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# The Devastation of Garhwal Himalaya: Reminiscence of Kedarnath Flash Flood, June 2013

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**Abstract**

Kedarnath temple, one of the holiest shrines dedicated to Hindu deity lord Shiva. In the mid of June 2013, Kedarnath faced natural calamities of flash floods, compelling the researchers to look through the reasons behind this fateful tragedy. The causes of the tragedy can be categorized as natural as well as man-made. The natural reasons were due to climatic factors and vulnerable geomorphology of the region. However, man-made reasons were the unscrupulous and unplanned development as well as ignorance of proper government planning. This paper analyses all the happenings i.e. based on primary as well as secondary sources and focuses on the study of flash floods in special context of Kedarnath tragedy.

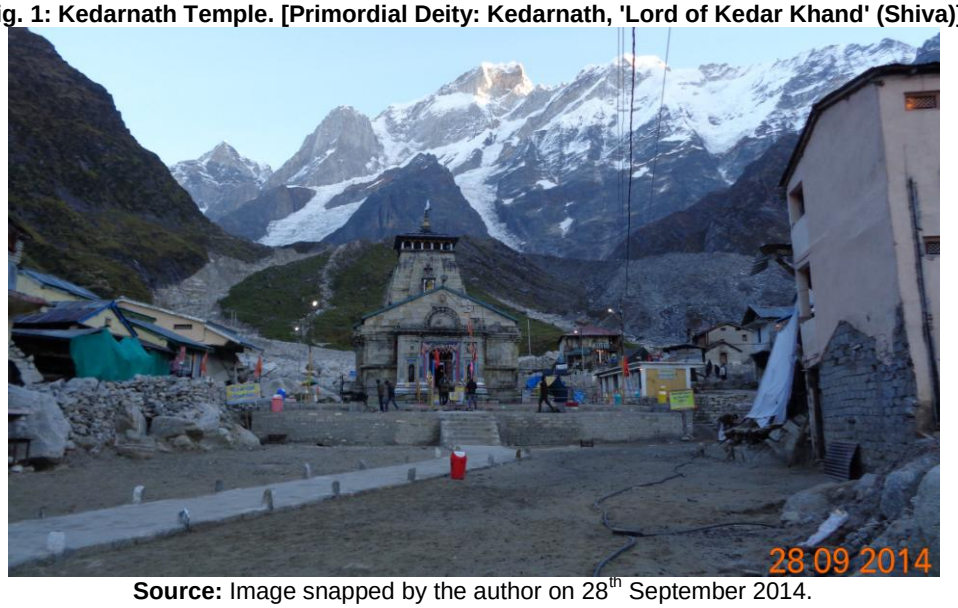
**Keywords:** Kedarnath, Rain Fall, Flash Flood, Affected Areas, Loss Incurred.

**Introduction**

Kedarnath is one of the twelve Jyotirlingas and the most remote of four Chhota Char Dham sites. It is situated on the bank of river Mandakini in the Garhwal Himalayan region having an elevation of about 3581 meter (11750 ft) [BKTC, 2014]. The coordinates of Kedarnath are 30°44′N-79°4′E [Wikipedia, 2013]. The river Mandakini originates from Chorabari glacier near Chorabari lake at a distance of about 4 km behind the temple in the upper areas of Kedar valley [Dobhal et al. (2013)]. The source of Chorabari Lake is Chorabari glacier which is adjacent to mountain Kedarnath and Kedar Dome. There is another river, named Saraswati, which originates from the companion glacier and meets Mandakini at some distance behind Kedarnath temple. There are two peaks situated behind the temple, Kedarnath main and Kedar Dome, which are a part of Gangotri group of peaks in the western Garhwal Himalayas. Kedarnath is inaccessible by road and therefore it had to be reached by about 20 km uphill track from Gaurikund (about 80 km from Rudraprayag district head quarter) which was connected by road from Rishikesh, Haridwar, and other known hill stations of Garhwal and Kumaon regions.

