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# Infrastructural destruction and disaster mitigation: A study after June 2013 natural disaster of Uttarakhand

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## ABSTRACT

Natural disasters are an extreme event which causes great losses to life, environment and damage to socio- economic infrastructures. One of the most natural disaster prone regions in the world is the Himalayan region. The Uttarakhand region of Himalaya is geologically very sensitive zone. Two of India's largest rivers, the Ganges and the Yamuna, originate in the glaciers of Uttarakhand. In this region, every year, one or other types of disasters like earthquakes, landslides, floods etc. Uttarakhand has witnessed a natural disaster that has caused huge damaged to life, infrastructure and environment during the month of June in 2013. So, this paper focuses on the infrastructural destruction and disaster mitigation after natural disaster and some suggestion have been given to reduce the impact of natural disaster in the study area.

**Key Words :** Natural disaster, Infrastructure, Disaster mitigation, Himalaya, Uttarakhand

## INTRODUCTION

Natural disaster such as earthquakes, droughts, floods and tropical cyclones, fires, land slide and volcanic eruptions have caused major loss to human lives, socio-economic livelihood, the damages of economic and social infrastructure, as well as environmental damages. When occurring at district or regional level, a large number of people can be affected. Disaster is an undesirable occurrence resulting from forces that are largely outside human control, strikes quickly with little or no warning, which causes or threatens serious disruption of life and property including death and injury to a large number of people, and requires therefore, mobilisation of efforts in excess of that which are normally provided by statutory emergency services. A natural disaster occurring in a developing country which lacks the economic resources to meet the needs of its citizens at the best of times will no doubt undermine the quality of life of affected individuals and communities. Humanitarian and recovery assistance provided by the international community may serve to bridge this gap and help restore population to their former status. Natural disasters are extreme events which causes great losses to life, environment and damage to socio- economic infrastructures.

According to the Indian Government National Policy, the foremost responsibility for Disaster Management rests with the States Government. National Disaster Response Fund (NDRF) and State Disaster Response Fund (SDRF) plays very important role in disaster response, recovery

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**Table 1 : Natural disaster categories, types, and subtypes**

| Biological | Geophysical | Hydrological | Meteorological |
|---|---|---|---|
| 1.Epidemic | 1.Earthquake | 1.Flood | 1.Storm |
| * Viral infectious disease | 2.Volcano | * General flood | *Tropical cyclone |
| * Bacterial infectious disease | 3.Mass movement (dry) | * Storm surge/ coastal flood | *Extra-tropical cyclone |
| * Parasitic infectious disease | * Rock fall | 2.Mass movement (wet) | *Local storm |
| * Fungal infectious disease | * Landslide | *Rock fall | **Climatological** |
| * Insect infestation | * Avalanche | *Landslide | 2.Extreme temperature |
| | *Subsidence | *Avalanche | *Heat wave |
| | | * Subsidence | *Cold wave |
| | | | * Extreme winter condition |
| | | | 3.Drought/wildfire |
| | | | *Forest fire |
| | | | * Land fire |

Source: (EM-DAT), retrieve from http://www.emdat.be.

and mitigation of disaster, which directly helps in sustaining sustainable development of the disaster effected area.

The disaster management act 2005 lays down institutional, legal, financial and coordination mechanisms at the National, State, District and Local levels. As the Fig. 1 shows that how all the institutions are playing step wise role in the disaster management. As it can be seen from the Fig. 1 that actual implementation of ground level activities is down by the local government and panchayats.

There are necessary Budgetary provisions for short, medium, long term activities. ('The Calamity Relief Fund') is constituted by the State of Uttarakhand for the purpose of financing natural calamity relief assistance.

