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Disasters and sustainable development: A case study from Kumaun Himalaya

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Abstract
Kumaun Himalaya is geologically very active and sensitive for tectonics and slope instability that reasons a disasters occurrence as a common problem either natural or man-made. This region is highly prone to landslides, earthquakes, cloudbursts, glacial bursts, flash floods and many more man-made activities causing disasters. Disasters are undesirable and sudden events which cause physical, human, economic and environmental losses that exceed the coping capability of the affected community or society. Natural hazards in extreme conditions which can be Metrological, Hydrological, Climatological and Geophysical often cause disasters. Disasters caused due to human actions may either occur in the form of man-made environmental and technological disasters (dam construction, mining, forest fire and pandemics etc.). Uncontrolled forms of man-made disasters may result in desertification and other environmental problems. In such a situation sustainable development is required because it is "Development that meets the needs of the present, without any compromising the ability of future generation to meet their own needs". Therefore quality of the environmental components has to be checked keeping in mind the concepts of sustainability. This paper discusses the causes and effects of disasters caused by man-made activities and geological sensitivity. The most effective way to address the man-made activities is to adopt sustainable development pathway by modifying the present situation to environmentally sustainable technologies and promotion of energy efficiency, renewable energy, forest conservation, reforestation and water conservation etc. Addressing disasters human requires a good scientific understanding as well as coordinated action at 'Vocal for Local'.

Keywords: Kumaun Himalaya, anthropogenic disasters, tectonically, slope instability, flash flood.

Introduction
Kumaun, an administrative division of Uttarakhand is located in the Indian Himalayan region known for its rich spiritual and religious tourism, ecological richness and diversity and cultural ethos rooted in traditions, but it is also known for growing frequency and intensity of natural disaster and for its fragility of ecological geological systems (NIDM, 2013) [16]. Disaster is an extreme sudden event which mainly occurs due to geological sensitivity and unplanned or mismanaged anthropogenic activities. Disaster is an undesirable occurrence resulting from forces that are largely outside of human control, strike quickly which causes serious disruption of physical landforms or phenomena as well as life and property include death and injury to a large number of people (Ashok Kumar, 2016) [23]. The disaster can be broadly divided into two parts based on the causes of disaster which are natural disasters and anthropogenic disasters (Jha, 2010) [7]. It appears on earth surface in the form of extreme events both natural and man induced, which cause serve damage to human life on one hand and other biological communities on the other hand. Such sudden catastrophic events are the result of natural and human factors; for example volcanic eruption, earthquake and tsunami are exclusively caused by natural processes but landslide, flood, fire and nuclear disaster. In the 20 year period between 2000 and 2019, EM-DAT recorded 7,348 disasters events, which claimed a total of approximately 1.2 million lives and affected more than 4.03 billion people. On average, there were 367 disaster events each year, the majority of which were floods and storms (44% and 28% respectively). The economic loss due to disasters during this period was US $ 2,97,000 crore (UNDRR, 2019) [26]. The disaster events are the most common phenomena of Kumaun Himalayas, Uttarakhand. According to the Bureau (UNDP, 2016) [24] of Indian Standards, on a scale ranging from I to V in order of increasing susceptibility to earthquakes, study area lies inside seismic zone VI and V.

Study of geomorphology and geology are very useful aspects for disaster mitigation, Remote Sensing (R.S) and Geographic Information Science (G.I.S) are very helpful techniques for disaster management and identification of disaster-prone areas (Ahmad and Goparaju, 2018) [1] and sustainable development. The advance knowledge of disasters, new techniques of reduction are developed in many countries but the frequency and intensity of disaster remain constant (Gardner, 2002, Van Aalst and Burton, 2002) [4]. In present, forest fire and landslide are very frequent events in the form of man induced disaster and earthquake, erratic heavy rainfall, cloudburst, flood and flash flood events are occurred frequently during before and after monsoon season are commonly observed as natural hazards often resulting in disasters. Consequently effect of these disasters, damage to plants, the habitats of humans and wild animals, agricultural land and construction sites as roads, bridge and other infrastructures are devastating. The disaster events affect the development process of the entire Kumaun Himalaya region and the life inhabitants live in the hilly areas. It is not possible to stop the occurrence of disasters but human the damage caused can be reduced by disaster by sustainable development.

In the recent years extreme rainfall events have become common and recurring phenomenon in the Himalaya, especially in Garhwal and Kumaon regions of Uttarakhand. In the year 1998 the state witnessed major landslides at Malpa, Pithoragarh and Okhimath, that took toll of more than 350 human lives (Rautela P, Paul SK, 2001) [20]. In the year 2010 Uttarakhand experienced unusually heavy rainfall between 16 and 20 September that resulted in a number of landslide, cloudburst and flash flood events throughout the state. Around 9,162 villages and many towns with population of 29.23 lakh were affected by these incidences that took toll of 214 human lives. More than 26,011 residential houses were damaged while around 1,771 farm animals were lost (Sharma S., 2012) [21]. Development in the mountains, therefore, has to have a different approach, given the fragility and vulnerability of the Himalayan ecosystems due to the uniqueness of mountain specificities (Jodha NS, 1992) [11].