Due to extreme cold weather and heavy snowfall in winters, Kedarnath temple remains closed for six months on the day after Kartik Purnima (end of October or 1st week of November) and opens on Akshaya Tritiya (last week of April or first week of May) [BKTC, 2014]. Nobody stays there in between this time due to extreme adverse climatic conditions. During the winters, when the temple remains closed, the vigrahas (replica of original deities) from Kedarnath temple are brought to Ukhimath (a place near Guptakashi in Rudraprayag district and worshipped there for six months [Wikipedia, 2013]. Beyond this time, the temple remains open for pilgrimage.

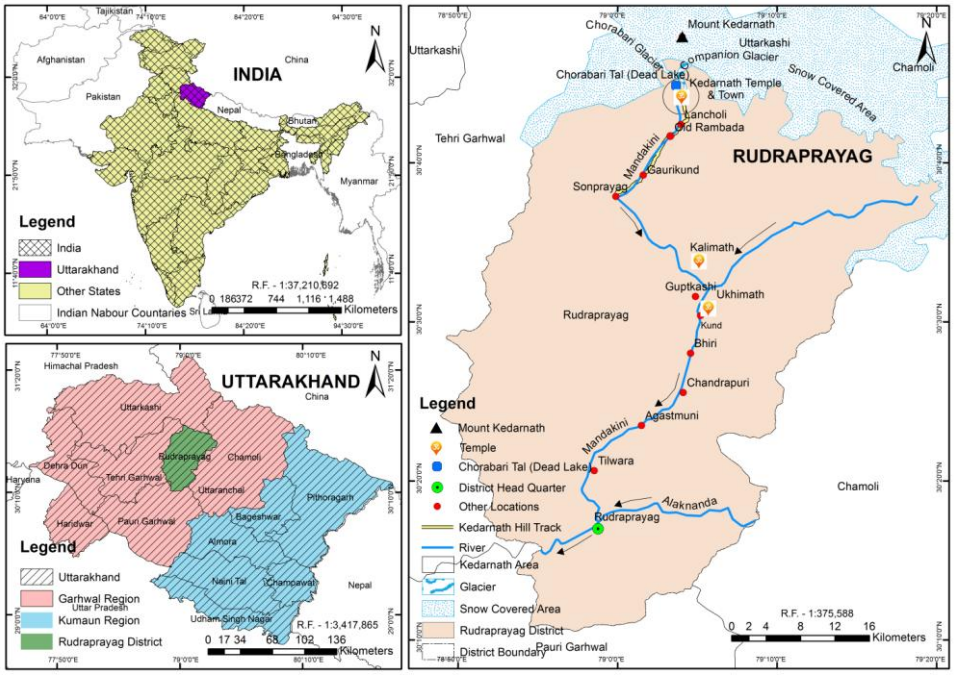
**Fig. 1: Kedarnath Temple. [Primordial Deity: Kedarnath, 'Lord of Kedar Khand' (Shiva)]**




**Source:** Image snapped by the author on 28th September 2014.

Fig. 2 is geographical map of study area that refers to location of Rudraprayag district, Kedarnath area and other Rudraprayag localities devastated due to flashflood in June 2013 (i.e. given in Table-1).

**Fig. 2: Location Map of Study Area**




**Happenings in Kedarnath**

At its schedule, the Kedarnath temple was opened for holy pilgrimage from 13 May 2013 (on Akshaya Tritiya). During 16-17 June 2013, i.e**.** about a month after the start of holy pilgrimage, the temple and adjoining areas received an extremely heavy rainfall recorded as 315 mm near Chorabari Glacier prior to monsoon schedule that was about 375% more than the normal [Gupta, 2013]. The heavy rainfall stimulated the melting of glaciers rapidly. This unexpected heavy rainfall and consequent melting of glaciers simultaneously flooded the Mandakini River and Chorabari Lake that led to flash floods near the surroundings of Kedarnath temple. During 16-17 June 2013, Kedarnath temple and its surroundings faced flash flood two times; first time on 16 June 2013 at approximately 8:30 pm and another on the next day around 6.40 am [Wikipedia, 2013]. These flash floods were followed by gushing of huge amount of waters down Mandakini River that made flash flood fury in the surroundings of the Kedarnath temple and the upper side of the valley [Wikipedia, 2013]. This washed away everything in its path as well as bringing along with its flow a huge amount of silt, rocks and boulders. A gigantic boulder got stuck behind Kedarnath temple and protected it from the ravages of the flood's fury. The flood water gushed on both sides of the temple destroying everything in their path. The flash flood deposited nearly a 10-foot-high mound of debris around Kedarnath shrine. Although