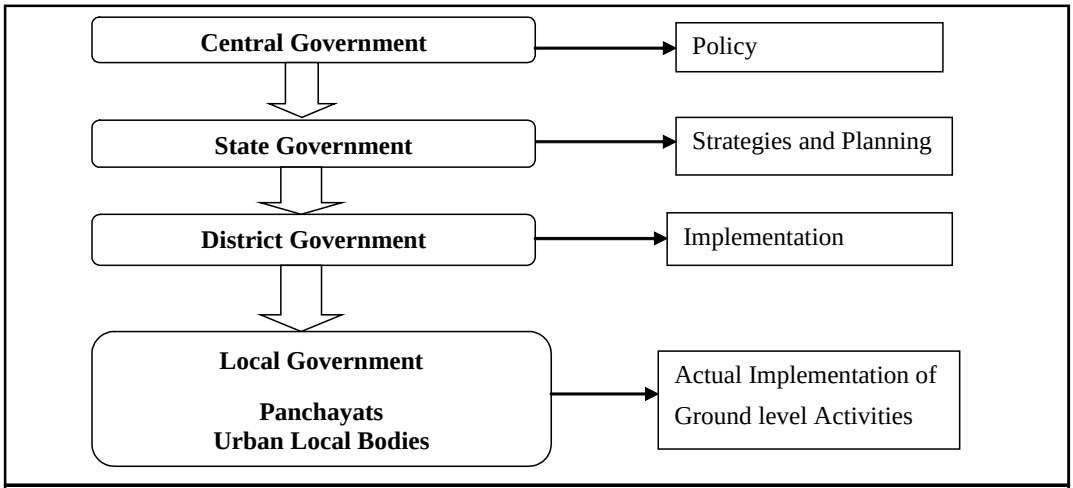


**Fig. 1 : Step wise work of disaster management system in India**

**Objective of the study** :

To study the impact of June 2013 natural disaster on infrastructure and disaster mitigation work done in the study area.

## METHODOLOGY

**Study area :**

This research was carried out in one of the state of India *i.e.* Uttarakhand. India's one of the Himalayan states, Uttarakhand, came into existence on November 9, 2000, lying between latitudes $28^0$ 44' and $31^0$ 25' and longitudes $77^0$ 45' and $81^0$ 1'E (Handbook of Statistics, 2007). It stretches across an area of 53,485 of which 93% is mountainous and 64% is covered by forest. The state's total population is 101, 16,752 in 2011 census, which constitutes 0.84 percentage of India's total population. The gender ratio is 963 females per 1000 males (Indian State of Forest Report 2013). Nine of its 13 districts are mountainous while the remaining four southern districts have substantial portions that are plains. Local folklore refers to Uttarakhand as 'dev-bhoomi' or the land of the gods. Over a million pilgrims and tourists annually visit the five prominent shrines – Yamunotri, Gangotri, Kedarnath, Badrinath and Hemkund Sahib – in this region. Other tourists visit the state for adventure, its wilderness and scenic vistas. In the disaster prone map of the country, Uttarakhand has attained its position among first five states in respect of natural hazards, *i.e.*, earthquakes, flash floods triggered by cloud burst, landslides, forest fires, avalanches and frequent droughts in summers.

**Research Methodology :**

The study is based on the data collected from secondary sources and field study by the researcher. Almost all 13 districts of Uttarakhand, directly or indirectly were affecting by natural disaster. District selection was totally based on the maximum impact of natural disaster, which affected the district in June 2013 disaster. For data interpretation percentage method and pie chart have been used. Secondary source include the official reports, documents, policies of the government analyses etc. The study is totally based on the June 2103 natural disaster of Uttarakhand.

## RESULTS AND DISCUSSION

The State is prone to severe earthquakes, landslides, flash floods triggered by cloud burst, forest fires, avalanches and frequent droughts in summers. The state falls in the highest seismic risk zones of the country *i.e.* Zone V and IV. These disasters have caused immense loss of property, natural wealth, and human lives. This paper basically focuses on the main infrastructure like houses, official building and road. In the month of June 2013, the region suffered its worst disaster in its living memory with huge loss of lives, property and wide spread destruction.

**Natural disaster impact on houses :**

The human settlement in the Uttarakhand like elsewhere, is concentrated along the rivers side. Over the time, as the river are drying shifting its route people are moving closer and building their houses near rivers by encroaching into flood plains. Table 2 shows the status of those five districts of the state which were worst effect after disaster. The table includes the numbers of pucca houses damaged in the urban areas and the number of pucca and kuchha house damaged in this district, which are further sub divided in two groups partially damaged and fully damaged house. The maximum number of partially damaged houses to be reported in Uttarkashi (650) followed by Bageshwae (135), Rudraprayag (144), Chamoli (118) and Pithoragarh (37). On the other side maximum number of fully damaged house was in Chamoli (662) followed by Rudraprayag (624), Pithoragarh (440), Uttarkashi (341) and Bageshwar (16).