Objectives

The present study mainly focuses on disaster and Sustainable Development. The main thrust of this study discusses disasters and their types and how sustainable development correlates disasters with occurrences planning and management. The following objectives are presented in this paper:

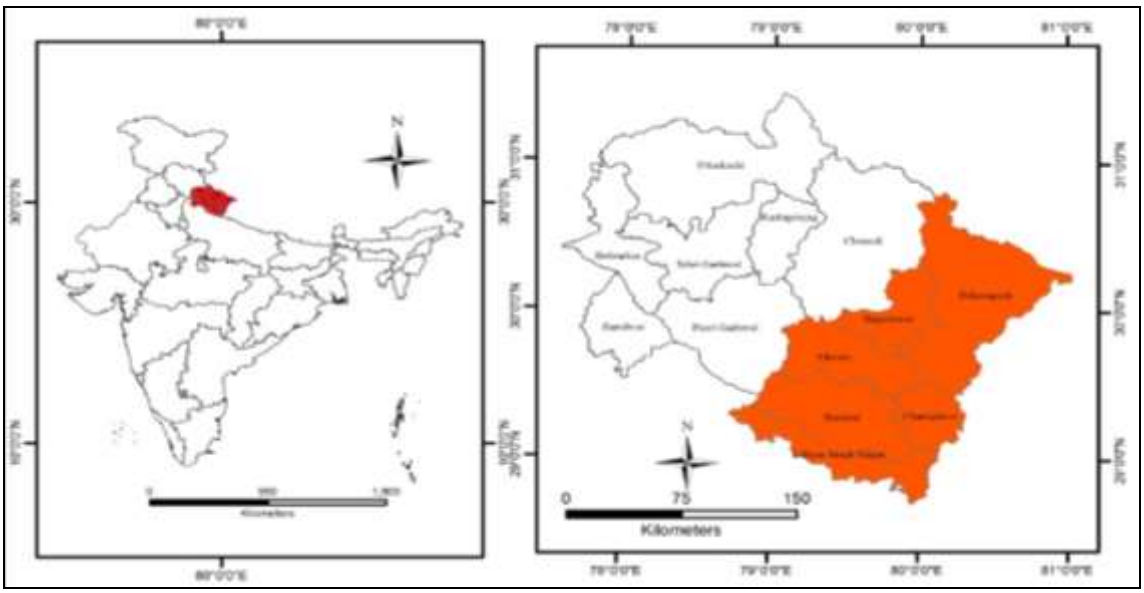
1. To study the disasters and their types in Kumaun Himalaya.
2. To identify disaster vulnerable areas.
3. To study the causes due to man-made activities.
4. Identify the important role of sustainable development in disaster management.

Methodology

The present study is completed with the help of primary and secondary data collection. The study used data set collected from Disaster Management Office, District of Kumaun Himalaya, Literature review and Census of India, 2011, which include disaster vulnerable areas past disaster occurrence and their impacts. Mapping of vulnerable areas was possible by Geographical Information System (GIS) tools.

Study Area

Kumaun Himalaya is a part of Himalayan region. Administratively, this hill state is divided into two divisions-Kumaun (South-east part) and Garhwal (north-east part). There are total 13 districts in this hill state, Kumaun division consists of 6 districts, while the remaining the 7 districts fall in Garhwal division. Kumaun division is also known as Kumaun Himalaya. It comprises the six north eastern Himalayan districts of Almora, Bageshwar, Champawat, Nainital, Pithoragarh and Udham Singh Nagar. Geographically, the study area is located in the Kumaun Himalaya region of Uttarakhand state, India extending from $29^0 25'39.5"$ N to $29^0 59'33"$ N latitudes and $79^0 03'03"$ to $79^0 04'45"$ E longitudes which encompasses an area of 21,035 km^2 out of total areas. It has an average elevation of about 4,466 meters. Its total population is 4,230,570 out of total state and density is 189/ sq. km., literacy rate is 79.63% (Census of India, 2011) and Languages spoken are Kumaoni and Hindi. To the east and the north the region touches the international boundaries of Nepal, China and Tibet. The study area surrounded by Chamoli in the north west, Pauri Garhwal in the west and Uttar Pradesh in the south.