the temple survived along with its compound but surrounding area was destroyed completely, henceforth town of Kedarnath turned into the worst affected area. Thus, heavy rains resulted in large flash floods and massive landslides destroying entire villages in the basin of Mandakini valley as well as settlements such as Gaurikund. The market town of Rambada, a transit point to Kedarnath was obliterated, while the market town of Sonprayag suffered heavy damage and loss of lives. The temple and adjoining area faced devastating flash flood in June 2013, one of the worst disasters in the north Indian states of Himalaya.

**What is Flash Flood?**

A flood is an overflow of water in the water bodies, such as a river, lake or any other water drainage systems. The flood happens when an area of land, usually low-lying is covered with water. Flooding is usually divided into two categories: flash flooding and river flooding. Both can cause death, injury and property destruction. The flash floods are the natural phenomena of rapid flooding in geomorphic low-lying areas, which are distinguished from a regular flood by a timescale of less than six hours [Wikipedia, 2013]. Flash floods can occur under several types of conditions. In mountain regions, flash floods occur when an abundant volume of water, as a result of heavy rains or rapidly melted ice water collected in fragile landscape creating a lake and in case of outburst, it flows rapidly downwards on the hills with tremendous force getting everything flown lying on its path. It can sweep all kinds of debris downstream in just a few seconds. It may be caused by extremely heavy rainfall; cloud bursts conditions, rapid melting of ice sheets or glaciers and its water collected behind the fragile moraine dammed boundary thereafter sudden flow of this stored water due to outburst conditions. The Kedarnath flash flood occurred due to combined impact of unexpected heavy rainfalls, cloud burst-like conditions and Glacial Lake Outburst Flood (GLOF) [Gupta, 2013].

**Factors Responsible for Flash Floods**

Considering the Kedarnath tragedy and Geomorphology of the Himalayas, the possible conditions for flash floods are given in following sections.

1. Extremely heavy rainfall occurs in the upper areas of the valley and it causes a huge collection of water which flows rapidly downwards through narrow valleys having steep slopes.
2. The condition of heavy rains or cloud burst occurring at the fragile land of mountain regions that stimulates heavy erosions and landslides in many areas. When landslide creates a barrier in the natural flow of water in upper areas, it results into a huge collection of water. Thus the pressure of collected water breaks the barrier of landslides suddenly and huge collected water gushed downward with tremendous force causing flash floods in low-lying areas.
3. The fresh water from heavy rain falls, cloud bursts or rapid melting of glaciers collects in small fragile moraine lake, which results in an increase of the water level in this lake suddenly. These conditions can cause the outburst of this lake resulting in a flash flood in their adjoining low lying areas.
4. Flash floods can happen in case of heavy rainfall, dam or levee failure, rapid melting of snow or in a condition of the breaking of an ice jam occurs.

**Review of Literature**

1. Dobhal et. al. (2013) inclusively articulated the losses to human lives and damage to livestock as well as property in this fateful tragedy. In this article, authors reported the time and date wise happenings with the support of all pervasive details such as climatic reasons (with sufficient and relevant data) and geomorphologic setup of the region (with satellite images and real photographs).
2. Gupta (2013) expatiated all the innate specifics of Kedarnath pilgrimage and narrated the quintessence of each and every happening in this disaster. Author also expressed his reactions (as a pilgrim) and observations (as an expert) regarding all the natural circumstances, losses to mankind and response of government agencies on this catastrophe.
3. Varshneya (2015) extensively described the survival of Kedarnath temple and Chorabari glacier in millennia. The author further tried to establish the fact "What came first: Glacier or temple?" In this article, certain findings regarding submerging of temple in to ice for 400 years are also illustrated.
4. Dutta and Mishra (2017) have elaborated the nightmare in kedarnath during flash floods of the year 2013. In this article, authors have comprehensively estimated the losses incurred to cottages, settlements and towns as well as human being due to this natural calamity.
5. Joshi (2017) discussed the events that caused to death of Chorabari lake with proper citation of chronological developments in its structure during previous years. The author also discussed about poor policies of government as well as administration that led to multiplication of Himalayan flood effects.
6. Shahani (2018) penned the history of Kedarnath with geological references and explicitly demonstrated the happenings in Kedarnath town and surroundings during flash flood of June 2013.

