सत्यमेव जयते

A CASE STUDY ON
KOTRUPI LANDSLIDE 2017, MANDI DISTRICT, HIMACHAL PRADESH

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National Institute of Disaster Management (NIDM)
(Ministry of Home Affairs, Government of India)

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A Case Study on Kotrupi Landslide 2017, Mandi District, Himachal Pradesh

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राष्ट्रीय आपदा प्रबंधन संस्थान
(गृह मंत्रालय, भारत सरकार)

Maj Gen Manoj Kumar Bindal
VSM
Executive Director

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Foreword

The insights from past disaster events will help develop a better understanding of all dimensions of disaster management, from its risks to effective responses and recovery. Documentation not only captures the information or characteristics of the disaster, it also examines why such an uncomfortable episode occurred and how we could have avoided, prevented, or mitigated it. Accurate documentation is the foundation for good historical records and simultaneously for drafting the strategies for disaster risks reduction and resilience in future.

In pursuance to mandate under Disaster Management Act 2005 for documentation and publication and to foster the Hon'ble Prime Minister's 10 Point Agenda on DRR, point 9 to ensure that the opportunity to learn from a disaster is not wasted, National Institute of Disaster Management (NIDM) every now and then document the learning of major disasters in the country. This time the insitute has documented the different attributes of the Kotrupi landslide that was triggered in Mandi District of Himachal Pradesh State. The incident was first of its kind in the history of Mandi District that shattered the calm and picturesque terrain.

Hopefully, the document will help disaster management authorities and other relevant stakeholders in finding the gaps in current scenario and the strategies to be adopted to avert or reduce the impacts of such catastrophic events.

MKBindal

Manoj Kumar Bindal

Preface

Landslides, one of the major geo-hydrological phenomenon affects a large part of India from the mighty Himalayan range in the north to the coastal areas of the south including the island regions. Every year, especially, during the monsoon season. Landslides cost precious lives beside damages to our infrastructures, strucutres, resources and environment. Landslides disrupt commuters, commodities, utilities, functionality and services, as well as communication networks, in addition to having a negative influence on the economy and environment. They have distinct behaviour not just in terms of space, but also in terms of time. Landslides cannot be considered in isolation since, in addition to being a primary disaster, they can also occur as a secondary disaster as a result of earthquakes, severe precipitation, river toe erosion, or anthropogenic activities. On the other hand, disasters such as flash floods and tsunami can also be triggered by an episode of landslide.

Himachal Pradesh, a north Indian mountainous state nestled in the western Himalaya is persistently jolted by landslides. They are second most recurring hazards in the state. Unprecedented rainfall events, seismic activities, toe cutting by rivers and streams, deforestation, mining, blasting, drainage changes, loading/unloading, encroachment on steep hill slopes, and chaotic construction activities are among the key elements that position the state in a high-risk zone for landslides. In the month of August 2017, a massive landslide occurred near the village of Kotrupi on National Highway-154, the road between Mandi and Pathankot, Tehsil Padhar, District Mandi of Himachal Pradesh. In the area's history, there has never been a landslide of this magnitude. The calamity claimed the lives of 46 people, as well as cattle, agricultural land, vehicles and a large section of the national highway.

Comprehending the severity of Kotrupi landslide and the mandate to document the major disasters, NIDM endevours to clutch the lessons of the event in order to strengthen our future strategies for landslides risks reduction and resilience.

(Surya Parkash)

Acknowledgement

At the outset, I would like to express sincere thanks to Major General Manoj Kumar Bindal, VSM, Executive Director, National Institute of Disaster Management (NIDM), New Delhi for his kind encouragement and support in documentation of Kotrupi Landslide, 2017.

I would like to place on record the significant contributions made by different persons in compiling the information and literature apropos of Kotrupi Landslide. I am particularly thankful to local adminsitration and local communtiy of Mandi District Sh. Rugved Thakur, IAS, DC Mandi; Sh. Shiv Mohan Saini, SDM Padhar; Dr. Kala Venkata Uday, Assistant Professor, IIT Mandi and his team mates; Sh. Satish Chand Bhatiya, Patwari Padhar; Ms. Priti Negi, T&CB Coordniator, DDMA Mandi; Sh. Naveen Nischal Sharma, Reporter, Divya Himachal; Sh. Sharwan Kumarr Yadav, Public Work Department and local dewllers of the regions.

I would like to express my gratitude to Sh. Rugved Thakur, IAS, DC Mandi and Dr. Kala Venkata Uday, Assistant Professor, IIT Mandi for reviewing the document.

It gives me immense pleasure in acknowledging the cooperation of my colleagues - Dr. Harjeet Kaur, Dr. Raju Thapa, and Sh. Ritesh Singhal, GMR Division, NIDM and supporting staff at NIDM, without which it would not have been possible in preparation of this document completed.

Sincere thanks are due to co-author of this document, Sh. Anil Kathait, who made every effort to collect, compile, analyse and assess all available information on Kotrupi landslide and helped in preparation and finalization of this document.

Last but not the least, I would like to thank my wife Reeta and daughter Rasika, without whose consistent moral and logistic support, I would not have been able to give due attention and time to this work.

Finally, I am grateful to the Almighty without whose grace and kindness, I would not have been capable to carry this task successfully.

(Surya Parkash)

Contents

1. INTRODUCTION

Himachal Pradesh, a north Indian mountainous state, located between Latitude 30° 22' 40'' N and Longitude 75° 45' 55'' E to 79° 04' 20'' E in the lap of western Himalaya covering an area of 55,673 square kilometres is famous for its serene snow capped mountains, deep gorges and cascading rivers. The picturesque land due to its fragile geological setup in different altitude of the world's highest mountainous range is prone to various natural and man-made hazards. The state is vulnerable to a number of hazards namely, earthquakes, landslides, flash floods, snow storms and avalanches, droughts, dam failures, fires – domestic and wild, accidents – road, rail, air, stampedes, boat capsizing, biological, industrial and hazardous chemicals[1]. According to the Himachal Pradesh State Disaster Management Authority, the vulnerability matrix developed for the state apprises that the district Chamba, Kinnaur, Kullu and part of Kangra and Shimla falls in very high vulnerability risk (Figure 1.1). Whereas, the high vulnerability risk include areas of district Kangra, Mandi, Una, Shimla and Lahaul and Spiti. Remaining districts of the state i.e., Hamirpur, Bilaspur, Solan and Sirmour falls in moderate vulnerability risk.

Fig. 1.1: Vulnerability Map of Himachal Pradesh (source: HPSDMA)

In view of vulnerability to various hazards, earthquake hazard poses biggest threat to Himachal Pradesh, followed by landslides. As per the available historical data of the earthquakes, the state has been jolted more than 80 times by the hazards having a magnitude of 4 and above on the Richter scale. The five districts, Chamba, Hamirpur, Kangra, Kullu and Mandi have 53 to 98.6 percent of their area prone to the severest intensity of MSK IX or more, the remaining area of these districts being liable to the next severe intensity VIII.

Landslides are second most recurring hazards in this mountainous region of the country (Figure 1.2). Every year, especially, during the monsoon season the state witness one or more major landslides resulting huge number of

fatalities and damage to various structures and infrastructures viz. houses, roads, bridges, telecom system etc. Besides adverse impact on economy of the state, landslides also affect movement of commuters, goods and services as well as also interrupt communication systems. The main variables which place state in high susceptible zone of landslides includes, inter alia unprecedented prolonged rainfall events, seismic activities, toe cutting by rivers and streams, deforestation, encroachment on steep hill slopes, unscientific construction activities etc[2].

