JOURNAL OF CRITICAL REVIEWS

ISSN-2394-5125 VOL 6, ISSUE 7, 2019

A STUDY ON THE LANDSLIDE HAZARDS IN THE PIR-PANJAL RANGE

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Abstract
Landslide is a global natural hazard that occurs frequently in the areas of incompetent weak rocks, undulating topography, steep slopes and incessant rainfall. All over the world soil is widely used natural material for construction. The Himalayas truely one of the most outstanding yet fragile ecosystems of our planet constitutes one of the most threatened life-support system on the earth today. The Pir-Panjal range a group of mountains situated in the inner Himalayan region is no longer left untouched by the development fever depicting the consequences of the same in the form of landslides, soil erosion, climate change and loss of biodiversity. Of them landslides is the most common and conspicuous environmental hazard prevailing almost every year in the study area. Occurrence of landslides not only disrupts the environmental equilibrium but also checks and retards the overall development of the area. The Pir-Panjal range is under threat due to constant occurrence of landslides caused by natural and anthropogenic mechanisms. Therefore, the management of such an environmental hazard has become one of the prime importance in the pursuit of human development. In this study, an attempt has been made to find out the landslides affected areas in the Mughal road in Poonch district. It can be stated that the climatic conditions change such as earthquakes, rainfall pattern variation and various anthropogenic activities has increased the landslide vulnerability of the area. The possible factors triggering the landslides and need for checking of landslides have also been discussed. But when this material is available in the form of natural slope can cause landslide due to instability of slope because of various factors.

Keywords: Landslides, Pir-Panjal Himalayan Range, Environmental Management, Landslide, Slope Stability, Rainfall, Landslide Susceptibility Zonation, Remedial Measures

I. INTRODUCTION

Landslide is a term which is used to describe the downward or outward movement of slope forming materials like mass of rock, soil or debris under the influence of gravity. Varnes (1978) provided an idealised schematic presentation that displays the features of a landslide in soil material. Varnes classified landslide on the basis of type of material and type of movement as falls, topples, slides, lateral spreads, flows and combination of two or more type of movement [1]. In India, nearly 0.42 million sq. km or 12.6 percent area of land, not including snow covered area, is prone to landslide hazard. Out of this, 0.14 million sq km falls in North West Himalaya including Jammu & Kashmir. Himalayan mountains are geologically seen as very young mountains. In these young and not so stable slopes, the events of landslides are increasing due to activities like cutting of roads, deforestation and agricultural changes that require intense watering. In Jammu & Kashmir, the land sliding is a very serious problem, particularly in hilly areas, which initiates either by the natural processes including erosion, rainfall and thrusting etc. or by anthropogenic activities like road cutting, excavation of foot slopes, etc. The govt. of Jammu and Kashmir is spending huge amount of money to stabilize the areas where landslide creates high risk to the society. In recent years the landslide incidences have increased in the state because of upcoming new developmental projects. Almost all districts of Jammu and Kashmir are vulnerable to landslides. Some of the known landslides in Jammu and Kashmir State include Khairi (Udhampur), Nashri (Ramban), Sadal (Udhampur), Panthal (Udhampur), Surankote (Poonch) and Sunergund (Pulwama) landslides etc . According to the research done by Surya Prakash, the west and north-west regions of Himalayas suffer more from landslide compare to north-east and south of India. The Himalayan mountain range runs from West-Northwestto East-Southeast in an arc of 2400 km length having rich geo-diversity. The increasing population along therange and at the foothills have increased anthropogenic activities (Pande, Uniyal, 2007). Increased human activities are the main drivers for changing climate, extreme events and geo morphological changes in the Himalayan region (Froude, Petley, 2018). Climate change can affect t he t iming, size, and frequency o f natural hazards in the Himalaya in an uncontrolled manner with changing topography (Haritashya et al., 2006). The steep slopes with thin soil cover without any vegetation, over impervious bedrock and high orographic precipitation are the favorable conditions for landslides and floods in the Himalayan region (Haritashya et al., 2006). Being the youngest mountain range in the world and structurally unstable, Himalayan region is highly prone to topographically controlled natural hazards. Globally, many lives are lost, huge amount of properties and revenue is lost each year due to landslide (Tiwari, Ajmera, 2017). Global landslide database shows that distribution of land slideis heterogeneous, have caused largest causalities in Asia especially in the Himalayan **region** (Froude, Petley, 2018). Landslides are more prevalent in the Himalayan region mainly due to varying lithology, changing weather, extreme