**Aim of the Study**

The authors followed up all the instances from very first day through print and electronic media as well as internet that became helpful to develop an insight for all the happenings behind this fateful tragedy and further investigation. The present study aims to describe the genuine reasons with scientific and quantitative approach behind this devastation happened in Garhwal region of Himalaya.

**Data Base and Methodology**

The present work is based on primary and secondary sources, which are meticulously analysed to perform this research. Primary data is collected through field survey and observations. Further, various websites, research papers and blogs are reviewed and comprehensively studied to maintain a

base for secondary data. Later, the secondary data from various government organizations (like Uttarakhand State Government, Indian Meteorological Centre, Dehradun, etc.) were collected to draw a final conclusion. According to the requirement; pictures, maps and diagrams are portrayed to make this research work adequate and purposeful.

**Observations**

The above mentioned details represent one of the worst natural calamities occurred in the mountain regions across the world. This deeply saddened the entire human being as well as authors also. The tragedy has drawn the attentions of various researchers to look through the logical and scientific reasons behind it.

Table-1 portrays the Monsoon rainfall in Rudraprayag district of Uttarakhand occurred during June to September from the year 2012 to 2017.

**Table – 1: Monsoon Season Rainfall (mm) in Rudraprayag, Uttarakhand**

| Year | June | July | August | September |
|---|---|---|---|---|
| 2012 | 95.4 | 306.5 | 504.6 | 175.5 |
| 2013 | 617.4 | 416.7 | 309.6 | 126.8 |
| 2014 | 56.5 | 550.9 | 266.9 | 97.2 |
| 2015 | 187.5 | 423.3 | 352.1 | 53.5 |
| 2016 | 275.8 | 696.7 | 551.9 | 136.1 |
| 2017 | 263.7 | 530.4 | 413.6 | 284.8 |

**Source:** Indian Meteorological Centre, Dehradun, Uttarakhand.

Fig. 3 is a histogram of Monsoon period rainfall pattern of Rudraprayag district representing the values of Table-1. The figure illustrates that generally maximum monsoon precipitation occurred between July-August, while the district received heavy rainfall in June 2013 if compared from other years.