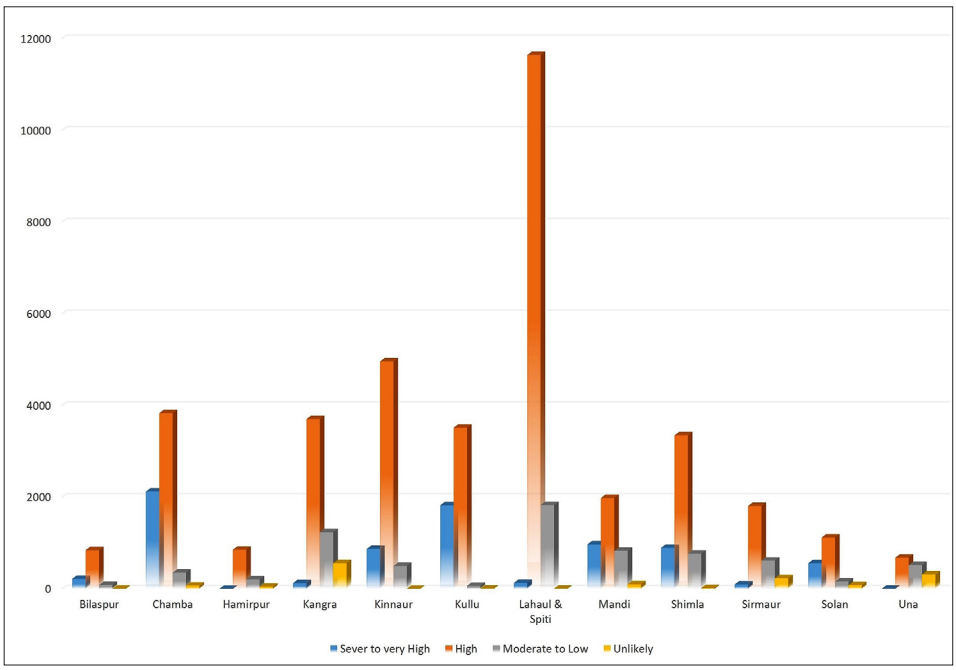


Fig. 1.2: Landslide Prone Areas of Himachal Pradesh (source: HPSDMA)

A Landslide Risk Analysis was accomplished by TARU in year 2015 for the road networks, human settlements and hydroelectric power plants of the state (Figure 1.3). The road network of Himachal Pradesh includes 1628.377 kms of national highways and 2178.988 kms of the state and village roads. According to the study, out of the total length of national highways, 10.96 kms are in extreme vulnerable zone, 993.29 kms are in high vulnerable zone and 516.46 kms fall in moderate risk zone, 1111.552 km of the state highways and village roads fall in high vulnerable zone. The state is famous for its tourist spots all over the globe. Thousands of the tourists visiting these spots are stranded due to recurring landslides on roads connected to tourist spots. 866.14 sq. km area of the human settlements and other built-up areas of the state fall under the landslide risk zones. Himachal Pradesh is hub of 18,577 numbers of villages, out of which 22 percent (4,065 villages) of the villages are in high risk zone,

32 percent (5,883) of villages are in medium risk zone and 3 percent (486) of villages are in low risk zone. Rest of the village are in landslide risk free zone. Total areas of human settlement inhabited in urban regions are vulnerable to the landslides due to haphazard expansion and unscientific land use planning.

Satluj, Beas, Ravi, Chenab and Yamuna, the five perennial rivers of the Himachal Pradesh houses 118 mini, small large and mega hydropower stations. 67 hydro power stations are built in landslide hazard risk zones and among these 10 mega hydropower stations are in medium to high risk landslides areas [3]. The power stations which required major structural and non-structural intervention to mitigate landslide risk are located in Karcham Wangtu, Nathpa Jhakri and Bhakra.

Some of the important landslides occurred in history of Himachal Pradesh which caused huge damages are:

- Maling landslide in year 1968 which damaged 1km NH-22 and is still active.
- Kinnaur landslide (Dec, 1982), that occurred at Sholding nala collapsing 3 bridges and 1.5 of road was vanished.
- Jhakri (March, 1989), at Nathpa about 500 m of road was damaged due to this slide and is still active.
- Landslide at Luggarbhati buried alive 65 (39 as per official record) on 12th September 1995,.
- Marhi, Bhang, Chhyal, and Mandu in upper catchment of the Beas river are some of the prominent landslides in Beas valley.

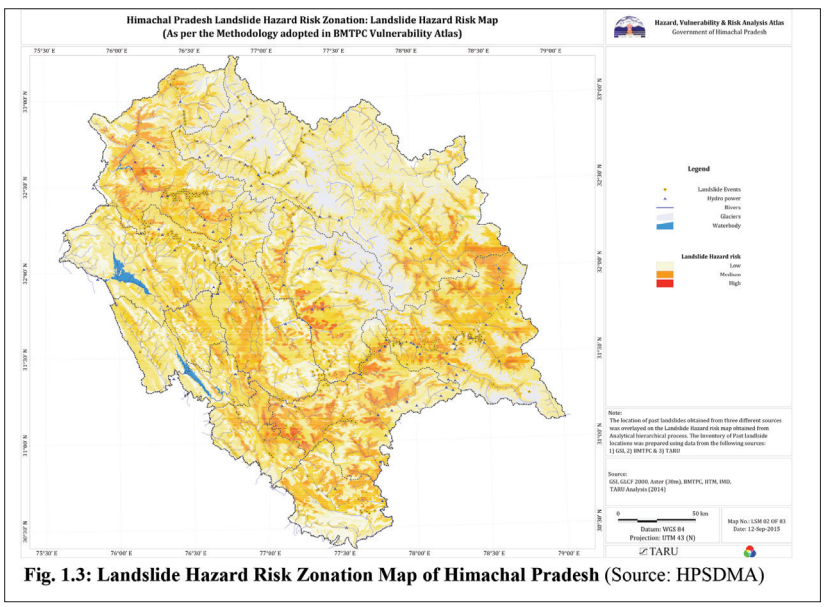


Fig. 1.3: Landslide Hazard Risk Zonation Map of Himachal Pradesh (Source: HPSDMA)

2. PROFILE OF MANDI DISTRICT, HIMACHAL PRADESH

2.1 Administrative Divisions, Geography and Demography

The district of Mandi, situated between 31°42′25″ Northern latitude and 76°55′54″ East longitudes came into existence by amalgamation of two princely states Mandi and Suket on 15th April 1948, the year when the state of Himachal Pradesh was shaped. The boundary of the district is allied with Kullu on the north-east, Kangra on the northwest, Hamirpur & Bilaspur in the west, Solan district in the southwest and Shimla district in the south (Figure 2.1). Mandi, located at the banks of river Beas in the Shivalik Region is often referred to as "Varanasi of Hills or "Chhoti Kashi". Administratively the district is consists of 10 Sub-divisions, 17 Tehsils, 10 Development blocks and 469 Panchayats comprising of with 3,888 villages. In terms of number of villages, Mandi is