Fig. 2 shows the total numbers of partially damaged and fully damaged house of those five

**Table 2 : Total number of houses damaged in five severely affected district of Uttarakhand**

| Sr. No. | District | Number of units | | |
|---|---|---|---|---|
| | | Partially damaged | Fully damaged | Total |
| 1. | Bageshwar | 135 | 16 | 151 |
| 2. | Chamoli | 118 | 662 | 690 |
| 3. | Pithoragarh | 37 | 440 | 810 |
| 4. | Rudraprayag | 144 | 624 | 768 |
| 5. | Uttarkashi | 650 | 341 | 991 |
| | Total | 1084 | 2083 | 3410 |

Source: National Institute of Disaster Management, Govt. Of India, New Delhi, 2013

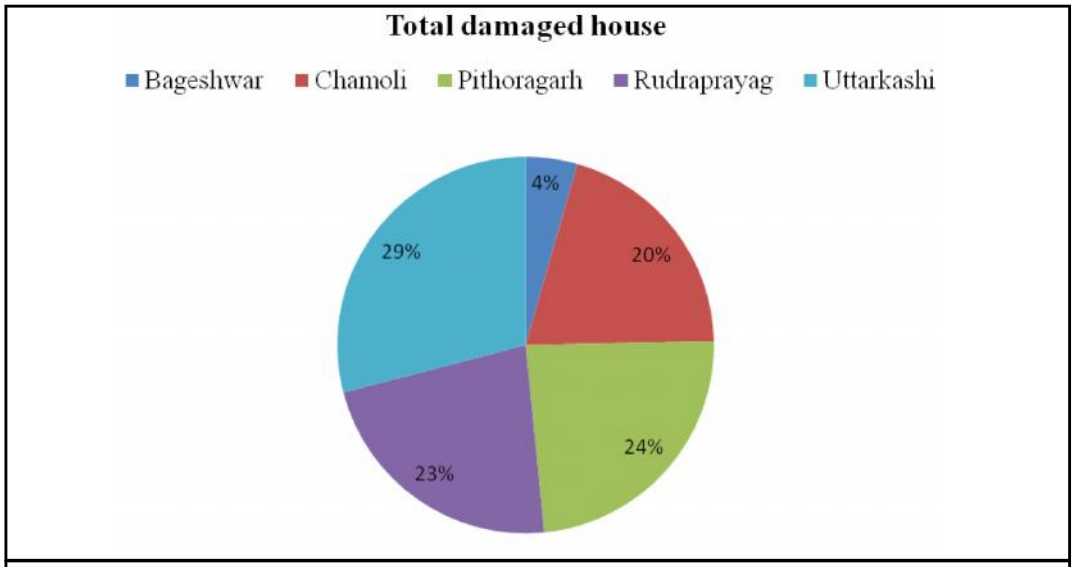


**Fig. 2 : Percentage of total house damaged in five severely affected district of Uttarakhand**

district of Uttarakhand whose infrastructure were severely affected after natural disaster. The Fig. 2 shows the maximum number of total houses reported damaged were from Uttarkashi (29%), followed by Pithoragarh (24%), Rudraprayag (23%) Chamoli (20%), and Bageshwar (4%).

Houses were damaged due to various reason but primarily many houses were washed away either by sudden shock caused by the forceful water currents were washed away, rising water levels or by erosion of the foundations and, many houses including other buildings were damaged either partially or fully and becomes unsafe for habitation. In this district there is a need to build building away from river side and the model of building should disaster proof. Damage to houses forced the affected people to move either to Government shelters or to their relative's house. Impact was more severe for those people who were economically more vulnerable; most of them lost their belongings and faced harsh wither conditions too.

**Natural disaster impact on Roads and Bridges :**

Other important infrastructure of this study is roads and bridge. The overall road network in Uttarakhand covered a length of approximately 31,929 km. Flash floods due to heavy rain caused intense erosion of the river banks and which damaged number of bridges at many places. The

Source: Field Survey (Photo taken by researcher after June 2013 disaster, Kedar valley)

**Fig. 3 : View of houses damaged after June 2013 Natural disaster**

disaster damaged about approximately 2174 roads, 85 motor bridges, and 140 bridle bridges.

