

Planning Strategies For A Challenging Floodplain Settlement, Case Of Kedarnath, Uttarakhand

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ABSTRACT

Kedarnath is a small town located in Rudraprayag district of Uttarakhand in India with a population of 612 (Census, 2011) and spread over an area of approximately 2.5 sq. km at elevation of 3583m from sea level. It is in Garhwal Himalayan ranges which are prone to catastrophes such as floods, landslides, earthquakes, cloud bursts, and glacial lake outbursts. Additionally, the town is situated between the holy rivers, Saraswati and Mandakini making the town fragile and unstable. The temple is one of the chota char dhams and one of the twelve jyotirlingas making it a significant Hindu shrine. Due to extreme weather conditions, the temple remains open for a specific period of six months. The Kedarnath flood was a hydro meteorological incident which stroked down the town during June 2013 impacting the settlement largely. Anthropogenic actions are responsible for the Kedarnath flood catastrophe and unfavourable geographic circumstances were to blame for the flash flood, ecological damage, loss of life, and socioeconomic structure of human existence in Kedarnath, Uttarakhand. The restoration works are carried out after the new government came into action in 2014 with collaborations of private and public consultations, Kedarpuri (Kedarnath temple area) master plan was prepared, targeted in 2022. Presently, Kedarnath pilgrimage routes are open for tourists until future announcements and the adventure activities are also conducted there. The study is carried out to identify the gaps in the disaster management planning and implementation. Various government reports, media articles, disaster guidelines and reports, GIS maps among others are analyzed to understand the damage caused and potential measures for development against future challenges. Development strategies for floodplains and seismic zone are provided in terms of town and country planning. The paper is an endeavor to assist the concerned authorities, researchers and communities working to resolve and minimize the planning issues escalated due to such incidents.

Keywords: hill area planning; disaster; Kedarnath; floodplain; development

Introduction to hill area Disasters and Kedarnath incident

The vulnerability of international tourism is one of the main issues with contingency planning. Devastating natural disasters like floods, landslides, earthquakes, cloudbursts, and glacial lake eruptions are very common in the Himalayan region. An essential component of every tourist destination—especially during a crisis—is disaster management. The land sharks were drawn in by the expanding tourist sector, and they disregarded all environmental regulations to build multi-storey hotels. Any town, region, state, or country can be severely affected by special situations like war, terrorism, crime waves, epidemics, and natural catastrophes. Threats like the ones listed above can raise concerns about the safety of visitors and locals as well as damage a destination's reputation in the marketplace. As such, it is imperative that all parties involved in the destination do an analysis and create backup plans in order to address hazards of varied degrees. The year 2013 had two significant occurrences: the "Phailin" cyclone, which devastated the coastal regions of Odisha and Andhra Pradesh, and the Uttarakhand Flash Floods, which mostly affected the state of

Uttarakhand. Both of these incidents were distinct from one another, and everyone involved could draw lessons from them. Disasters referred as catastrophes, mishaps, calamities, or grave events that affect an area due to natural or manmade causes, accidents, or negligence, and that causes a significant amount of property damage, human suffering, or loss of life, or that degrade the environment to the point where the affected communities are unable to deal with. A flood is a disastrous event that occurs when river levels rise above the danger zone. Its primary causes include sudden, intense rains, cloudbursts, glacial lake outbursts, etc. Frequently, these flooding events escalate to such an extent that numerous lives are lost, along with property, infrastructure, and biological systems being impacted. The Himalayan Mountain range, formed by the collision of two tectonic plates, is the youngest fold mountain range (Deen, 2020). The Himalayan region has suffered several floods, landslides, earthquakes, clod bursts, and glacial lake outburst disasters. Flooding is a temporary overflow of water onto land that is normally dry. Flooding can develop slowly or quickly. Floods can result from rain, snow, coastal storms, storm surges, overflows of rivers, and dam failure. Types of flood include are flash floods, river floods, storm surges, coastal floods, burn scars, debris flows, ice/debris jams, snowmelt, dry wash, dam breaks, and levee failures.

Cloudbursts are sudden, very heavy rainfall, usually local in nature and of brief duration. Most so-called cloudbursts occur in connection with thunderstorms. In these storms there are violent up rushes of air, which at times prevent the condensing raindrops from falling to the ground. A large amount of water may thus accumulate at high levels, and if the upward currents are weakened, the whole of this water falls at one time. Landslides are caused by disturbances in the natural stability of a slope. They occurs when masses of rock, earth, or debris move down a slope. Debris flows, also known as mudslides, a common type of fast- moving landslide that tends to flow in channels.