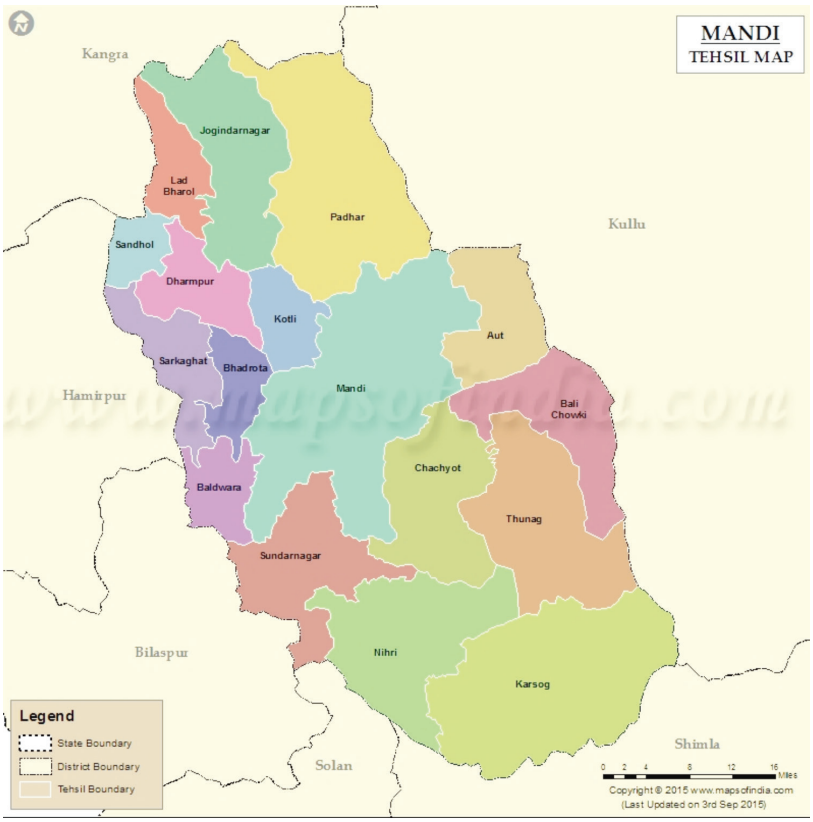


Fig. 2.1: Mandi District Map

Source: https://hpmandi.nic.in/map-of-district/

5th largest district in the state and 2nd and 3rd in terms of population and sex ratio. 81.5 percent of literacy rate stand Mandi 7th among all the states[4].

Table 2.1: Geography and Demography of Mandi

Total Area	3, 950 Sq. Km.
Altitude	750 m
Forest Area	1734. 21 Sq. Km.
Agricultural Area	1611.81 Sq. Km.
Major River	Beas and Satluj
Population	9, 99, 777
Male	4, 98, 065
Female	5, 01, 712
Proportion to Himachal Pradesh Population	14.56%
Density/ Km2	253
Sex Ratio	1007
Literacy Rate	81.53

2.2 Geology

The rock formations mainly comprises of igneous and metamorphic rocks from Precambrian to Quaternary period. The Formation of the district belongs to the Jutogh, Shali/ Largi and Shimla Group. Intrusion of granites and gneisses are observed in meta-sediments of Largi and Shimla Group. The sedimentary rocks namely, sandstone, shale, siltstone, conglomerate etc of Dharamshala/Sabathu Group and Siwalik Group of Tertiary age are observed in western and southern parts sediments. Deposits (Alluvium, terrace deposits, fluvial deposits) ageing to Quaternary period occur in the intermontane valleys, viz., Balh valley, Sarkaghat valley etc[5].

2.3 Climate and Weather Seasons

Mandi has a sub-tropical climate in valley regions and temperate near hilltops. Variation in average minimum and maximum temperature is in the range of

3 degree Celsius to 35 degree Celsius. Cold climate is experienced throughout the year in the higher altitude regions whereas Balh valley and other low altitudes are quite hot in summer. Winter arrives in middle of November and extents to the middle of March, the period in which snow fall occurs down to elevation of 1300 m amsl[5]. The melting of snow starts from end of the March from places having altitude of 3300 m. Monsoon in the region emerge from the last week of June or early July and persists till the middle of September. In the monsoon period from July to September, region receives precipitation in the form of rainfall. High variation is observed in the annual average rainfall from place to place in the district, which range from 700 mm to more than 2000 mm at Jogindernagar.

3. HAZARD VULNERABILITY AND RISK ASSESSMENT

3.1 Hazard Profile

The district of Mandi being geographically situated in the lap of Himalaya is exposed to a number of natural hazards viz. landslides, earthquakes, floods, cloud bursts, hailstorm, fires, lightning and so on. The hazard profile of the district is discussed below:

Table 3.1: Hazard Profile of Mandi District[4]

S. No.	Hazards	Potential	History
1.	Earthquake	97.4 percent of area is in Zone V, 2.6 percent of area in Zone IV	Major earthquakes occurred in year 1986, 1997, 2005 and 2016
2.	Flood	Though drought prone yet monsoon rainfall has potential to craft flood like situation	Year 1957, 200, 2005 and 2015 witnessed floods in the district
3.	Landslide and Mudflow	968 Sq. Km. of area falls in very high landslide susceptible zone whereas 1978 Sq. Km. area in high landslide susceptible zone	Landslides jolted the district in year 2000, 2003, 2004, 2006, 2015 and 2017
4.	Cloudburst	Topography of the region enhances the devastation caused by cloudbursts	Some of the noted incidences occurred in the year 1984, 2004, 2005 and 2015
5.	Fire (Forest, Urban and Rural)	Generally in summer season, forest area mostly affected	561 incidences of fire occurred between 2013-16
6.	Drought	Mainly influenced highlands, consequences on agricultural, March to end of May dry period	Drought like situation occurred in 2001 and 2006
7.	Dam Failure/ Burst	Monsoon season rainfall have the potential for dam failure/burst	-
8.	Thunder and Lightning	Phenomena is common in Pre-monsoon and monsoon season	-

Note: For detailed hazard profile of the Mandi District, please refer to District Disaster Management Plan Mandi (2017), HPSDMA

3.2 Vulnerability Profile

The district of Mandi with a population of 9, 99, 777 is the second most populous district of the Himachal Pradesh. The major portion (84.37%) of its population dwells in the rural area and thus, agriculture is the locus point of its economic development. 20.06 percent of the households in the district live below the poverty line. The population of Persons with Disabilities (PwDs) stands to 25, 921 that represents 16.5 percent of the total population of Persons with Disabilities in the state. The majority of PwDs resides in rural area.

3.3 Risk Profile

The table below provides risk matrix of the district including elements at risk and degree of the vulnerability to various hazards.

Table 3.2: Risk Matrix of the Mandi District

Elements at Risk	Degree of Vulnerability to Various Hazards					
	Earthquake	Landslide	Flash Floods/ GLOF	Drought	Forest Fires	Domestic Fires
Community	High	High	High	Moderate	High	Moderate
Houses	High	High	High	Nil	Low	Moderate
Infrastructures	High	High	High	Moderate	Moderate	Moderate
Livelihood Sector	Low	Low	Moderate	Moderate	High	Low
Environment	High	High	High	High	Very High	High

4. KOTRUPI LANDSLIDE 2017

4.1 Introduction

The vulnerability of the hilly terrains to various geo-meteorological disasters is renowned, especially during the monsoon season. Landslides, floods, flash floods, cloudburst are some of the weather related disasters that are horrendous for the elevated terrains. The midnight (around 12:20 am) of 12th -13th August, 2017 became dreadful when a massive landslide occurred near the village of Kotrupi on National Highway- 154, the road between Mandi and Pathankot, Tehsil Padhar, District Mandi of Himachal Pradesh. The incidence was first of its kind in the region. The area didn't witnessed such a gigantic incidence of landslide in its history. The disaster engulfed forty six human lives beside livestock, agricultural land and major portion of the national highway Figure 4.1)[6].