ISSN-2394-5125 VOL 6, ISSUE 7, 2019

precipitation, density of drainage, tectonic activities, orography, topography, and ongoing seismicity (Tiwari, Ajmera,2017). Precipitation coupled with weak lithology and unattended slope mitigation leads to pervasive landslides along road corridors, which impose high risk on urban settlements (Sarkar et al.,2015).

II. REVIEW OF LITERATURE

Hemalatha T. and Ramesh Maneesha 2015 conducted a study on "Indian landslide Scenario: with Special Reference to Landslide Research Method". In this paper is all about bringing in the real landslide situation existing in India. The following topics are discussed in very detail. 1. Landslides, 2.Types of landslide in India, 3. Annual precipitation events 4. Geology of different mountain ranges and various parameters controlling landslides in a particular mountain range 5. Great landslides occurred in the past 6. Research methods practiced in India for landslide inventory, mapping and monitoring. 7. Suitable technology that can be adapted in future for efficient landslide inventory, mapping and monitoring. It also gives an idea about different terrain condition, climate condition, monsoon conditions existing in India. Historical landslides in the past also help us to understand how vulnerable Indian terrains are to landslides. This paper also discusses about the current state of research exiting in India for landslide detection, monitoring and mapping. This also serves as a guide for selecting appropriate remote sensing technique for monitoring different types of landslides.

Sartaj Ahmad Sheikh et al. 2019 conducted a study on "Analysing the Soil Types of Kashmir Valley and to Asertain the Areas Affected by Soil Erosion in Kashmir" in this study they have ststed that since soil takes so long to form but is so easily lost, it is important that steps should be taken to halt soil erosion immediately; there are incipient signs of its action. Once erosion has occurred and the topsoil has been lost, little, of course, can be done, but where it is in process, action can be taken to check it. As a result of devastation, the government initiated wide-spread soil conservation methods which have very largely tried to bring the problem under control, without much success. The soil erosion is still rampant, and good soil, which the farmers can ill afford to lose, is being lost. Soil conservation, however, is as much a matter of education as of capital. Regarding the intensity of soil erosion, the soil conservation becomes very essential. The Govt. in past has been making generous allotments of funds for soil conservation operation. But the results have not been impressive partly because different departments and agencies has been executed these works in isolation, without any integrated approach to problem. The first really serious and large-scale attempts to tackle the grave problem of soil erosion was started in the year 1976 when, the soil conservation board was set up on the basis of recommendations from the board of directorate of soil conservation, with the following functions: i. Research ii. Demonstration iii. Formation of soil conservation scheme iv. Monitoring v. Evaluation and coordinate of soil conservation activities of various departments