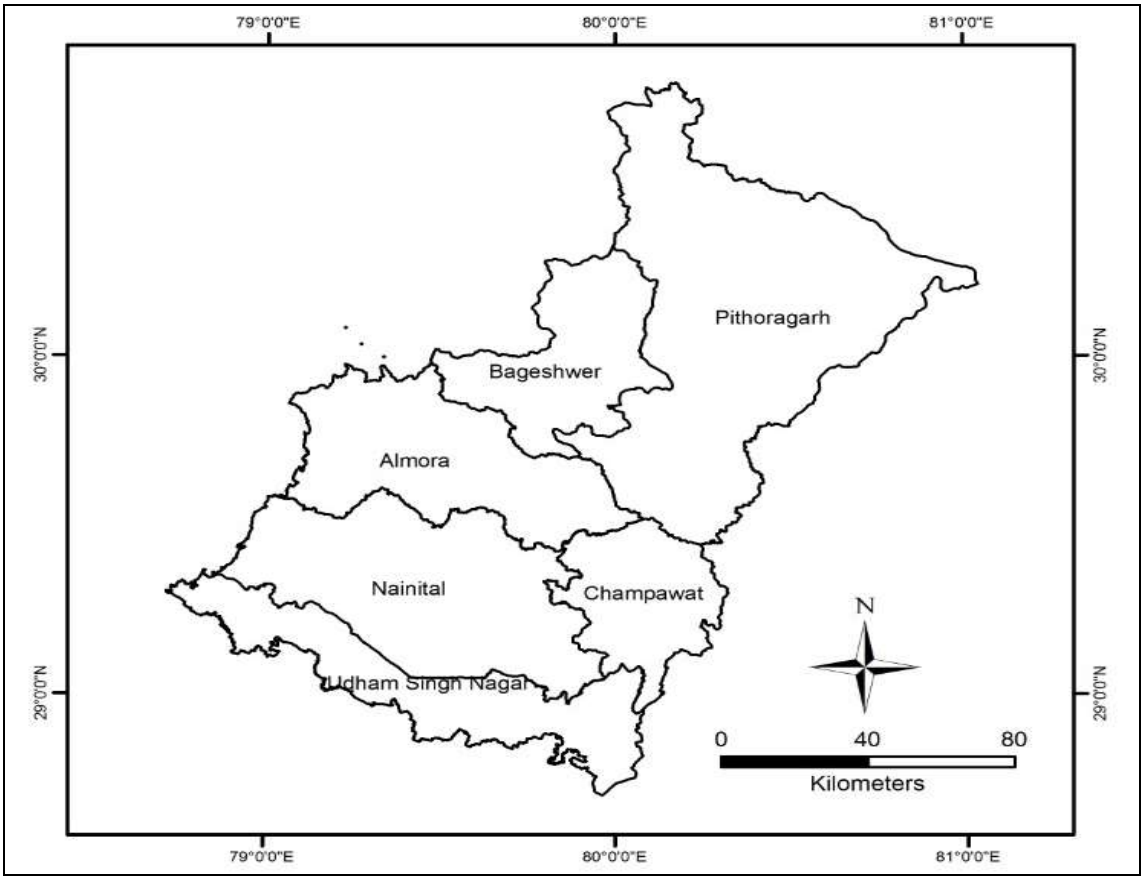


Fig 1: Location Map of Study Area

Geomorphology, geology and climate

The geomorphology of the region is defined by the Himalayas being completely land locked. The region has a wide range of geomorphic features such as mountain cliffs, moderate to gentle slopes, waterfalls, major and minor ridges, river and glacial valleys (Pithoragarh), highly and denudational hills, river terraces and various fluvial geomorphic features like point bar, meandering scars and natural levees. The region of the state is sensitive (Phithoragarh and Bageshwar) towards earthquakes, landslides, mass wasting processes, flash floods, cloudbursts and heavy rains. In the foot hills the Terai and Bhabar areas (Nainital and Udham Singh Nagar) of the state are prone to flooding and water logging. Therefore this region becomes very important from the point of view of disasters.

India has the highest mountain chain on earth, the Himalayas, which are formed due to collision of Indian and Eurasian plate, the northward movement of the Indian plate towards China causes continuous stress on the rocks making them friable, weak and prone to landslides and earthquakes. The slow motion of the Indian crust, about 5 cm/year accumulates stress to which natural disasters are attributed. Some landslides make unique, and unparalleled catastrophes. Geographical area of the state is 53,483 square kilometers; 93% of which is mountainous and 64% is covered by Forest (Khanduri, 2020) [28]. Geologically, this region is a young mountainous terrain and this region is delimited by various Thrusts/Faults as Trans Himadri Fault (THF), Main Central Thrust (MCT), Main Boundary Thrust (MBT) and Main Frontal Thrust (MFT) from north to south.

All three ranges (Himadri, Lesser and Shivalik) of the Himalaya Mountains exist in Kumaun region. The Himadri is lies in the northern part (Pithoragarh), the Lesser Himalaya (Almora and Nainital) in the central part and the Shivalik Himalaya (Nainital and Udham Singh Nagar) in the southern part. This region is mainly divided into two climate regions. Majority of Kumaun Himalaya's area is hilly while south Nainital and Udham Singh Nagar district is plain. Thus there is a severe winter in the summer here. There are two clearly defined seasons, summer and winter. During the coldest months of December and January, the tropical and temperate mountain ridges and high locations receive snowfall and have an average temperature of 5.5-8.0 °C (41.9-46.4 °F). Pithoragarh, Nainital and Udham Singh Nagar districts experience extreme variations in temperature due to the large variations in altitude. The temperature rises from mid-March through mid-June. The maximum rainfall occurs in Kumaon region from July to September, due to which the possibilities of disaster increase the most.

Results and Discussion

Kumaun Himalaya is geologically very sensitive and prone to man induced disaster events. The study area faces several disaster occurrence such as earthquakes, landslides, heavy rains, flood and flash floods, cloudbursts and forest fires due to uneven relief, mountains region, slope instability, erratic heavy rainfall, flash flood and their interrelationship with human activities. Extreme disasters events strike the study area occur most during the monsoon season (July to September) and forest fires in the summer season (March to June) apart from this cloudbursts and earthquakes may occur at any month or anytime throughout the year. This research paper focuses upon the major sensitive areas where disasters frequently were high.

Disasters vulnerable areas in Kumaun Himalaya region

Natural and man induced disasters in Uttarakhand are define due to its tectonic activity, lithological, structural and ecological setting, topography and changing landscapes owing to various natural and anthropogenic activities. Natural disasters like earthquakes, landslides, slope failers, rock falls, avalanches, cloudbursts, hailstorms, Glacial lake outburst floods (GLOF), floods, flash flood, lightning, forest fires etc. are frequent in Uttarakhand causing loss of life and property from time to time (NIDM, 2013) [16]. The disaster events are the most common phenomena of Kumaun Himalaya, Uttarakhand. The district of Kumaun Himalaya specifically Nainital, Bageshwar, Pithoragarh and Udham Singh Nagar were the worst affected. They occur almost every year, due to which agriculture land, life infrastructures and ecosystem are most affected. Disasters create a significant constraint in development of the any area. Therefore, it is very important to analyze and indentify the disaster and sustainable development in disaster vulnerable area. That's why the development should be in such a way that a dangerous situation does not happen at the time of disaster.