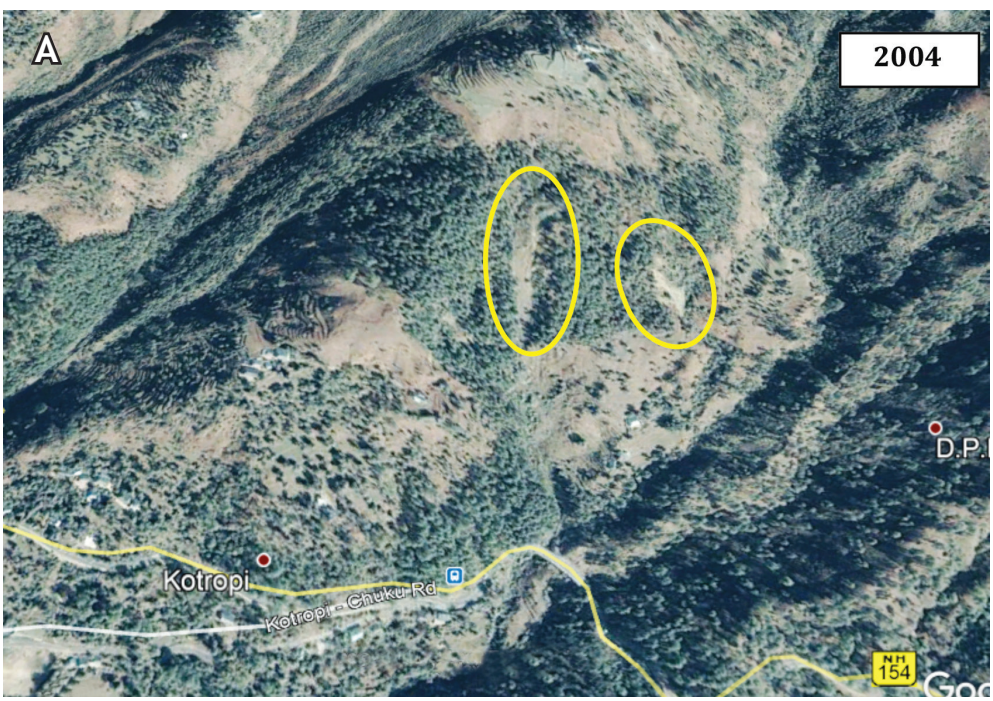
Fig. 4.1 Kotrupi Landslide 2017 (Source: GSI)

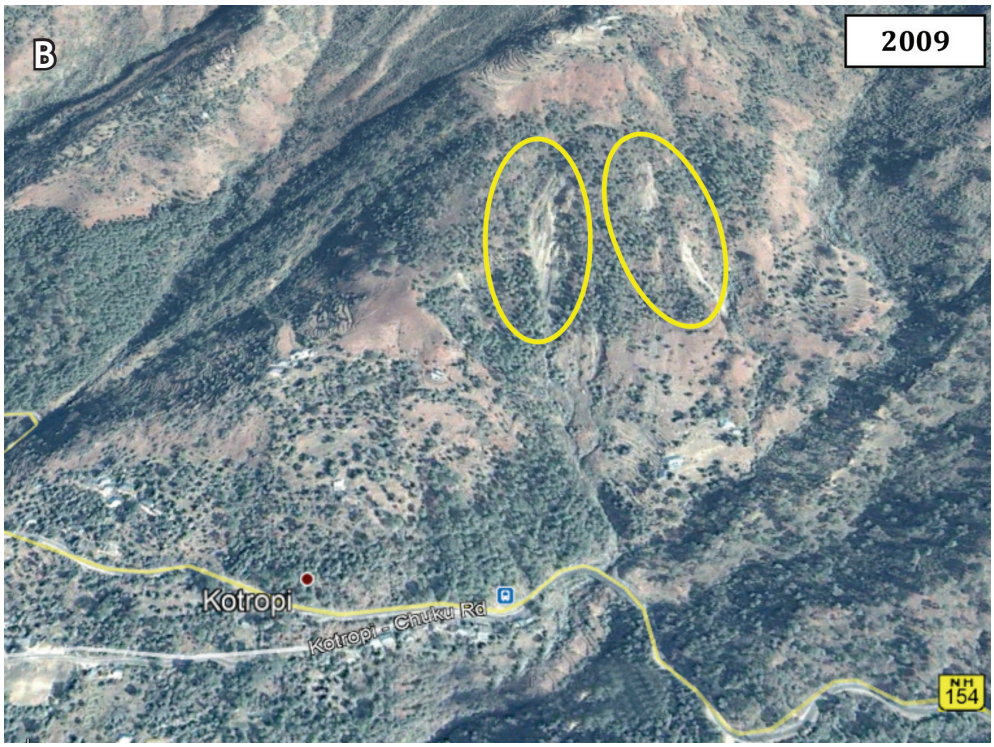
As per the local community, the landslide has a return period of 20 years. The landslide was first initiated in August 1977. No causality was recorded at that time. Again, after a leap of 20 years in August 1997 the slope failure destroyed a bridge and the road was blocked for three days. The periodical phenomena increased its scale and devastation power with due course of time. In the month of August 2017, the fragile slope reactivated for the third time. But this time, it left an unforgettable scare in the memory of the local communities. In words of villagers, they heard nerves shivering loud sound of blasting at the midnight. No one has any clue what might have happened. Local residents of the area informed the relevant authorities about the incidence. Local

authorities from nearby areas rushed to the site as soon as they received the information of mishap. The rainfall and the darkness hampered the inspection of the situation. The bus destined to Katra-Manali route was half buried in the huge mound of the debris. In addition, one car and one bike were also swept away by the debris. Local authorities along with villagers tried to rescue the persons stranded in the bus with help of torches and vehicle lights. The actual gravity of the situation became clear only in the early morning when the dawn broke out. Later it was found that a bus routed between Chamba and Manali was also been washed by debris 800 metres downstream of the road.

A preliminary report of the National Remote Sensing Centre-ISRO, Hyderabad also verified the claims of the local people. According to their investigation, the affected area showed evidence of the presence of two existing landslide scars on the slope that unveiled the area have a history of landslides occurrence in past and was unstable as well as prone to failure[7].

The analysis of the satellite imagery obtained from Google Earth Pro depicts small scarps/cracks in the initials years of the twenty first century (Figure 4.2). Those scarps gradually enlarged in the subsequent years. They were neglected as they didn't create any tricky situation till year 2017. In fact, in year 2017 before the monsoon season there was not much movement in the area.