Singh N et al. 2019 conducted a study on "Analysis of Landslide Reactivation using Satellite Data: A Case Study of Kotrupi Landslide, Mandi, Himachal Pradesh, India. In this study, they have analyzed various parameters such as seismic, hydro-meteorological, soil moisture, geology and lineaments which were likely responsible for triggering the Kotrupi landslide on National Highway (NH-154) on the night of 13 August 2017. This landslide was the biggest of its type that took place in Himachal Pradesh. The recurrent behavior of Kotrupi landslide has put a lot of pressure on not only the government but also the people living near that landslide. The preliminary reports prepared by various agencies suggested that it occurred due to excessive rainfall, however the effect o f antecedent rainfall was not considered. Moreover, the landslide scar could be seen on the satellite images from December 2001 to March 2017 on Google Earth. The earlier occurrences of small landslides already carved the way for bigger landslides which was waiting to happen. This was also confirmed b y local residents who have witnessed all the small incident shappening in the landslide regime. The freely available multi-temporal satellite images from Google Earth provides a good platform for comparative study and analyzing the continuous behavior of recurrent slides. About 55% of the earthquakes occurred at shallow depth during 1970-2019. The frequency of earthquakes within 50 km radius of the landslide has increased from 1997. However, the magnitude varies in between 4-5.The area as mentioned above lies in between MCT and MBT and is crossed by several local and regional faults that makes thearea highly prone to seismic activity. The highly crushed and weathered rock in the vicinity is the proof of stress accumulation within the region, which has repeatedly vented out in form of slope failure.

Umair Ali1 et al., 2018 "Soil Erosion Risk and Flood Behaviour Assessment of Sukhnag catchment, Kashmir Basin: Using GIS and Remote Sensing" in this study the they have studied that the drainage basin characteristics through remote sensing and GIS demonstrate its utility in categorizing the watershed situated in highly rugged terrain of Himalayas. Drainage analysis with the support of lineaments and lithology illustrated their connection with landsliding and flooding behaviour of the watershed. Results of categorization elucidates that sub-watersheds SF1, 2, 5, 6 and 7 fall under high priority in terms of susceptibility to soil erosion because of lose upper layer, high elevation, high lineament density, and unstable slopes. In contrast, the low lying sub-watersheds like SF10, 12, 13 and 14 falls in the category more prone to flooding which results in associated siltation hazards and other environmental problems. This study thus illustrates the applicability of spatial technology in predicting natural hazards possible due to landslides and also minimizing the flooding and siltation problems of the plainer sub-watersheds as observed in recent flooding (Sept. 2014 and March 2015) in Kashmir valley and surroundings. High erosion rate or landslide in the hilly area results from heavy rainfall, structural weak planes in hard rocks and loose upper soil cover which drives rapid physical erosion. In highly urbanized settings, rainwater cannot infiltrate asphalt and cement and there may be little or no vegetation to slow sheetwash. Plainer areas with low drainage density, low frequency, slower runoff, and higher overland flow can face more floods and flood related problems. Thus, the systematic analysis of morphometric parameters and other factors derived from SRTM DEM using

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GIS environment are useful to highlight the watershed characteristics with respect to soil erosion and floods faced in intense weather conditions.

III. LANDSLIDES & ITS CONTRIBUTING FACTORS

There are several causes for a land to slide. Few major causes are as follows,

1) Rain fall as a factor which causes saturation of the soil through infiltration and the soil loses its cohesion, thereby accounting for sliding.

2) Soil erosion of slopes by River as a factor. River when it takes it path through mountains and slopes, soil erosion occurs and thereby it undercuts the toe region and makes the slope unstable and creates the likelihood of sliding.

3) Geological setting of the earth as a factor of sliding. Earths geological setting varies from place to place, it depends upon soil layers, deposits, minerals, etc, present in that area. Few combinations of soil layers render poor geological setting and make the slope unstable. These types of slopes will be non-cohesive and will have reduced shear strength which tends the slope to slide.

4) Human settlement as a cause for landslide. Deforestation happens as and when human settlement starts in any region and as a result the soil loses its strength, thereby tending to slide. Cutting of slopes for constructing roads and buildings will also render the slope unstable. Infiltration of domestic drainage in areas possessing highly permeable soil layers increases soils pore water pressure and thereby rendering the soil non cohesive. Heavy load imposed by buildings and complexes in highly unstable areas of slope causes sliding.