Table 1: Major disaster vulnerable areas in Kumaun Himalayas (1969 to 2013)

S.N.	Vulnerable Area	Frequency (in Last 6 Decades)			
		Earthquake	Landslide	Cloudburst	Flashflood
1	Pithoragarh (Dharchula, Munisiari, Didihat)	8	3	2	3
2	Bageshwar (Kapkot)	8	NA*	1	3
3	Nainital (Dhari and Naini lake)	1	NA*	NA*	1
4	Almora (Khetgaon, Ranikhet)	2	NA*	3	1
5	U.S.Nagar	NA*	NA*	NA*	2
6	Champawat	NA*	1	NA*	NA*
Total	-	19	4	6	10
Damage	-	NA*	285 people died	103 People died and 8 injured	105 People died, 4 injured

*NA- Not Available

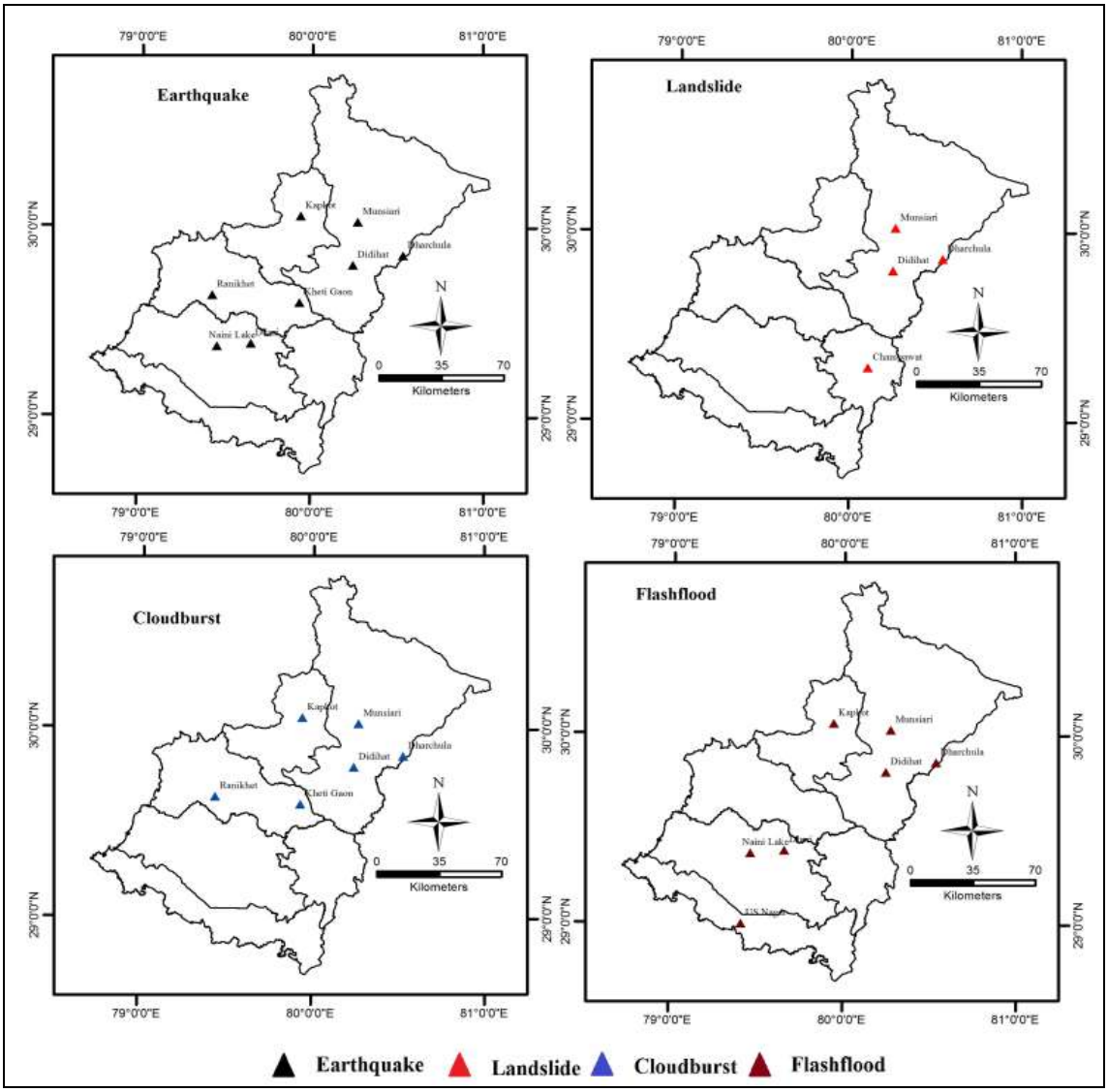


Fig 2: Disaster vulnerable area in Kumaun Himalayas

Table 2: District wise vulnerability to natural hazards of Kumaun Himalaya

S.N.	Disaster	Earthquake	Landslide	Flash flood	Flood
1	Almora	H	H	H	L
2	Bageshwar	VH	VH	VH	L
3	Chapawat	H	H	L	VH
4	Nainital	H	VH	H	VH
5	Pithoragarh	VH	VH	VH	L
6	Udham Singh Nagar	H	L	L	VH

*VH (Very High), H (High), L (Low)

*Earthquake Zone (V) - VH (Very High), Zone (IV) - H (High)

It is clear from the above table 1 that the intensity of disaster in Kumaun Himalaya is increasing 1969 to 2013. Among the districts of Kumaun Himalayas, the most vulnerable areas from disaster point of view are Dharchula, Munsiyari and Didihat of Phithoragarh, Kapkot of Bageshwar, Dhari and Naini lake area of Nainital, Khetgaw and Raniket of Almora, and Plain area of Udham Singh Nagar and Champawat. Pithoragarh and Bageshwar (Fig. 2) are the most vulnerable areas out of these disaster affected areas of Kumaun Himalaya, which show the highest frequency of disaster (Table 2). Various geomorphic processes including pluvial, fluvial, mass wasting and anthropogenic processes are degrading the basins in this fragile area, (Joshi, 2016) [9]. These active processes result into disasters several times in the basin area.