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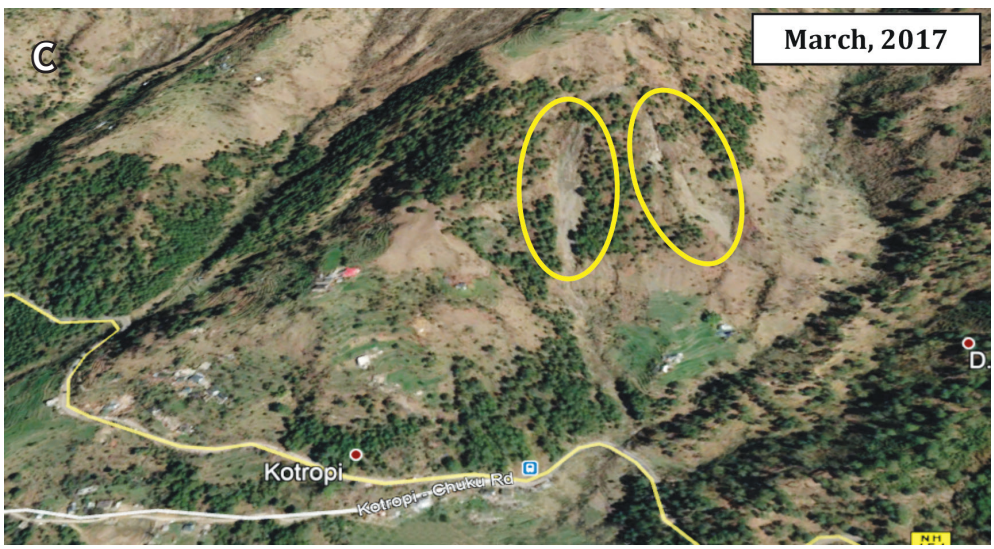
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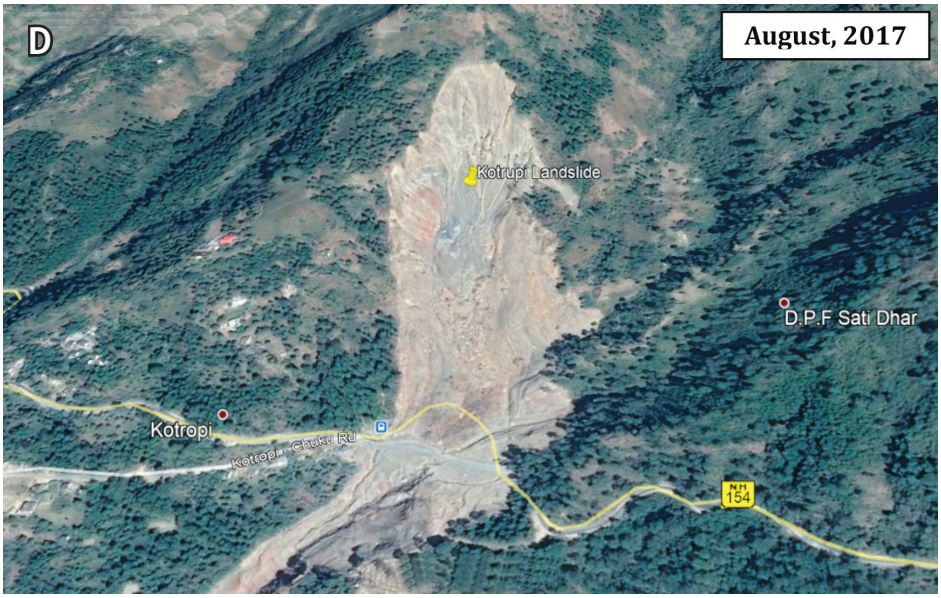

Fig. 4.2: A, B, C and D Different Time Interval Satellite Imagery obtained from Google Earth Pro

4.2 Characteristics of the Area

The area lies between the latitude 31° 54' 37.584'' N and longitude 76° 53' 26.304'' E. The moderately dissected and colluvial slope houses debris of past

Fig. 4.3: Red Bricks Shale

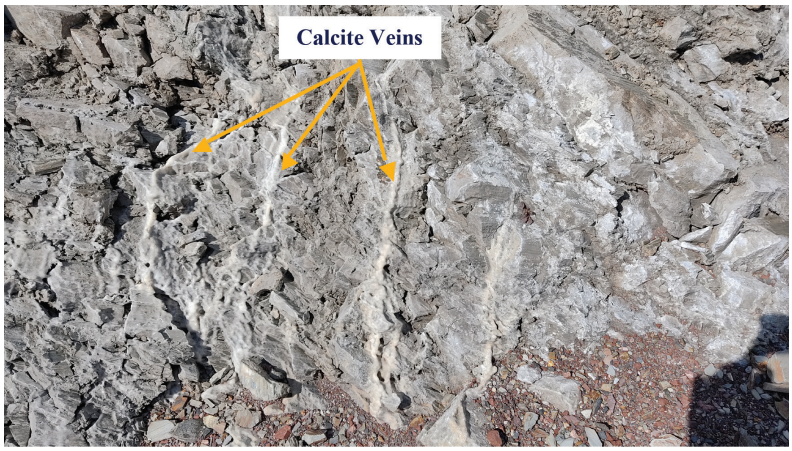

Fig. 4.4: Calcite Veins in the rocks

Fig. 4.5: Carbonaceous shale

Fig. 4.6: Highly Weathered Rock

Fig. 4.7: Leaching of Iron in the Slope

landslides. Geologically the area lies in zone of Main Boundary Thrust between the Siwaliks and Shali Group of rocks belonging to Dhramshala Group sheared rock mass in the upper inaccessible reaches of main slide body. Carbonaceous shale, brick red shale and calcite dolomite rock were present in the landslide area (Figure 4.3, 4.4 and 4.5). The rock mass are moderate to highly weathered (Figure 4.6). Leaching of iron was also detected in the slope (Figure 4.7). The slopes are moderately vegetated, damp and have sporadic agricultural terraces[6].

Rill erosion has been observed below the crown of the landslide (Figure 4.8). The shallow channels formed due to erosion of flowing water is known as rills

Fig. 4.8: Rill Erosion below the Crown of the Landslide

and when these get larger they are termed as gullies. Generally, the factors that fabricate the environment for the formation of the rills include poorly structures soils, nature of the soil, rainfall intensity and frequency, slope length and slope angle.

4.3 Causes of Landslide

The landslide was reactivated for the third time in mode of debris flow, as per the local community[6]. The dimensions of the landslide are given below:

Table 4.1: Dimensions of the Landslide[6]

Length	300m
Width	350m
Height	300m
Depth	Generally deep-seated (10m)
At crown (5-8m)	
Run out distance	1155m

Though, the main triggering factor of the disaster was monsoon precipitation yet the factors which contributed to make slope prone to landslide are:

- Sheared/Thrusted rock mass
- Slope material was formed by past landslides debris
- Dearth of appropriate slope drainage system

4.4 Impacts of landslide

The nasty incident graved two buses of Himachal Road Transport Corporation and took forty six human lives. Several cattle beside wild fauna were also got buried, though their numbers were unknown. The few agriculture terraces/ fields, bikes and vegetable vehicles were also in the victims of landslides. The structures, infrastructures and other losses in the event were as follows:

- 7 houses were damaged, resultant 7 families were rendered homeless.
- Livestock including 6 cows, 2 oxen, one goat and one calf buried under the debris.
- Approximately 300-350m stretch of road was damaged.
- A bridge of 25-30m in length devastated.
- Hutments (3-4) on upslope were destroyed.
- 30 bigha of land of 10 families and crop were also washed way during the incidence.
- Cattle shades were also damaged.
- Loss of livelihood of the villagers dependent on agriculture and livestock.

NIDM team led by Prof. Surya Parkash, Head, Geo-meteorological Risks Management Division had a field visit during February 2021 and consulted with the local disaster management authorities and local communities. Local communities were cognisant about the vulnerability of the slope. Every year during the monsoon season incidence of rock boulders tumbling was experience. Therefore, as a precautionary measures, villagers used to abandon the area during the monsoon season. They used to practice agriculture activities in the middle option of the slope and also constructed cattle shades.

Fig. 4.9: Google Satellite Imagery of March 2017 showing Agricultural Land

Fig. 4.10: Now Devoid of Agricultural Land and Cattle Shades

The disaster wreaked havoc on the passengers of two buses of Himachal Pradesh State Transport that were designated from Katra to Manali and Manali from Chamba. The first bus (Katra to Manali) had 8 to 10 passengers while in latter one 40-45 passengers were boarded. As per the local authorities, the debris washed away two buses of Himachal State Transport along with few other vehicles. The bus slide down 400-500 metres below the road with debris. Bus was vertically in the debris and passengers were alive until the bus completely merged in the mound of debris. As per the rescuers and locals, the bodies of the children were found with their hands on their heads.