5) Weathering as a factor of sudden landslides. Weathering of rocks in slopes and mountains contribute to sudden fall or topple. Weathering of rocks occur mainly due to rainfall, anthropogenic activities such as improper land use practices along steep slope, deforestation, soil erosion, and chemical actions in the rocks. Rising temperature creates extreme storms and fastens soil and bedrock weathering. Rising temperature also uplifts the risk of forest fire, which denudes slopes and further hastens weathering process.

6) Flood as another main cause of landslides. Monsoon rains, excessive rains, prolonged rains, glacier melt and cloud burst are main causes for flood. Overflow of water with increased pressure from river bodies washes away the slopes, buildings, vegetation, etc developed on the banks. Excessive rains on the mountainous areas affects and overloads the drainage pattern in the slope. Slope is rendered unstable due to excessive water, irregular drainage, and soil erosion and caters to slope failure. Sometimes when water fills the washed away area dams are created. The death toll due to floods and landslides are higher than other natural disaster.

7) Earthquake as yet another main factor which induces large number of landsides. Due to sudden and higher magnitude seismic vibrations from earth crust, instability problems occur on the earth surface. Buildings, vegetation and other developments on the plain land get collapsed, and even submerged inside the earth sometimes. In case of slopes, landslides are triggered, dislodging huge amount of disaggregated sediments from slopes.

The number of landslides triggered depends upon the magnitude of seismic wave. For example the great Assam earthquake with a magnitude of 8.6 in 1950 triggered over100,000 landslides and dislodged 47 billion meter cube of sediments from steep slopes.

8) Changes in climate/season also accounts for increasing landslides. Present days we are able to witness the changes in environment like glacier shrunk, early melt of ice on rivers and lakes, shifting of plant and animal ranges, early flowering of trees, more intense heat waves. These climate change variations disturb the usual pattern of the environment. Increase in extreme weather events like heat waves, precipitation is predicted in south Asia. Unusual patterns like changes in annual and seasonal rainfall increase in extreme events like typhoons, rainfalls, droughts, increase in mean air temperature, and increase in intensity of summer rains are predicted earlier and reported in many parts of the world nowadays. These unusual patterns in season bring more negative impact in the nature and behavior of the environment. Extreme rainfall events accounts for increase in the risk of slope stability. Increase of pre monsoon rains leads to early soil saturation and higher chance for slope failure during monsoon rains. Increase of post monsoon rains accelerates landslides in slopes near saturation during monsoon periods. Based on IPCC (Intergovernmental Panel on Climate Change) fourth assessment report, the following predictions are made for India

• Increases in pre monsoon rains (7-8 percent) and monsoon rains (5-7 percent) could lead to a significant rise in landslide incidence in the Himalayas and Western Ghats of India.

• Furthermore, the period of elevated landslide risk will lengthen because increased pre-monsoon rain in April and May will cause soil moisture to build up sooner.

• In southern India, landslide incidence is greatest during the retreating monsoon between October and December. At this time, the expected increase in rainfall is only 1-3 percent. But in Kerala, where most of annual precipitation falls during the monsoon, a small amount of additional rainfall, particularly at end of the season, may lead to significant number of landslides if soils are near saturation.

• Additionally, the severity of South Asia tropical cyclones and storms is increasing although their frequency appears to be declining

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IV. GREAT INDIAN LANDSLIDES

In this section, we review the most fatal landslides in Indian history. We also outline the causes for fatal landslides, triggering factors, property damage, casualties, and remedial measures undergone.