Past Disasters in Kumaun Himalaya

During this period (1980-1999), 4,212 disasters killed about 11.9 lakh people, affected 300 crore people and caused an economic loss of US $ 1,63,000 crore (UNDRR, 2019) [26]. Better reporting and recording can be considered responsible for this increase in disaster incidents to some extent, but mainly the increase in weather related disaster incidents is responsible for this. Environmental Hazards and disasters are normally divided into the following two broad categories on the basis of main causative factors and their mode of origin (Singh S. and Singh J., 2014, pp.5) [25]: (i) Natural Hazards and Disasters (ii) Man induced (anthropogenic) hazards and disasters. From the causal point of view of disaster, natural disaster is the most influential factor in Kumaun Himalaya region, mainly due to origin of Himalayas and its tectonic activity. Naturally, it is a mountainous region in which slope stability, sensitivity of rocks and human interference are the main factors. It is true that geographical and meteorological conditions are mainly responsible for the occurrence of frequent disasters resulting huge loss of life and property, it cannot be denied that the factors like inadequacy of warning communication systems, lack of preparedness and workable disaster management plans (CEE, 2004) [27]. At present, the exploitation of nature is increasing due to the greed of human beings due to which the challenges of the victory (Possibilism) of man over nature is proving to be true. Therefore out of natural and man induced disasters, man induced disaster proves to be the most destructive, whose effect also remains on natural disaster. The major disasters in Kumaun Himalaya since 1969 to 2013 are described as follows.

It is clear from Table 1 that the entire Kumaun Himalaya has been affected in past calamities. Tectonically, Garhwal Himalayas have been more active than Kumaun Himalayas since geohistoric times, the main reason being the geological structures, rock formation, tectonic discontinuities (M.B.T and M.C.T) and indiscriminate development work. It has however not experienced a great earthquake (Mw $\geq$ 8.0) for more than previous 200 years. But still, 1803 Garhwal earthquake occurred 7.8 magnitudes had an epicenter in Uttarkashi with the loss of about 300 lives, 1816 Gangotri region with 6.5 magnitude, 1902 the south west Pauri with 6.2 magnitude, again 1906 Gangotri with 6.1 magnitude, 1926 near Nanda Devi with 6.5 and 1991 Uttarkashi district with 6.8 magnitude with 768 people were killed and nearly 5000 injured. Therefore Garhwal region have been among the most prone areas to earthquakes rather than Kumaun. Dharchula and Munisyari of Pithoragarh; Kapkot of Bageshwar and Nainital are the most vulnerable areas where earthquakes with highest magnitudes (5.0) 1969 to 2013 (Table 1) have occurred. Geological structure and human activities are the main causes for an increase in the disaster vulnerable areas. Earthquake hazard potential is assessed to be particularly high in the entire Himalayan terrain and in the past the region has been joined by four great earthquakes, apart from Kumaun Earthquake of 1720 and Garhwal Earthquake of 1803 (NIDM, 2019) [26].

It is clear from the above Table 1 that the entire Kumaun Himalaya has been affected in past landslides. The Malpa landslide of 1998 is considered one of the most severe landslide disasters in recent times. Due to which not only the local people but also at the national and international level were affected (Fig. 3). Some events of tragedies are reported as landslide in Kumaun Himalaya, 1998 Malpa in Pithroagarh, 2009 Berinag- Munsiyari road, Pithoragarh as well as 2008 Amru Band in Champawat. The landslide wiped out two villages namely Jhakhla and Lah claiming 43 lives in Pithoragarh. The lake burst in the night of 17 August 1998 released a huge amount of water together with boulders and debris. On 18 August 1998, the inevitable happened and the huge landslide overran the Malpa habitation and took toll of more than 200 people besides blocking the stream yet again. Bursting of the landslide dam this time washed off the dead bodies and severely hampered the pace of the rescue work (Paul *et al.*, 2000) [20].