Fig. 4.11: Landslide and its Run out Length (Source: DDMA Mandi)

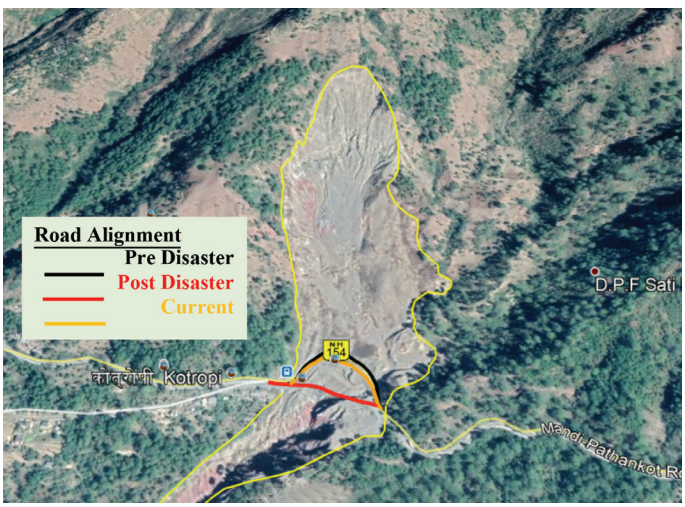

Fig. 4.12: Different Road Alignment at Kotrupi

The debris run out length was 1155 m (Figure 4.11) and it also completely buried 300 meters of the highway besides destroying a bridge. The debris completely blocked the National Highway. The restoration of the highway became challenging due to overnight rain. To re-establish the highway for commuters, a new alignment was laid on the debris 60m from previous alignment. (Figure 4.12) Currently, the highway is constructed in its pre-disaster alignment.

4.5 Rescue and Response Operation

The local authority promptly launched rescue operation as soon as they received information of the catastrophe to save the lives of the people buried in the debris. On the direction of Deputy Commissioner, Mandi line departments of the district including Police department, fire services and Medical Services beside local community rushed to provide helping hand in the operation. District administration approached to the Army, NDRF, SDRF, Reserve Police forces for the operation. Teams of the NDRF and Indian Army rushed to the spot-on. The whole area has been covered with several feet of mud and big boulders. Traffic was diverted from both sides of the National Highway. Heavy earth-moving machinery was deployed at the gorge where the two buses lay buried under a heap of debris. 3 Poclains, Hydra, crane, 2 bulldozers, 4 JCBs, hydraulic jacks, sledgehammers and power saws were used to cut through steel and concrete to rescue the inhabitants trapped under tons of debris and to remove the dead bodies. Relentless rescue and clean-up operations continued for the many hours. Forty-six bodies were recovered and five injured rescued in a day-long operation. Amongst the recovered bodies, 43 are from the Chamba-Manali bus and three from the Manali-Katra.

All the line departments, Emergency Response Functionaries and Social Emergency Response Volunteer (SERVs) joined hands for the response operation. Detail of work /duties done by District Administration, Emergency Response Functionaries and Social Emergency Response Volunteer (SERVs) at Kotrupi landslide incidents is as follows (District Disaster Management Authority, Mandi, Himachal Pradesh):

4.5.1 Search & Rescue

- Operation of search and rescue for victims trapped in landslide was carried out by District Administration, police and National Disaster Response Force (NDRF).
- Social Emergency Response Volunteer helps in Transportation of injured persons and causality from incident site to medical outpost.

4.5.2 Crowd management

- Police, Traffic polices and Social Emergency Response Volunteer helped in managing and monitoring the traffic situation and the presence of a huge crowd and vehicles, apparently volunteers from across Mandi who had rushed to the site on hearing the news of the tragedy.

- Police, Traffic polices and Social Emergency Response Volunteer helped to maintain the law and order situation at the incident site.

4.6 Recovery and Rehabilitation

The post disaster operation included:

4.6.1 Shelter management

- The victims and families from the villages that were declared unsafe, shifted to nearest government schools/residences, community buildings and Panchayat Ghar by the District Administration with their household with the help of Social Emergency Response Volunteer.

4.6.2 Resources Distribution

- Blanket, clothing and other necessary items were distributed to the victims and the affected families and were shifted to Emergency Shelter.
- Social Emergency Response Volunteer helped in the arrangement of food and drinking water supplies to search & rescue operation teams working on the incident site.
- Few SERVs female members prepared and brought home cooked food along with drinking water for affect family & rescue teams from water streams far from the incident sites.

Fig. 4.13: Glimpse of Rescue and Response

(Photos Source: DDMA Mandi)

The district administration as per the norms provided relief to the kin of the victims. The total amount of Rs.2,98,03,966/- was expensed on relief and miscellaneous expenditures (Table 4.1 Source: DDMA Mandi, Himachal Pradesh). A relief of Rs.10,000/- each to the next of the kins of deceased was provided by SDM Joginder nagar and SDM Padhar.

Table 4.1: Details of the expenditure on relief and miscellaneous

Sl.No.	Name of Deceased Person	Amount (Rs.) Given by HP Govt.	Amount (Rs.) Given by Center Govt.
1	Pankaj S/o Mehar Chand R/o Chachoga Tehsil Manali	4,00,000/-	2,00,000/-
2	Pawan Kumar S/o Kehar Singh R/o Patli Kuhal tehsil Manali	4,00,000/-	2,00,000/-
3	Khub Ram S/o Jeet Ram R/o Jana PO Archandi Tehsil Kullu	4,00,000/-	2,00,000/-
4	Pushap Raj S/o Shyam Chand R/o Dhar Tehsil Bhunter	4,00,000/-	2,00,000/-
5	Suresh Kumar S/o Nain Singh R/o Panjathi Tehsil Sadar Mandi	4,00,000/-	2,00,000/-
6	Chandan Sharma S/o Harbansh R/o Bagla Muhala Mandi	4,00,000/-	2,00,000/-
7	Hem Singh S/o Kameshwar Singh R/o Vir Tungal Tehsil Sadar Mandi	4,00,000/-	2,00,000/-

8	Kartar Chand S/o Tarlok Chand R/o Lower Kunsal Tehsil Baijnath	4,00,000/-	2,00,000/-
9	Neha Kumari D/o Ravinder Kumar R/o Khadan Po Sidhpur Tehsil Dharmpur	4,00,000/-	2,00,000/-
10	Anil Kumar S/o Parmanand R/o Navani Tehsil Baldawara	4,00,000/-	2,00,000/-
11	Palak Sharma D/o Tilak Sharma R/o Hudaa Tehsil Sluni Chamba	4,00,000/-	2,00,000/-
12	Muskan Sharma D/o Tilak Sharma R.o Hudaa Tehsil Sluni Chamba	4,00,000/-	2,00,000/-
13	Arman Sharma D/o Tilak Sharma R/o Hudaa Tehsil Sluni Chamba	4,00,000/-	2,00,000/-
14	Geeta Devi W/o Satish Kumar R/o Hudda Tehsil Saluni Chamba	4,00,000/-	2,00,000/-
15	Satpal Singh R/o Charan Dass VPO Khel Tehsil Nurpur Kangra	4,00,000/-	2,00,000/-
16	Vinod Kumar S/o Tara Chand VPO Gumma Tehsil Joginder Nagar	4,00,000/-	2,00,000/-
17	Shani Kumar S/o Tilak Ram Vill Chanvi PO Tikkar Tehsil Joginder Nagar	4,00,000/-	2,00,000/-
18	Somdev S/o Ravi Bhardawaj VPO Urai Tehsil Bharmor Chamba	4,00,000/-	2,00,000/-
19	Sheela Devi W/o Ravi Bhardawaj VPO Urai Tehsil Bharmor Chamba	4,00,000/-	2,00,000/-
20	Manisha Kumari W/o Amit Kumar Village Satapar PO Sandhi Tehsil Chamba	4,00,000/-	2,00,000/-
21	Amit Kumar S/o Duni Chand Vill. Satpar PO Sandhi Tehsil Chamba	4,00,000/-	2,00,000/-
22	Pawan Kumar S/o Tej Singh Vill. Kahueka PO Sandi Tehsil Chamba	4,00,000/-	2,00,000/-
23	Saruchi Thakur D/o Gyan Chand Vill. Jimjima PO Dula Joginder Nagar	4,00,000/-	2,00,000/-
24	Madan Lal S/o Man Singh R/o Goadog Tehsil Saluni Chamba	4,00,000/-	2,00,000/-
25	Mohanish Gurang S/o Vijender Kumar Vill. Kandrodi Tehsil Indor Kangra	4,00,000/-	2,00,000/-