June 2013 Floods & Landslides:

One of the great disasters in Indian history after 2004 Tsunamis is the June 2013 floods followed by landslides in Uttarakh and and its neighboring states Himachal Pradesh, Delhi, Haryana and Punjab. The month of June was the monsoon season and the amount of rainfall recorded was 375 percent higher than rains during normal monsoon. Most of the places in North India were wet during these days. Wide spread heavy rainfall activities were reported in many stations over Uttarakhand and in few stations of Himachal Pradesh, Haryana, Punjab, Delhi. During the period, on 16 June 16 stations reported heavy rainfall with 11 stations≥ 10 cm and 1 stations ≥ 20 cm; on 17 June 23stations reported heavy rainfall with 18 stations ≥ 10 cm and 7 stations ≥ 20 cm and on 18June 16 stations reported heavy rainfall with 9 stations ≥ 10 cm and 2 stations ≥ 20 cm .The rainfall distribution shows that heavy to extremely heavy rainfall occurred on 15June and 16 June (reported at 0300 UTC of next day) over the western districts ofUttarakhand (Uttarkashi, Dehradun, Haridwar, Tehri, Rudraprayag and Pauri) with a maximum rainfall of 37cm reported on 17 June at Dehradun. Thereafter the heavy rainfall belt gradually shifted towards eastern part of Uttarakhand. Heavy to extremely heavyrainfall reported on 17 June and 18 June over the districts of eastern parts of Uttarakhand (Almora, Nainital, Udham Singh Nagar, Champawat, Bageshwar, Pithoragarh and Chamoli) with a maximum rainfall of 28 cm reported on 18 June at Haldwani of Nainital district. The north Indian state Uttarakhand which includes Badrinath, Kedarnath and Hemkunth Sahib is a pilgrimage site for Hindus and Sikhs is severely affected. More than one lakh pilgrims were standard in these pilgrimage sites.

The main objective of the present study is therefore, aimed at to discuss the landslide causes in a stretch of Mughal road at Poonch region for which there is lack of information till date and this communication also suggests some measures to check the landslides.

V. MATERIALS AND METHODS

Study Area

The present study area i-e, Behramgala-Chattapani-Peer Gali lies in the Poonch district of J&K State. It is one of the frontier remote districts of the State situated on the line of control surrounded by Kashmir valley in the north-east; district Rajouri in the south and Pakistan occupied Kashmir (POK) in the west. Poonch is separated from Kashmir valley by the gigantic Pir-Panjal range of the Himalayas whose highest peak Tatakuti standing at 15560 ft above sea level falls in poonch. The historical Mughal road links up Poonch region of Jammu and the Kashmir valley. (Figure, 1).

Figure-1: A Segment of Historical Mughal Road in Pir-Ki-Gali Sector of Poonch

The topography of the district Poonch is hilly and mountainous barring few low lying valleys, sky touching peaks covered with shining snow and the lush green surroundings presents a stunning scenery. The general climate varies from sub-temperate to temperate. Barring some low altitudinal areas, the summers are cool & winters cold with unusual snowfalls. January and February are typical cold months in the region with the temperature in higher reaches (4000 m asl) as low as 10 to 20 C below freezing point while in the lower reaches and above (1100 masl) it is of the order of 2 to 3C. During April through June, the temperature goes as high as 25C.The annual rainfall ranges from 1500 to 2000 mm, the bulk of which is received during monsoon period. (July to September).The natural vegetation of the higher reaches is comprised dominantly of Pinus wallichiana (Kail), Cedrus deodars (Deodars), Pinus rouxburghii (Chir) and Quercus sp.(Oaks)

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METHODS OF ANALYSIS

The survey was conducted on several occasions to study the mountain slope characteristics and gently slopping valleys were observed for their macro- morphology and vegetation cover. Relevant still photography of the desired sites was done with the help of the digital photographic camera (Sony make). Landslides prone areas were identified and probable causes noticed. Additional data and information has been collected from literature, local folks and from fields by the authors themselves.

VI. OBSERVATION AND DISCUSSION

The study area of Pir-Panjal is one of the environmental hazard prone areas not only in the J&K State but also in the country as a whole. Human interference in this virgin land started during the Mughal rule when Mughals preferred and selected the area not only as a health resort but also for various sporting activities. Since then, the pressure of population in the virgin forest land had been increasing decade after decade and century after century. Behramgala-Chattapani-Pir Ki Gali Road, the south western sector of Mughal road is vulnerable to landslides every year especially at the time of intensive and heavy rains.