**Fig.3: Monsoon Rainfall (mm) in Rudraprayag District of Uttarakhand**

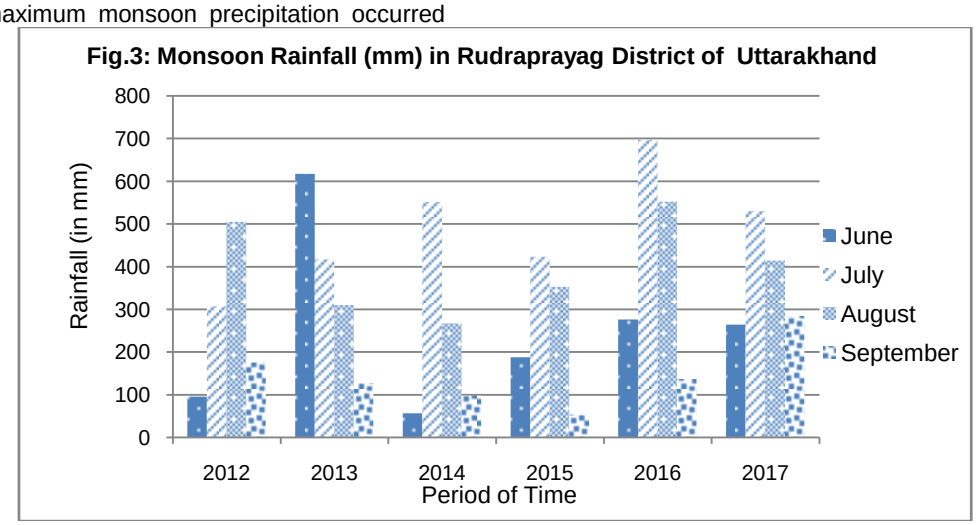
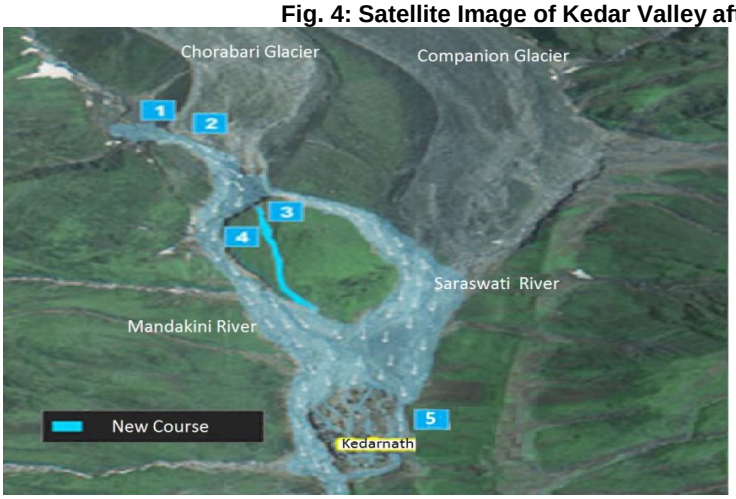



Fig. 4 is a satellite image of Kedar valley taken after the flash flood June 2013 which adduces the happenings in Kedarnath [Singh, 2014].

**Fig. 4: Satellite Image of Kedar Valley after Flash Flood**




**A Satellite Image of Kedar valley:**
(Taken after the Flash Flood)

**1. Chorabari Lake,**

**2. Breached boundary of the lake,**

**3. The place where rock got removed and giving way to new stream,**

**4. The new stream,**

**5. Kedarnath town**

**Fig.5 (a) Pre-Flood Image**


**Fig. 5 (b) Post-Flood Image**


**Source:** Sacred Yatra & Petley D, 2013

Table-2 demonstrates the details for nearby localities of Kedarnath and the effect of flash floods in Rudrapruayg district. According to the field survey and observation it has been observed that most of the area in Rudraprayag district including Kedar Valley and Mandakini river vicinity are fragile and vulnerable to landslide and flash flood conditions.

**Table-2: Localities in Rudraprayag District Devastated Due to Flashflood in June 2013**

| S. No. | Localities | Type of Habitations | Situated in River Valley/ Confluence | Intensity of Flood |
|---|---|---|---|---|
| 1. | Kedarnath | Small Town / Nagar Panchayat | Mandakini River | Majorly Affected |
| 2. | Rambada | Hamlet/Small Town | Mandakini River | Fully Affected |
| 3. | Gaurikund | Urban/ Small Town | Mandakini River | Majorly Affected |
| 4. | Sonprayag | Urban/ Town | Mandakini River | Partially Affected |
| 5. | Kalimath | Rural/Village | Mandakini River | Majorly Affected |
| 6. | Kund | Rural/Village | Mandakini River | Partially Affected |
| 7. | Bhiri | Rural/Village | Mandakini River | Partially Affected |
| 8. | Chandrapuri | Rural/Village | Mandakini River | Partially Affected |
| 9. | Augustyamuni | Urban/Small Town | Mandakini River | Partially Affected |
| 10. | Tilwara | Urban/ Small Town | Mandakini River | Partially Affected |
| 11. | Rudraprayag | Urban/Nagar Palika | Mandakini & Alaknanda River | Partially Affected |

**Source:** Data collected through field survey and observation by the researcher.

Table-3 Inscribes the Losses to Human Beings, Animals, Infrastructure and Cropped Area etc.