26	Devender Sharma S/o Kedar Sharma Villae Rai Tehil Bharmor Chamba	4,00,000/-	2,00,000/-
27	Prem Singh S/o Goverdhan Dhari Lal Vill. Baru PO Pipali Tehsil Joginder Nagar Mandi	4,00,000/-	
28	Vijay Kumar S/o Dalip Kumar Village Rndhar Tehsil Chamba	4,00,000/-	2,00,000/-
Uttar Pradesh			
29	Rana Pratap Singh S/o Ram Janam Singh Village Hardaspur The. Mau Sadar UP	4,00,000/-	2,00,000/-
30	Vabhabhi D/o Rana Pratap Singh Vill. Hardspur The. Mau Sadar UP	4,00,000/-	2,00,000/-
31	Vaishnabi D/o Rana Pratap Singh Vill. Hardspur The. Mau Sadar UP	4,00,000/-	2,00,000/-
32	Tejsabi D/o Rana Pratap Singh Vill. Hardspur The. Mau Sadar UP	4,00,000/-	2,00,000/-
33	Krish UP Ansh Singh S/o Akhilesh Singh Vill. Kurthi Jafar Tehsil Mau Sadar UP	4,00,000/-	2,00,000/-
34	Tanu D/o Akhilesh VPO Kurthi jafar Tehsil Mau Sadar UP	4,00,000/-	2,00,000/-
35	Surya Dev Singh S/o Shyam Dev Singh VPO Kharuaab The. Rasra District Baliya UP	4,00,000/-	2,00,000/-
36	Satya Prakash S/o Surya Devi Singh VPO Kharuaab The. Rasra District baliya UP	4,00,000/-	2,00,000/-
37	Mehak UP Anushka D/o Surya Devi Singh VPO Kharuaab The. Rasra District baliya UP	4,00,000/-	2,00,000/-
38	Pawan Kumar S/o Rajender Parsad VPO Asraer Tehsil Bundanpur Distt. Aajamghar UP	4,00,000/-	2,00,000/-
39	Umesh Soni S/o Avdesh Soni VPO Atreha Tehsil Budan Pur Distt. Aajmghar UP	4,00,000/-	2,00,000/-
40	Kanhya S/o Din Dyal VPO Atrehar Tehsil Budan Pur Distt. Aajmghar UP	4,00,000/-	2,00,000/-
41	Dep Chand S/o Shiv Shankar Vill. Bhulana Pur PO Kanshi Pur Tehsil Budnpur Distt. Aajmghar UP	4,00,000/-	2,00,000/-

Jammu Kashmir			
42	Jagpreet Singh S/o Harcharn Singh Vill. Vali Charn H.No.341/6 PO Satvari The. Jamu South Distt. Jammu J& K	4,00,000/-	2,00,000/-
43	Mandeep Singh S/o Inder Jeet Singh Vill. Vikram Nagar Gardi Mara PO Meeran Sahib J & K	4,00,000/-	2,00,000/-
44	Sagar Singh S/o Kaku Ram Vill. Chaina PO Dingra Amb Tehsil Hira Nagar Distt. Katuaa J & K	4,00,000/-	2,00,000/-
45	Subhash Chand S/o Roop Chand Vill. Chena PO Dinga Amb Tehsil or Distt. Katuaa J & K	4,00,000/-	2,00,000/-
46	Kewal Kumar S/o Rattan Chand Vill. Deyot PO Khun Tehsil Mjalta Distt. Udhampur J & K	4,00,000/-	2,00,000/-
Total Amount (Rs.)		1,84,00,000	90,00,000

Sl.No.	Compensation for loss of livestock/crop	Amount (Rs.) Given by HP Govt.	Amount (Rs.) Given by Center Govt.
1	Vyuti Sharma D/o Upender Sharma Vill. Batna PO Bijdhari Tehsil Kesariya District Champaran Bihar	15,000/-	50,000/-
2	Manju Kumari D/o Ram Krishan Village Silhi PO Taivan Tehsil Karsog District Mandi	15,000/-	50,000/-
3	Suchiliya D/o Mela Ram Village Doya PO Arsu Tehsil Nirmand District Kullu HP	5,000/-	
4	Anita D/o Nek Ram VPO Kuradi Tehsil Joginder Nagar District Mandi HP	5,000/-	
5	Shubham D/o Mohinder Pal Vill. Bhunagal PO Bandhari Tehsil Pathnkot	5,000/-	
6	Chobai Ram S/o Lekhu Ram Village Rawa Kotrupi PO Urla Padhar (livestock)	40,000/-	
7	Bhola Ram S/o Het Ram Village Rawa Kotrupi PO Urla Padhar (livestock)	40,000/-	

8	Naryan Dass S/o Gandhi Vill. Badhwahan PO Urla Tehsil Padhar (crop)	16,450/-	
9	Hem Kant S/o Lekh Ram Village Badwahan PO Urla Tehsil Padhar (crop)	3000/-	
10	OM Praj S/o Ganhdi Village Badwahan PO Urla Tehsil Padhar (crop)	3150/-	
11	Khem Singh S/o Jhadgu Vill. Badwahan PO Urla Tehsil Padhar (crop)	4,200/-	
12	Himu Ram S/o Jhagdu Ram Badwahan PO Urla Tehsil Padhar	4,200/-	
13	Anant Ram S/o Nupa Badwahan PO Urla	2,400/-	
Total Amount (Rs.)		**1,58,400/-**	**1,00,000/-**

Sl.No.	Name of effected Person and Other Payment	Total Amount (Rs.) Given
1	Sharma Crane	9,000/-
2	Baldev S/o Vrestu Ram	4,500/-
3	Daulat Ram S/o Maya Ram	3,700/-
4	Chovi Ram S/o Tirkhu Vill Kotrupi	1,39,200/-
5	Jai Chand S/o Tirkhu Ram Vill Kotrupi	1,38,450/-
6	Bhola Ram S/o het Ram Kotrupi	72,617/-
7	Saju Ram S/o He Ram Kotrupi	54,967/-
8	Mani Ram S/o Het Ram Kotrupi	54,966/-
9	Lugu Ram S/o Tirkhu Ram Kotrupi	1,19,900/-
10	Sita Ram S/o Lohar Village Kotrupi	1,21,700/-
11	Fuli Ram S/o Lohar Village Kotrupi	1,19,900/-
12	Dole Ram S/o Lohar Village Tiyun	3,000/-
13	Khimar Ram S/o Lohar Village Tiyun	3,000/-
14	Duni Chand S/o Niharkhu Vill Kotrupi	1,25,450/-
15	Bhag Singh S/o Duni Chand Kotrupi	1,19,950/-
16	Gourav Goods	1,000/-
17	Sahid Hira Singh Filling Station Narla	84,075/-
18	Shahid Hira Singh Filing Station Narla	17,326/-
19	New Man Pasand	9,020/-
20	Nav Yug Emporium Near Thesil Padhar	9,295