They can accompany heavy rains or follow droughts, earthquakes, or volcanic eruptions. Uttarakhand, located in northern India, is a mountainous state of 53,483 square kilometers, of which 46,025 square kilometers are hilly and 7,448 square kilometers are plain. The state borders Tibet in the north, Himachal Pradesh in the north-west, Nepal in the east, and Uttar Pradesh in the south (Scholar & Jaiswal, 2021). Its capital is Dehradun, located in the south.

The state is very vulnerable to natural disasters, including landslides, floods, and earthquakes. In June 2013, Uttarakhand, a state in the North- Western Himalayan area, experienced a terrible hydro meteorological event. It was discovered that there was a significant proportion of the tragedy that broke out at the Hindu pilgrimage site. Thousands of humans and animals perished in this horrific flood, which had an extremely bad effect. Anthropogenic activities and unfavorable geographical conditions were identified as the main causes of the

Kedarnath flood catastrophe. (Disaster Management_A_Case_Study_of_Uttakhand 2013). These factors also contributed to the flash flood, ecological damage, loss of life, and socioeconomic structure of the local population in Kedarnath, Uttarakhand.

Methodology

The study is conducted through understanding the case of Kedarnath town and the disaster occurred in 2013 in detail. Analysis of probable risks and vulnerability of the area is covered in the paper. The author studied thoroughly more than sixty articles, papers, journals, media reports and government documents to understand the incident in detail and identify gaps that exists that will lead us to formulate corresponding solutions for a fresh approach to disaster and tourism based spatial planning.

Case of Kedarnath floods

Located in the North-Western or Garhwal and Kumaon Himalayan area, Uttarakhand is a state in India that is tucked away in the Himalayan Mountains. As Uttaranchal's Dev Bhumi, Uttarakhand is well-known. Hindus have four Dham (holy places): Kedarnath, Badrinath, angotri, and Yamunotri, all of which are located in Uttarakhand's Garhwal Himalayan area. For Hindus, the Four Dham are the most revered locations.

One of the holiest sites among these four Dhams is Kedarnath, a popular destination for Indian pilgrims. A considerable distance separates the Chorbari glacier from the Kedarnath shrine. Mandakini and its tributaries arise from the snout of the Chorabari and companion glaciers. Located a few kilometers above the Kedarnath shrine lies the Chorabari Glacier.

There is a lake called Chorabari Lake that is located between the glacier's snout and above Kedarnath. The tragedy initially began with heavy rains and frequent cloudburst, which resulted in flash floods and landslides. It occurred in Kedarnath town, Rudraprayag district (86 km from the town) in 16 June 2013. It is a small town having a nagar panchayat. Kedarnath lies in a floodplain area, surrounded by two holy rivers Mandakini and Saraswati in Proximity to Chorabari glacier. It is one of the most remote 'chota char dham'

(Sati & Kumar, 2022).



Figure 1 Location map showing nearby places
Source: author



Figure 2 yellow line shows the major path to the temple and nearby areas; red shows town area limits Source: google earth



Figure 3 Site before disaster
Source: (SDMA UTTARAKHAND, 2016)

Shortcomings and response in the area

Even though Uttarakhand receives 1631 mm of rain on average each year, the state recorded its greatest total rainfall in 80 years during the period of June 1–18, 2013, with 385.1 mm. Rainfall during this period was 440% over average, with 71.3 mm being the typical amount (Scholar & Jaiswal, 2021). As per the Geological Survey of India (GSI), this caused the melting of Chorabari Glacier at the height of 3800 metres. Many thousands of pilgrims and tourists came on the Char Dham pilgrimage to Gangotri, Yamunotri, Kedarnath and Badrinath, Hemkunt, and to the Valley of Flowers and Roopkund were stranded without food and transportation for days because of rivers' overflowing, roads and bridges being washed out at over 450 locations, including National Highway 58. This completely stopped transportation and interfered with communication and the supply of electricity. Due to the challenging geographical conditions, hill areas are already at a vulnerable state during hazards making it difficult for people to communicate and access for help. As per the State Government report, 169 people died and 4021 people were reported missing (presumed to be dead) on 9th May 2014. The government issued about 2,845 death certificates (J Anandha Kumar Maj Gen V K Naik, 2014). About 10,000 people died, 3000 missing and hundreds were injured. (Fatewar & Kaur, 2020) Under rescue and relief operations, 105 satellite phones were distributed by the Government of India to various Central and state agencies including BSNL. Organisations such as Indian Army, Air Force and Central Paramilitary Forces, ITBP, NDRF also joined in on June 16 2013. A Coordination Committee was formed under the leadership of the Chief Secretary for conducting daily reviews. The State Government established a Missing Persons Cell on June 27 at the Disaster Mitigation and Management Centre (DMMC) at Dehradun (P, 2018). The "missing persons" data was managed with the support of International Business Machines (IBM) Corporation professionals. Social media platforms like Facebook and Twitter accounts were opened, where site photographs and emergency information were updated.(J Anandha Kumar Maj Gen V K Naik, 2014)