**Table-3: Losses Incurred Due to the Disaster, June 2013**

| S. No. | Particulars | Details |
|---|---|---|
| 1. | Worst Affected Districts (losses in descending order) | Rudraprayag |
| | | Chamoli |
| | | Uttarkashi |
| | | Bageshwar |
| | | Pithoragarh |
| 2. | Population Affected | > 5 Lakh |
| 3. | Dead Persons | 245 |
| 4. | Missing Persons (deemed dead) | 5474 |
| 5. | No. of affected Villages | 1603 |
| 6. | Permanent loss of Land Area (in hectares) | 20400 |
| 7. | Cropped Area affected (in hectares) | 40802.24 |
| 8. | No. of Damaged Houses | 4790 (Pucca)+74 (Kuchcha) |
| 9. | No. of Lost Animals | 18089 |
| 10. | Damaged Roads (in Km.) | 18223 |
| 11. | No. of Damaged Bridges and Culverts | 245 |

**Source:** Memorandum submitted by Uttarakhand Government

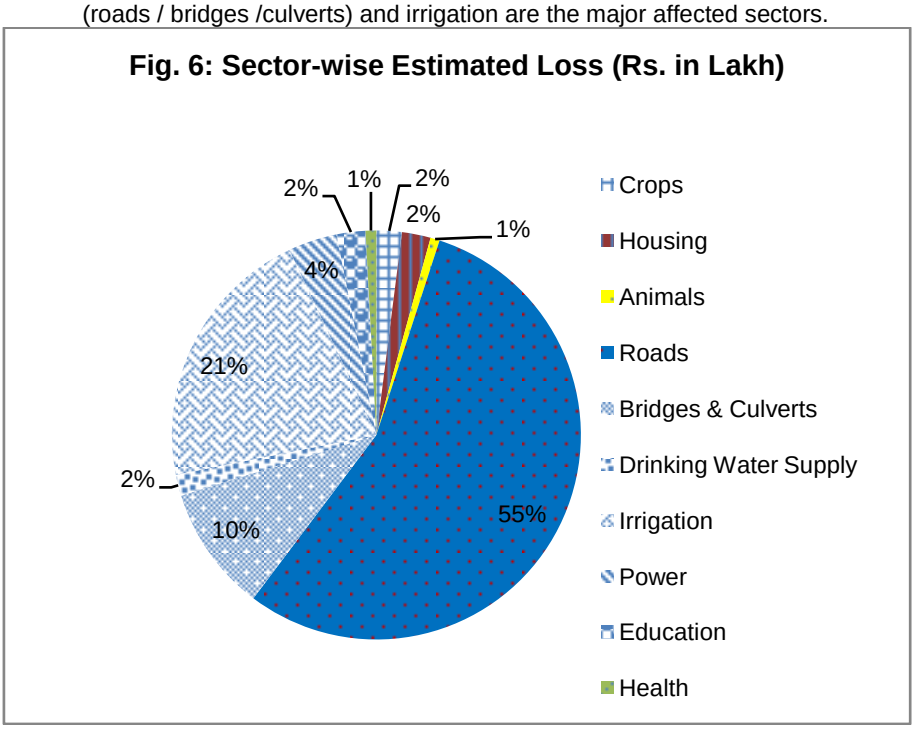
Table-4 Estimates the Sector Wise Monetary Losses in the Tragedy

| Table- 4: Sector Wise Estimated Loss in the Disaster, June 2013 | | |
|---|---|---|
| **S. No.** | **Sector** | **Estimated Loss (Rs. In Lakh)** |
| 1. | Crops | 2613.11 |
| 2. | Housing | 2954.58 |
| 3. | Animals | 949.29 |
| 4. | Roads | 71998.58 |
| 5. | Bridges & Culverts | 12945.13 |
| 6. | Drinking Water Supply | 2172.9 |
| 7. | Irrigation | 27525 |
| 8. | Power | 5048.65 |
| 9. | Education | 2968.16 |
| 10. | Health | 1099.82 |
| | Total | 130275.22 |

**Source:** Memorandum submitted by Uttarakhand Government.

Fig. 6 illustrates the sector wise estimated loss in the form of a pie-diagram. This further clarifies that infrastructure (roads / bridges /culverts) and irrigation are the major affected sectors.