Figure 2: A Landslide Prone Area along the Mughal Road which occurred instantly as the Authors' Vehicle Crossed the Site

The hazard of soil erosion and landslides is one of the greatest human made disasters, which poses a serious threat to the livelihood and food security of the local people, especially those in the lower economic strata living in the hill areas and remote places in the valleys. Though landslides and soil erosion is a global phenomenon in India it is seen in its worst form in the Himalayas and its watershed that sustains a huge population and replenishes several perennial river system. The major factors (natural and manmade) responsible for causing slides in this study area are:

VII. NATURAL FACTORS

Virgin slopes

The virgin slopes predominate along the Mughal road which either are bare of any vegetation or have scrub and bushy growths .At some slopes there are lush green pastures where grazing is practiced .The mindless cutting of trees (deforestation) for fuel andover-grazing of the livestock has also reduced the vegetative cover of the rain fed areas of Pir-Panjal range. Bare rocky surfaces rather than vegetation cover are much susceptible to landslides. The environmental degradation has been quick in these areas because of the poor quality of soil and also due to increased demands on fuel, fodder and food. Lack of environmental awareness due to low socio-economic status of the people living in these areas has made them their own enemy.

In the study area, the average slope starts from 150and it reaches about 300 as we move from Bufliaz (Poonch) to the Peer Ki Gali Sector (Gupta et al. 1995). The influence of slope steepness on landslide occurrence is the easiest factor to understand as steeper slopes have a greater chance of land sliding. There are many factors which are responsible for instability of hill slopes. The variations in degree of these factors viz. nature of relief, bedrock regolith, drainage, earthquake and human interference (Cook and Deornakamp, 1990) effectively determines the intensity and spatial extent of slope failure. Landslides usually occur at unstable hill slopes. The factor stability and instability is determined by the factor of safety FS, where FS = shear strength/shear stress If FS>1.0 than the stability is likely to occur and if FS<1.0 than the instability is likely to occur causing landslides. The altitude along the study area varied from54,00ft masl to 11,500ft masl which is known to have maximum landslides in relation to the relative relief. The amount of landslides as

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per rule gradually decreased towards the lower and higher relief zones. The study area is characterized by monsoonal climate where the rainfall starts from the month of July and continues till September. The average annual rainfall recorded was approx. 1500-2000mm. This study area also experienced precipitation in the form of heavy snowfall from October to March every year as is evident from shots which were clicked during October 2011 overland flow is a common phenomenon during rainstorms. This may have been due to precipitation intensities exceeding soil infiltration with consequently greater surface run off over the soils which has only reduced the slope stability but also caused slumping down of the debris and loose soil leading to landslides as witnessed at Maansar. Besides the natural causes various anthropogenic activities noticed at the study area which can also be held responsible for the landslides in this sector includes: These includes not only the authorized extraction of timber for generating revenue for the state but also the clandestine plundering of forests by various agencies like villagers, contractors and the nomads who use this area for grazing of their livestock resulting in the destruction of the tree cover. Trees have an essential role to protect soil and water and preventing the landslides to a great extent because of the reason that the trees leaves act as a shield to the incessant rains and the rain water seeps down into the roots and protects the soil from being loosened. The hilly slopes made bare of tree cover as discussed earlier, are subjected to the torrential rains, which the soil devoid of vegetation and tree cover are not in a position to hold and as such water passes in great force uprooting scarce vegetation, boulders and topsoil thus creating erosions, landslides and floods. Along the Mughal road, the green pastures predominate and such grazing lands situated at high altitudes within coniferous forests or above them are known as “margs”, the comparatively flat lands devoid of the tree growth and supporting a thick grass cover. Nomad grazers called Gujjars and Bakerwals own largeherds of cattle and sheep use there margs for grazing of their livestock. The pressure of grazing on them ergs and the forest areas, adjoining these pastures is far above the carrying capacity of these areas which has caused rapid deterioration of the pasture lands, soil erosion and insignificant regeneration of forests on account of heavy trampling and browsing.