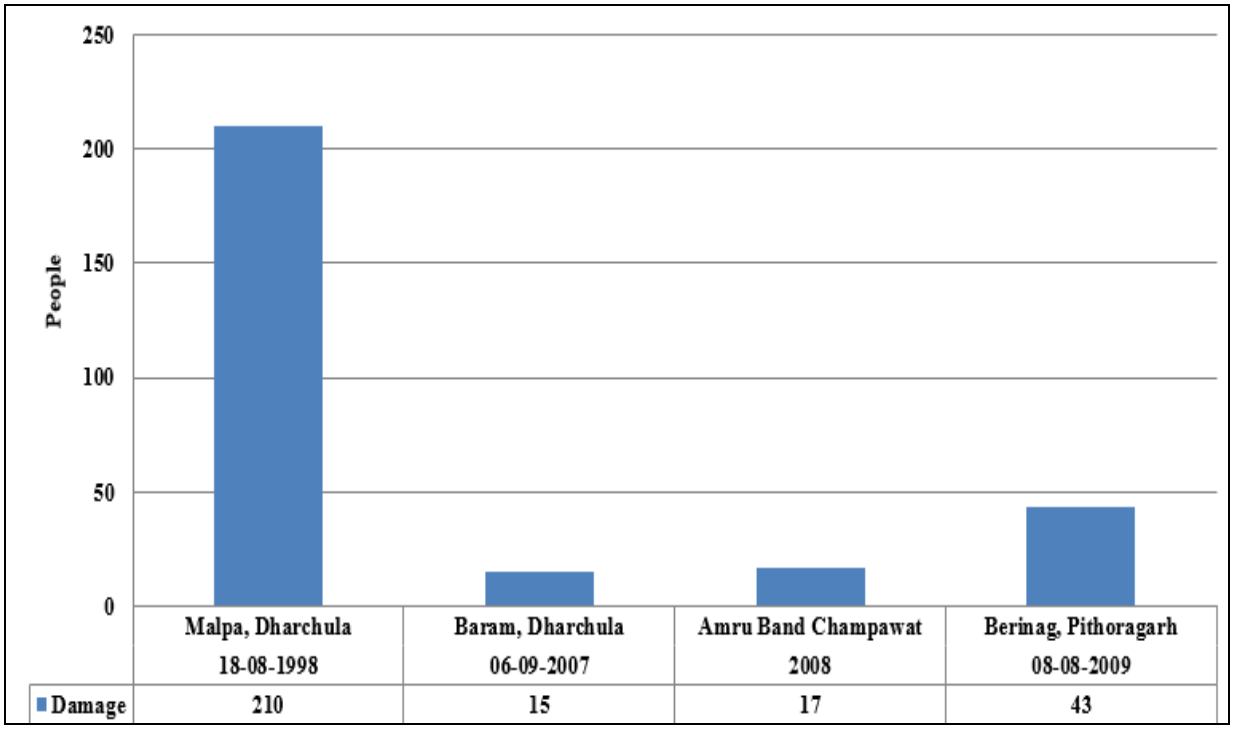


Fig 3: Disaster Impact: Total numbers of people deceased by major landslides in major year

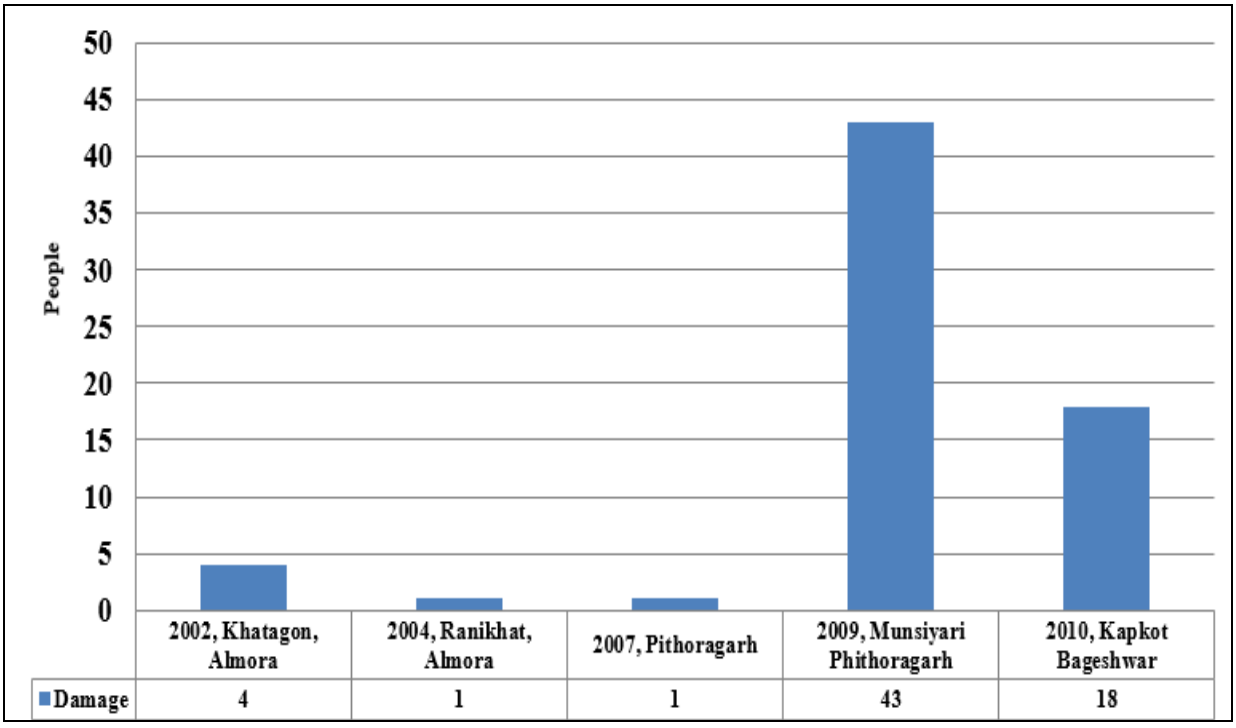


Fig 4: Disaster Impact: Total numbers of people affected by cloudbursts in major years

In recent times extreme rainfall events as cloudbursts are dominant phenomenon trigger large scale mass movement and flash floods in Kumaun Himalayan region, effecting Pithoragarh and Bagehwar districts severely. Cloudburst is a natural and common phenomenon in the Himalaya, especially in Garhwal and Kumaun region of Uttarakhand. Cloudburst and associated disaster affect thousands of people every year and cause loss of life, property, livelihood, infrastructure and environment in all year round. Cloudburst during Malpa (Pithoragarh), 2010, Bageshwar (Kapkot), and Almora are some of the examples of recent cloudburst incidences associated with flash floods and landslides in Kumaun Himalaya (Fig. 4).