Issues and Analysis of Kedarnath incident

A comprehensive risk assessment and vulnerability analysis are crucial to understanding the dynamics of flooding in the region, including factors such as hydrology, topography, land use patterns, and climate change projections. Some of the identified causes are unregulated construction activities and congested street pattern made it worse for a sensitive hill settlement. There are no building or spatial planning guidelines

followed. No proper planning laws or framework for settlement practiced. Irregular construction activities undertaken in the floodplain area. The eruption of the Mandakini River causing heavy floods in the Rudraprayag district and adjacent areas (SDMA UTTARAKHAND, 2016). The enormous volume of water also induced to erosion along all the river valleys, which in turn, triggered landslides at a number of places. Other reasons include poor crowd management system for tourists, new construction projects in eco-sensitive zone, large deforestation drives; construction of dams disturbed the water bodies' natural flow, poor communication and coordination among the authorities, even after receiving alerts and warnings from IMD and GSI, no restriction was imposed in public movement. Also under planning aspects, poor planning of spaces is analysed along with absence of building codes, guidelines and lack of local people's awareness about disaster response.



Figure 4 flow of river water before and after the incident (National Institute of Disaster Management (New Delhi, 2013)

S. No	Item	Details
1.	Number of affected districts	13
3.	Number of dead and missing persons (Presumed to be dead)	(169 + 4021)
4.	No. of houses damaged :-	
	(i) Fully damaged pucca houses	2,119
	(ii) Severely damaged pucca houses	3,001
	(iii) Partially damaged pucca houses	11,759
	(iv) Fully damaged kuchha houses	394
	(v) Severely damaged kuchha houses	360
	(vi) Number of kuchha houses partially damaged	1,676
	(vii) Number of huts damaged	471
	(viii) Cowsheds damaged	361
5	Animals lost :-	
	(a) No. of big animals lost	3,280
	(b) No. of small animals lost	7,811

Figure 5 Damage caused in state as per government report (J Anandha Kumar Maj Gen V K Naik, 2014)

Discussion and results

Under government recommendations for such incidents, flood Plain Zoning Act regulating construction within the flood plain of a river should be implemented strictly. Clearance of all hydropower and other mega projects in ecologically sensitive regions like Uttarakhand, the Disaster Impact Assessment (DIA) should be compulsory besides Environmental Impact Assessment (EIA). Provision of landslide risk zonation mapping to be on priority for similar sites. Development and enforcement of guidelines, regulations and codes for landslides is critical. Effective stabilization of slopes in shear and weak zones be undertaken using scientific techniques available at national/international levels. A Special Central Programme undertaken for construction of new roads and renovation of existing roads in a scientific manner (J Anandha Kumar Maj Gen V K Naik, 2014). Recommendations include preparation and implementation of early disaster management and mitigation plan, awareness and training of public and rescue forces, emergency disaster fund stock, research and development in the field of disaster planning and related pursuits, capacity-building programmes for people and relief/rescue communities. Land use planning and zoning regulations should be implemented to restrict development in high-risk floodplain areas and prioritize the protection of critical infrastructure, heritage sites, and environmentally sensitive areas. This may involve the relocation of vulnerable settlements to safer locations, accompanied by appropriate compensation and livelihood support for affected communities. Lastly, stakeholder engagement, collaboration, and capacity-building efforts are critical to foster a participatory planning process that incorporates local knowledge, priorities, and aspirations into flood risk management strategies. By working together across government agencies, community organizations, academia, and civil society, we can develop sustainable solutions that safeguard lives, livelihoods, and the cultural heritage of floodplain settlements like Kedarnath for generations to come.

Conclusion

A disaster occurs when there is a combination of hazard and vulnerability. This paper addresses the challenges of floodplain settlements, particularly in the case of Kedarnath, requires a multifaceted approach that integrates various planning strategies. The devastating floods of 2013 serve as a stark reminder of the

vulnerability of settlements situated in flood-prone areas and underscore the urgent need for proactive measures to mitigate future risks. The adoption of nature-based solutions, such as afforestation, wetland restoration, and the creation of green infrastructure, can help enhance the natural resilience of the floodplain ecosystem, reduce flood risk, and improve overall environmental quality are some non-technical solutions to the issue. Furthermore, the integration of early warning systems, emergency preparedness plans, and community-based disaster risk management initiatives is essential to enhancing the resilience of floodplain settlements and ensuring timely response and recovery in the event of future flood events. Finally, it now mandates that spatial planning is a basic and game changing measure to mitigate incidents like Kedarnath especially when it is a religious and tourist attraction.

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