Tourism Infrastructure

There has been a constant increase in tourists flow to Poonch-Rajouri twin border districts connecting Jammu division with the valley of Kashmir and such heavy tourist influx has enforced the govt. agencies as well as the local people to develop large scale infrastructural base in terms of roads, huts, guest houses and other installations of tourists use. The infrastructural development has no doubt boosted the tourist flow, but simultaneously threatened the environment of these areas which are highly fragile and ecologically less accommodating in nature. The infrastructural development in this region has involved the mass consumption of timber from the local forests and also stones being extracted from surrounding landscape. Soft rocks have been excavated manually while harder portions are blasted which weakens the rocks and debris produced has been dumped on the slope to further aggravate the situation. Construction of the motorable roads far & wide, for instance, along Mughal road has pierced the forest cover by massive felling of trees which has adversely affected the ecosystem. Occurrence of landslides at some points is one of the major problems in the Himalayas in general and the Mughal road in particular due to slope failures. These slopes are very sensitive and lithologically speaking consists of weak rocks which are very unstable. Moreover growth in transportation network and building constructions has enhanced slope instability. The Mughal road passing through Pir Panjal range presents a scene of massive degradation of the forests as a result of construction and maintainence of the road. Man and the mountains are at a constant war with each other in finding a safe road for carriage of traffic and goods.

VIII. CONCLUSION

In Jammu and Kashmir heavy rainfall is considered to be the main triggering factor for most of the landslides. The landslides at National Highway 1D from Sonamarg to Kargil, Jammu, and Kashmir is an example of rainfall induced landslide. Researches has shown, for heavy to extremely heavy rainfall (daily rainfall >=6.5mm) the maximum number of heavy rainfall days lies in the range of 2 to 3 days especially in some parts of Samba district, Jammu district, Kathua district and Reasi district. While minimum number of Heavy rainfall days lies in the range of 0 to 1 day especially in some parts of Kulgam, Anantnag, Srinagar, Budgam, Shopian, Kupwara and Baramulla districts. Research has also shown high probability of earthquake more than 6 Mw in future which makes it important to ensure safety in term of earthquake induced landslide. Landslide susceptibility zonation, a prediction technique is a very important tool for landslide mitigation. By this the areas under high susceptibility zone that comes in high hazard category should be given due attention while executing the civil construction works by government or domestic constructional works by public. More areas of the state needed to be covered under landslide susceptibility maps. As the roads in the Jammu and Kashmir are a decade old, creation of new roads is posing a major problem as a result of the unscientific cutting of upslope of the roads. So, there is a need of more research for understanding impact of anthropogenic and physical factor on landslides in area. Retaining wall is most of the time used for stabilizing slopes in the area, so there is need of highly engineered methods. The use of gabion walls and drain system is strongly suggested as much number of landslides are triggered by heavy rainfall. The sinking of the Chattapani is attracting the attention of the experts where, the road is sinking and the area ploughed to maintain the road. During rainy season it is a usual sight to see the pink muddy torrential rivulet coming from this site on all sides as the tree cover has almost crumbled and the soil binding and water holding capacity has collapsed. The exploitation of forest for timber and fuel is going unabated. The timber and the firewood which is sold in most private organized sale depots in Jammu and the innumerable kilns run on Jammu-Poonch route and Jammu-Pathankote route for

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production of wood charcoal and brick is a sufficient proof of the greater devastation of the forest cover in the region. It is an undesirable fact that society has to play a greater role in preventing exploitation of the forest resources of the state and protect the environment from fast degradation. It may be mentioned here that the environmental holocaust in the Himalayan range by man will ultimately destroy us and, therefore, it is very necessary to save the Himalayan environment not only in our own interest but also in the interest of our future generations to come.

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