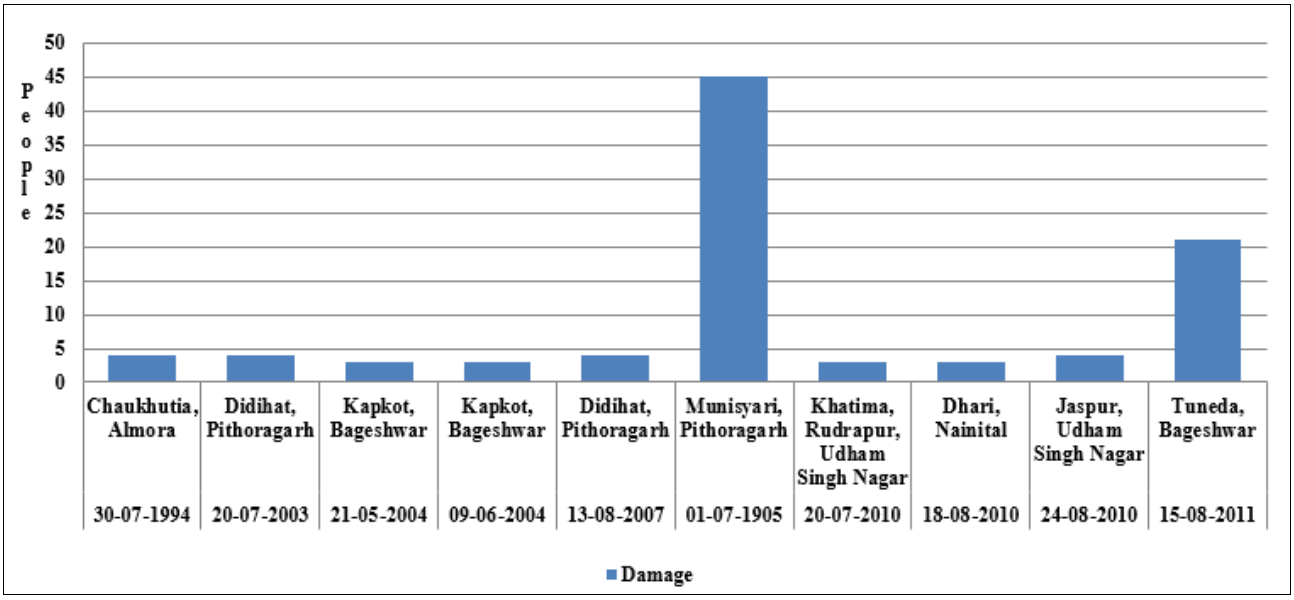


Fig 5: Disaster Impact: Total numbers of people affected by flood and flash floods in major years

Flash food is a differently damage life and property and is most visible in the southern part (southern Nainital and Udham Singh Nagar) of Kumaun Himalayas of Uttarakhand. It is clear from the disasters of past that it has been effective not only on the southern districts but also rather the areas including parts of Pithoragarh and Bageshwar in the northern part of the study area (Fig. 5). If studied in the context of flood the flood of 2011, Tuneda Bageshwar was very effective which caused maximum damage.

Man induced disasters in Kumaun Himalaya

Man induced disasters also known as anthropogenic disasters, are defined as activities of humans, whether deliberate or indeliberate, leading to great loss of human lives, economic and physical environment. Events that are caused by humans and their activities and occur in or close to human settlements are termed as anthropogenic disasters. Kumaun Himalaya being a mountainous region becomes important from the point of view of disaster because it falls under very sensitive zone from geological and tectonic point of view due to which landslides; earthquakes, flash floods and natural and man-made forest fire are common disasters. Intentional or unintentional all kind of man-made disasters lead to human sufferings loss of life and long term damage in economy. Some of the human activities also accelerate and motivate natural disasters such as dam failure floods, reservoir-induced seismic events, landslides (deforestation and road construction), accelerated soil erosion (caused by faulty farming practices and deforestation) etc. Human induced disaster could arise from the unintentional activity as poor maintenance, low quality work or human error, or from intentional activity likes sabotage, mischief, revenge, riots, mob fury, enemy attack etc. Sometimes, man-made disasters are the results of system or process malfunctioning as in the case of nuclear radiation, gas leak, explosion and fire. System failures or accidents occur due to technical malfunction or human error.

Main Causes of Man-made Disasters

Kumaun Himalaya's geography and geology is very dynamic as vast and maximum of the area is mountainous region. Deforestation, land grazing, legal and illegal development on the soft bed of rock leads to disasters when earthquake, landslide and flash flood hit the area. It is clear from the felid inventory of the study area that while tampering with the Himalayan slopes, one need to be extra careful as these are the slopes, which have evolved by earth exogenic and endogenic processes and hence are dangerously balanced, which makes them more vulnerable to disasters (Nair AS and Singh SK, 2014) [16]. India has the highest mountain chain on earth, the Himalayas, which are formed due to collision of Indian and Eurasian plate, the northward movement of the Indian plate towards China causes continuous stress on the rocks rendering them friable, weak and prone to landslides and earthquakes. The slow motion of the Indian crust, about 5 cm/year accumulates stress to which natural disasters are attributed. Some landslides make unique and unparalleled catastrophes. Cause of man-induced Disasters are.

i) **Unplanned cities:** Urban development can change the environment or ecosystem through, for instance, the expansion of paved, impermeable areas, which prevent rain from being absorbed by the soil thereby increasing flood hazard, particularly in low-lying areas. Most of the effects of the disasters are seen in the urban areas because the population density is high rather than rural areas. The main reason of disasters in these areas because of excessive development and infrastructures construction are high rather than rural areas. Inadequately planned and managed cities also create new risks which threaten to erode current development gains (Fig.6.a). The lack of adequate infrastructure and services, unsafe housing, inadequate and poor health services can turn natural hazard into a disaster. In 1993, several buildings collapsed in south western part of Almora town (Joshi and Pushpa, 2019) [10].

(a) (b) (c)

Fig 6: (a) Unplanned Town at Almora (b) Lack of Proper Drainage System in Udam Singh Nagar (c) Road Construction in Almora-Haldwani Highway

ii) Lack of proper drainage system: Flash flood is a main disaster which is influence local people. Due to which town and road networks drainage system are overflow in during heavy rainfall. Its resulting in even a small drain would attract the huge block water on the roads which would travel the people by walking, vehicle and everything (Fig.6.b). Natural drainage in and around Almora town area has blocked the natural drainage system in western part of city (Joshi and Pushpa, 2019) [10].

iii) Haphazard construction work-road, bridge and Urbanization: As development where on one hand proves necessary for human beings on the other hand it also invites various disasters. Construction of roads, bridges, settlements and dams are such an example which are influenced physical morphology, environment and human life and property. These types of disasters are often seen happening in all the districts of Kumaun (Fig. 6.c). It is a cause of disasters. January 19, 2020 in Pithoragarh a bridge have collapsed on Sunday after a heavy truck passed over it. The truck also got perturbed in the incident while two persons got injured. Same in Pithoragarh district 2 Feb, 2012 a metal bridge at canal Gandali village in Pithoragarh district has collapsed leaving two people dead and three other injured. Road construction work is active in Kalish Mansarover (Fig. 6.d) where the frequency of disasters is increasing.