Table 3 reveals that maximum length of road damaged was observed by Uttarkashi district (453 km) followed by Chamoli (337), Rudraprayag (239.18), Pithpragarh (119) and Bageshwar (101).

**Table 3 : Details of disaster affected roads under Border Road Organisation (BRO), National Highway (NH) and State Highway (SH)**

| Sr. No. | Worst affected Districts | Road with BRO (in km) | National Highway (in km) | State Highway (in km) |
|---|---|---|---|---|
| 1. | Bageshwar | 0.00 | 0.00 | 101 |
| 2. | Chamoli | 280 | 7.00 | 50 |
| 3. | Pithoragarh | 100 | 0.00 | 19 |
| 4. | Rudraprayag | 175 | 54.18 | 10 |
| 5. | Uttarkashi | 380 | 0.00 | 73 |
| | Total | 935 | 61.18 | 253 |

Source: National Institute of Disaster Management, Govt. Of India, New Delhi, 2013

The disaster essentially occurred due to wide spread heavy rains during the period 14-18 June 2013, which resulted in flash floods in all the major river vallies in the State. The disaster coincided with the peak tourist and pilgrim season, considerably the number of the casualties with adverse impact on the immediate rescue and relief operation. The entire region of the state was hit by 'heavy' to 'very heavy' rainfall triggered major landslide at numerous locations causing severe disruption to the infrastructure.

All the 13 districts in Uttarakhand directly or indirectly have been affected by the floods of which the five districts namely, Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi were the worst affected. The heavy sediment load along with big boulders acted as a tool of destruction and obliterated everything that came in its way. The enormous volume of water also

Photo taken by researcher (Road damaged due to flash flood at Kedarnath)

**Fig. 4 : View of damaged road of Kedarnath temple after June 2013 natural disaster**

induced to erosion along all the river valleys, which in turn, triggered landslides at a number of places. Building other than houses like hotel, restaurant assets and official buildings washed away. As it was the peak tourist arrival time, hotels and restaurants have suffered huge damage to their assets, and many of them faced sizeable business losses. The disaster damaged about 2174 roads, 85 motor bridges, and 140 bridle bridges.

It is very important to build a disaster resistant technology at individual house level in these disaster prone districts. Government should encourage, aware and help financially to the people for building their houses disaster resistant. There is also very much need of to find out different ways to encourage individual builder to use disaster resilient designs, techniques and material to construct any type of buildings. This will help in reducing the financial loss of the household and will help in fighting with after disaster impact.

## Conclusion and Suggestions :

On the basis of the above discussion of infrastructural impact of natural disaster in Uttarakhand, it can be concluded that the socio-economic systems of Uttarakhand state was highly susceptible to risks of natural disasters. Increasing frequency and magnitude of landslides, flood and the process of accelerated soil erosion have disrupted the components of the natural environment, and caused great loss of ecosystem services in the state. The flood disasters have also caused great damage to the social system and subsistence agricultural, animal husbandry, economy, and undermined food and livelihood securities of people inhibiting the disaster affected area

Finally the study says that there is an adverse impact of natural disaster on infrastructure of Uttarakhand. The households living in the zone of active bank erosion are required to be shifted to alternate safe locations. Suitably designed to protection walls are required to be constructed along the free face below the settlement on the river bank so as to avoid further bank erosion by the river. Water induced disasters like flood and landslides will occur in future also, but we cannot eliminate it. More collection and sharing of information and installation of warning systems are necessary. Rescue and rehabilitation should be fast and adequate. Rescue and rehabilitation should be fast and adequate.

Stabilization of landslides/shear zones should be given top priority while constructing roads, building in the hilly terrain.

The main thrust should be shifted from Disaster Relief to Disaster Mitigation. All development projects in vulnerable areas should be linked with and used to the maximum extent possible for disaster mitigation. Development projects having the potential to aggravate or cause hazards should be studied very carefully and so as to formulate and minimize their adverse effects in this regard.

Area flood mapping should be prepared to make future preparedness plans. Steps should be taken to involve more women in decision making levels in emergency management and disaster response planning. Such kind of participatory process should be created by public awareness through discussion, public meetings, and workshops related to mitigation and disaster response. Sustainable and safer infrastructure should be build basically in the hilly region like the present study area. The community-based disaster management system at the local level must be given utmost importance and strengthened through appropriate training and awareness programmes.

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