid holiday schemes, spurts in transport network and eco-enhancement were some of the contributory factors leading to mass tourism (Singh, 2005). As a result, there is a huge expansion of roads and transport network in the mountain regions of Uttarakhand, which has destabilized the mountains. Slope-cutting on the account of road construction has triggered landslides on the steep slopes and resulted in large erosional catastrophic events. Studies also showed that the erosion has increased surface flow and has raised the river bed due to disposal of debris and silt in the rivers. Unprecedented dam building in the Indian Himalayas holds serious consequences for biodiversity and could pose a threat to human lives and livelihoods. Mega dams have the multipurpose applications and are considered

Fig.2. Flood Affected Area of Kedarnath

Fig.3. Landslide Due to Heavy Rains

Source: www.dailymail.co.uk/indiahome/indianews/article

as the greener energy sources in comparison with the other alternatives, but scrupulous environmental degradation has taken place in lieu of these constructions. These dams pose severe environmental risks in the Himalayan region and mostly in the downstream (Perucca *et al*, 2009). The area of Ganga Basin up to Devprayag consists of 13 commissioned hydro power projects with 57 projects under construction. Generation of hydro power does not consume any water but may cause significant changes in the stream flow variability. The hydro power projects changes the stream flow variability by regulating the natural flow and generating the electrical energy so that benefits are maximized. Due to this there is an additional fluctuation in the flows downstream of the point where the outflow of the power plant of a project meets the river. The fluctuations get moderated because of valley storage effect and lateral flow joining the river. This is harmful in seismo-tectonic weak zones. Many times the migrants end up living in the vulnerable zones because of lack opportunities. The rising number of migrants adds to the poor in these regions, already living in weak conditions (Kattelmann, 2003).

Conclusion

Climate never acted alone in creating the hazard or societal risk, anthropogenic elements were also involved. Rampant constructions, be it of road or dams had led to land use change in the region and the cumulative effect is reflected in the extensive damage caused by the rains recently. Thus, the need of the hour is to check human intervention in ecology. There is also a need for a comprehensive physical and socio-economic risk assessment of climate change in the mountainous regions. Environmental knowledge, early warning systems, meteorological information, hazard maps, building materials and building codes all help to protect the societies and reduce disaster impacts.

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