**Fig. 6: Sector-wise Estimated Loss (Rs. in Lakh)**




**Analysis**

It has been analyzed that the Kedarnath flash flood was a combined impact of extreme adverse conditions of the climate as well as the geomorphology of the region. In the extreme adverse climatic conditions, there were extremely heavy rainfalls, cloud bursts like conditions as well as arrival of monsoon before its schedule when the melting of snow and glacier was on its peak. Thus, heavy rainfall stimulated the melting of snow. Heavy down pouring as well as rapid melting of snow flooded the Chorabari Lake and Mandakini river rapidly. This rapid increase in the water level at Chorabari Lake created pressure on its boundary resulting into outburst that aggravated the flash floods in Kedarnath and surrounding areas. Chorabari lake is a glaciated moraine lake and has a fragile boundary. Therefore, it could not bear the heavy pressure of water and resulted into an outburst flood. The Kedarnath is surrounded by snow-capped peaks and situated in a spreading and moderate slope on the bank of river Mandakini. Thus, the geomorphology of the Kedarnath area was vulnerable to flash flood conditions. The heavy water from cloud bursts as well as Chorabari lake outbursts gushed down to river Mandakini and created the devastation of flash floods near Kedarnath and its surroundings, which washed away everything in its path. Fragile landscape aggravated landslides at many places and resulted into muddy flood bringing huge amount of silt, rocks and boulders along with its flow. In last few decades, there were many unscrupulous, unplanned developments in the area due to the scope of tourism and the place being a famous pilgrimage site. This worsened the calamity causing heavy loss of lives and wealth. Thus, these muddy flash floods were the worst devastated fury in the north Indian state of Himalayan region.

Here another beautiful picture of Kedarnath is shown in Fig. 7. The photograph taken around 1860 by Kolkata based team of Geological survey Of India [Wikipedia, 2013]. About mid nineteen century, picture of Kedarnath shows the natural beauty of its surroundings as well as the low human interference in the valley of Kedarnath.

**Fig. 7: Kedarnath Temple in Mid-Nineteen Century**

**Conclusion & Suggestions**

The present paper is meticulous analysis on the fury of devastated flash floods happened in Kedarnath. It has been observed that behind this fateful incident, there were mainly three reasons. First of them is the climatic factors. The climate is getting extremely adverse due to heavy discharge of greenhouse gases and global warming. In the Kedarnath tragedy, there was unexpected heavy rainfall in the pre-monsoon season. The high temperature in summers as well as extreme cold weather and heavy snowfall in the winters give rise to melting of glaciers and aggravate the flood conditions. The second is geomorphology of the Himalaya, the fragile moraine or fluvial depositions as well as the gradient and steep slope in many areas making it very prone and vulnerable to heavy erosions as well as landslides. The extremely heavy rainfall increased the water level of the Chorabari Lake rapidly and created heavy pressure on its moraine deposited fragile boundary. Thus, the boundary got ruptured and it resulted into outburst of the lake. The third reason is man-made and is in the form of unscrupulous and unplanned development in the area without considering the ecology and environment of Himalayan region. These developments increased the pressure on land in the region heavily. Therefore, we have to be aware of the changes in climate, environment and ecology of the Himalayan region. The heavy and unplanned development in the region should also be avoided to save the environment as well as heavy loss of lives and wealth. The events of heavy rainfalls, cloud-bursts, resulted landslides as well as GLOFs are leading to flash floods in their adjoining low lying areas of mountain region, which occurs within a very short time span. Thus the government should issue a public notice to inform the people about the possibility of flash flood in the particular Himalayan region. The natives should be trained to tackle these conditions and be informed not to make their habitats in these disaster prone areas. The natives of a place having the history of flash floods need to be careful. They must listen to radios, watch televisions and use social media to get such information timely. Most flash floods occur when there is heavy precipitation in a particular area and the water is then canalized through streams or narrow gullies. Flash flood conditions may take minutes or hours to develop. It is also possible to face a flash flood without witnessing any rain. In this case, there would be heavy rain in upper areas of the valley. The residents should do the following when flash flood is imminent in the area:

1. Be aware of any signs of heavy rain.
2. Move to a higher adjoining land area if a rapid rise in the water level is observed.
3. Do not attempt to cross the flowing water when it is flooded.
4. Seek safety immediately if you are in the path of a flood or live in the close-by area where the flood may occur

In order to avoid such type of heavy casualties, the government and the authorities related to disaster management should be tactfully equipped, well trained and empowered to tackle these devastating conditions successfully. The ecosystem and environment of the mountain regions are different from other regions, therefore the natives of these regions must be aware regarding the geography as well as the climate on the mountains and its changing pattern, so that they may be capable to face the challenges for the safety of their lives and wealth. In this situation, it is necessary to float awareness programs, which may enable them to plan for their required settlements in accordance with the area and swinging patterns of the geo-environment.

**References**

*Dobhal D. P., Gupta A.K., Mehta M. and Khandelwal D. D. (2013), Kedarnath Disaster: Facts and Plausible Causes. Climate Himalaya. Retrieved from: < http://chimalaya.org/2013/07/30/kedarnath-disaster-facts-and-plausible-causes/>. (29 June 2014)*

*Dutta S. and Mishra A. (2017), Flash floods in 2013: A Nightmare in Kedarnath. The Week. Retrieved from:< https://www.theweek.in/webworld/features/society/flash-floods-in-2013-a-nightmare-in-kedarnath.html>.(15 September 2018 )*

*Gupta S.C. (2013), Kedarnath Cloudburst & Flood Disaster. Retrieved from: <http://www.satishchandragupta.com/2013/07/14/2013-kedarnath-cloud-burst-flood-disaster/>. (1 July 2014)*

*Joshi H. (2017), Death of a Killer Lake. The Third Pole.net. Retrieved from:< https://www.thethirdpole.net/en/2017/10/16/death-of-a-killer-lake/>. (16 November 2018)*

*Petley D. (2013), The Kedarnath debris flow disaster in Uttarakhand. AGU 100 Blogosphere, American Geophysical Union. Retrieved from: < https://blogs.agu.org/landslideblog/2013/06/21/the-kedarnath-debris-flow-disaster-in-uttarakhand/>. (29 May 2014)*

*Sacred Yatra (2013), Kedarnath Pictures. Retrieved from: <http://www.sacredyatra.com/kedarnath-pictures.html>. (27 May 2014)*

*Shahani S. (2018), How Kedarnath Temple Survived the Flood and 400 Years Under Snow. Conde Nast Traveller. Retrieved from:< https://www.cntraveller.in/story/how-kedarnath-temple-survived-the-flood-and-400-years-under-ice/>. (10 December 2018)*

*Shri Badrinath Shri Kedarnath Temples Committee (BKTC), (2014), Kedarnath. Retrieved from <http://www.badarikedar.org/kedarnath.aspx >. (9 May 2014)*

*Singh J. (2014), What really happened in Uttarakhand. Down To Earth. Retrieved from:< http://www.downtoearth.org.in/content/what-really-happened-uttarakhand>. (17 August, 2014)*

*Varshney V. (2015), Kedarnath Temple in Uttarakhand Survives Glacier, Floods. Down To Earth. Retrieved from:< https://www.downtoearth.org.in/news/kedarnath-temple-in-uttarakhand-survives-glacier-floods-41480>.(17 September 2017)*

*Wikimedia, File:Kedarnath in 1860.jpg (2013), Wikimedia Commons. Retrieved from: <http://commons.wikimedia.org/wiki/File:Kedarnath_in_1860.jpg>. (19 May 2014)*

*Wikipedia, Flash flood, (2013), Wikimedia Foundation. Retrieved from: <http://en.wikipedia.org/wiki/Flash_flood>. (27 May 2014)*

*Wikipedia, Kedarnath, (2013), Wikimedia Foundation. Retrieved from <https://en.wikipedia.org/wiki/Kedarnath>. (24 May 2014)*

*Wikipedia, Kedarnath Temple, (2013), Wikimedia Foundation. Retrieved from: <https://en.wikipedia.org/wiki/Kedarnath_temple >. (24 May 2014)*