(d) (e) (f)

Fig 6: (d) Road construction in Mansarowar pilgrimages (e) Forest Fire in Almora District (f) Damming effect in Dholiganga

iv) The Damming effect: Kumaun Himalaya is rich in hydrological powers which in Phithragarh, Udham Singh Nagar, Bageshwar and Champawat are main districts. While hydroelectric projects provide electricity to the state on the one hand, on the other hand it creates various problems (Fig. 6.f). Table 2 depicts the main power projects of Kumaon district in which maximum number of projects are under construction. Pithoragarh has the maximum number of power projects among all the districts. The dam construction is a cause of flood and earthquake disaster because dam failure is simply an uncontrolled release of water from a reservoir through a dam as a result of structural failures of deficiencies in the dam. There are major causes of dam failures in these areas are over topping of water, foundation defects such as slope and uplift pressures, piping and seepage failures as a result increase internal erosion The older, steep slope, constructed material and rock structure dams get, the more potential exists for catastrophic dam failures.

Table 2: Major list of hydro power stations in kumaun districts (Under Construction/ in Operation)

S.N.	Name of Project	Installed Capacity (MW)	Stream/River	District	Developer	Altitude	Status
1	Balighat Vinola	15	-	Champawat	-	-	Under construction
2	Kalika Dantu	230	-	Pithoragarh	-	730	Under construction
3	Ramganga Dam	66	Ramganga	Pithoragarh	-	-	In operation
4	Garba Tawaghat	630	Sarda	Pithoragarh	NHPC	-	Under construction
5	Dhauliganga	280	Dhauliganga (A)	Pithoragarh	NHPC	1992	In operation
6	Chungar Chal	240	Dhauliganga (K)	Pithoragarh	NHPC	-	Under construction
7	Bogudhiyar Sarkaribhyol	170	Goriganga	Pithoragarh	GVK-L&T	2160	Under construction
8	Bokang Baling	330	Dhauliganga (K)	Pithoragarh	THDC	-	Under construction
9	Khairana and Quarav	20	-	Almora	-	-	Under construction

Source: Indian Institute of Technology, Roorkee (Uttarakhand)

v) **Deforestation and forest fire:** In present human being are cut of trees cause of his greedy nature and unwanted desires which consequence most of trees are existence and losses of their species. Due to which the disasters of flash flood, landslide and soil erosion are increase. Instead of Kumaun districts, the problem, of forest fire is the biggest problem in Almora district in the last few years.

Disaster managements and sustainable development

Disaster management is a complex multidisciplinary aspect to tackle the pre and after effects of all type of natural and man-made disasters which occurs in a particular area. In India's geographical structure, the Himalayan region is a very vulnerable area which is included in zone IV and V from the point of view of disaster. The main concept of disaster management is a planning to minimize the adverse effects of a disaster in a concerned area. "Disaster management is primarily concerned with the steps taken by an organization or a country in response to unexpected sudden or anticipated extreme events to provide quick rescue and relief facilities and to initiate steps for disaster recovery and rehabilitation." Kumaun Himalayan maximum districts are very sensitive and are located in remote area with no network connectively such as remote places in Darma Valley, Vyas Valley which due to different development activities such as road, bridge and dam construction. The relationship between disasters and development are summed up with the development can increase vulnerability, reduce vulnerability and provide development opportunities.

In Kumaun Himalaya disasters consequence from natural hazards such as floods, landslide, earthquakes and forest fires impact development in several ways. Disasters damage infrastructure, human life, financial and environmental losses. Therefore always keep on mind disaster with development activities us. Thus, disasters influence development programs by contorted available assets and interrupting planning. Disasters also influence the economic potential of society by exacerbating poverty, disrupting small business and industry activities, and disabling lifelines vital for economic activity and service delivery. The social and cultural impact of disasters can take the form of psychological, demographic and economic in nature resulting directly from the physical impact and its psychological impact of cloudburst disaster due to landslide may include a wide range of mental trauma. It also includes emotional signs such as anxiety and depression. Disaster management is considered important for sustainable development as the losses due to disasters continue to grow. Disasters are often associated with development that disaster destroys the development of past and present years and decades due to which lack of adequate development, the weak, remote and backward class of the society are most affected by the disaster. Development itself invites new kinds of disasters, such as zonal divisions and houses built without predictable compliance of regulations and infrastructure become vulnerable which need proper management strategies in sites.

Conclusion

This research work through extensive field study identifies disaster and the vulnerable areas within Kumaun Himalayan region and developments keeping in mind the past disasters and their consequences. In present Kumaun Himalayas are suffering from different disaster events and situations such as climate change, glacial melting, pre-monsoon and during monsoon heavy rains due to which an imbalance between environment and sustainable development strategies. The maximum population of Kumaun Himalayas remains highly affected because where on one side disaster is showing its wrath on the other side they have no sources of job and infrastructure. Most of the Kumaun Himalayas districts are included in vulnerable areas as frequency and intensity of enormous extreme events is unpredictable and dangerous all over the entire region.

Natural factors are the major cause of disasters in Kumaun Himalaya but no doubt human activities are equally responsible in triggering these events. Prevention is necessary to have disaster management and sustainable development. Thus, determining vulnerable area assessment, forecasting, estimation, mapping, planning, strategies and management of the potential related with different disasters and assistance of sustainable development with the help of GIS and GPS is required. Therefore develop scoping exercise with the involvement of different government department that should not only be responsible for it but ensure active participation of the people at the local level is also necessary to mitigate the adverse effect of disasters.

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