21	Nikhil General Store	550/-
22	Gyan Chand S/o Niharkhu Kotrupi	60,000/-
23	Man Chand S/o Niharkhu Kotrupi	60,000/-
24	SDO Electricity Padhar	1,774/-
25	SDO Electricity Padhar	1,774/-
26	Subhash Singh S/o Brestu Ram Cowkidar IPH	3,200/-
27	Hem Singh VPO Ghta Tehsil Sadar Poklane ka bill	2,33,150/-
28	Jiwan Thakur Village Chatra Tehsil Balh	37,000/-
29	Chotu Ram Thakur Vill. Charot PO Lakhanu Tehs Naina	2,25,000/-
30	Lakhan Singh VPO Padhar	3,200/-
31	Lakhan Singh VOP Padhar	1,37,500/-
32	SK Enterprised VOP Padhar	25,360/-
33	Thakur Tent House Padhar	18,000/-
34	Thakur Tent House Padhar	24,000/-
35	Thakur Tent House Padhar	18,000/-
	Total Amount (Rs.)	**19,59,524/-**

Date	Miscellaneous Expenditure	Amount (Rs.)
10/06/2018	Regarding the power meter at landslide area	719/-
10/06/2018	Regarding the power meter at landslide area	1,956/-
16/08/2018	For street light at site	5,080/-
16/08/2018	Electrical equipments	7,535/-
10-03-2018	IPH GI Pipes	20,835/-
10-03-2018	Electricity payment	1,464/-
10-03-2018	Tent house	45,000/-
10-03-2018	On petrol by Home guards	330/-
22/10/2018	Consumption of electricity bill in Kotrupi landslide affected area	564/-
11-08-2018	Break up charges for new connection as per Demand notice	5,122/-
22/10/2018	Payment of cell put in Maga phone for informing people during rainy season	1,888/-

12-01-2018	Regarding Payment of Consumption of Kotrupi land slide site	665/-
24/01/2019	Electricity bill	1,055/-
02-11-2019	New manpasand mock drill	1,900/-
17/04/2019	Payment of JCB machine	22,000/-
07-09-2019	Payment of goods required by the personnel appointed in the Kotrupi landslide seal	18,351/-
24/07/2019	Electricity bill	1,058
10-10-2019	Goods rented during rainy season	50,520/-
	Total Amount (Rs.)	**1,86,042/-**

4.7 Precautionary Measures from District Administration

The precautionary measures taken by the district administration after the disaster are summed below:

- To facilitate the near ones of the victims Mandi district administration issued various helpline numbers such as 1905-226201, 226202, 226203, 1905-235538 and 094180-01051.
- The traffic on Mandi-Pathankot Highway (NH-154) was diverted to new routes — Ghatasi-Jhadigri-Katindi-Mandi, Jogindernagar-Nauni-Padhar and Jogindernagar-Dharampur-Potli-Mandi. The district administration advised people to take the Mandi-Kullu route via Kalota.
- Tarpaulin, blanket and other necessary items were distributed by the district administration to the victims.
- Affected villagers were shifted to the nearest government schools, community buildings and panchayat houses as rescue measures and a high alert has been issued to the surrounding villages like Sarajbagla, Jagehad, Badvahan, Ropa and Sasti.
- Under the direction of the DC Mandi, a committee was constituted for the inspection of the Kotrupi Landslide. The precaution measures suggested by the committee in September 2012 are as follows:
    - There should be proper arrangement of police person on both the ends of affected road alignment for regulating the safe movement of traffic. Deployed person must be equipped with the proper communication system to alarm the danger in advance. It was further suggested to provide high quality search light/flood light to the police persons deployed at the site for improving visibility of hill top slide area.

- The condition of the temporally road alignment should be constantly monitored by the concerned authority.
- The vehicular traffic should be allowed only in fair weather conditions.
- The experts of Geological departments may kindly be asked to give their valuable opinion on sustainability of the temporary alignment on debris.

4.8 Remedial Measures for the Kotrupi Landslide

NIDM Team led by Prof. Surya Parkash visited the landslide area during February 2021. The team had a detailed consultation with key district administration, local communities and other stakeholders. Sh. Rugved Thakur, IAS, DC Mandi, Sh. Shiv Mohan Saini, SDM Padhar; Sh. Satish Chand Bhatiya, Patwari, Padhar, Sh. Navven Nischal Sharma, Reporter, Divya Himachal, IIT Mandi and local people provided valuable information on the Kotrupi landslide.

At present, the authority is having wait and watch approach as the slope has not shown any movement in the year 2019-20. During monsoon period home guards are deployed on both side of the national highway to alert the people in case of any activity in the slope. As per observations during field visit, the remedial measures used to stabilize the slope include construction of gabion wall, check dams, precast concrete pipes, steps and plantations. (Figure 4.14)

Fig. 4.14: Remedial measures adopted at Kotrupi

4.8.1 Gabion walls

Gabions are wire mesh, boxlike containers filled with cobble-sized rock that are 10 to 20 centimeters size. A gabion retaining wall can also be constructed from stacked gabions. Gabion walls usually are inexpensive and are simple and quick to construct. Due to their flexibility, these can withstand foundation movement, and do not require elaborate foundation preparation. Because of their coarse fill, these are very permeable and thus provide excellent drainage. Gabion walls work because the friction between the individual gabion rows is very high, as is the friction between the basal row and the soil underneath [8].

4.8.2 Precast Concrete Pipes

Water in the form of unprecedented rainfall or groundwater is the most important single contributor to landslide initiation and its continuation. Not surprisingly, therefore, controlling drainage is the most effective element of slope stabilization scheme, for both existing and potential landslides. At Kotrupi landslide site to drain-off the water precast concrete pipes are used.

4.8.3 Check Dams

Check dams are usually constructed as hydraulic control work at the landslide site. They are effective in slowing down the flow, scattering the energy of the flow and therefore aid in preventing or mitigating landslides especially debris flow. Check dams were constructed along the natural drainage at the landslide site to reduce the impact of surface water flow.

4.8.4 Plantation

Plantation at the landslide site facilitate in slowing down the flow of water and also the roots of plants helps to reduce surface erosion, which can under certain conditions lead to landslides. The local administration carried out plantation at the Kotrupi landslide site where there was agricultural land before the devastation.

4.9 Establishment of Early Warning System

Internet of Things (IoT) based Early warning system was established on the site by IIT Mandi for monitoring purpose (Figure 4.15 & 4.16). The IoT is a powerful concept of interacting with the physical world through a network of natural or manmade objects that are connected to the internet and process the collected information automatically, with or without human intervention, to gain crucial insights that support more efficient management of limited resources.

The flexibility and scalability of IoT-based EW systems support significant automatization of landslide risk assessment through the implementation of advanced data analysis, statistical learning algorithms, and efficient integration of data with advanced geohazards prediction models. The criteria for issuing early warning is based on degree of saturation of soil and the supply of water to it through rainfall and snow melting.

Fig. 4.15: IoT based EWS Developed by IIT Mandi

Fig. 4.16: EWS Established by IIT Mandi at Kotrupi Landslide

After the discussion with NIDM, District Administration signed a MoU with IIT Mandi and planned deployment of 20 LEWSs at various location in the district.

Fig. 4.17: Prof. Surya Parkash along with Sh. Rugved Thakur, IAS, DC Mandi

Fig. 4.18: Discussion with Sh. Shiv Mohan Saini, SDM Padhar and others at landslide site

Fig.4.19: NIDM Team along with IIT Mandi Team

Key takeaways from the visit

- The slide was reactivated for third time. The dearth of proper monitoring of the slope led to the mayhem. Therefore, proper monitoring of such slopes potential to fail should be monitored appropriately.
- Though few officials from different departments visited the site but no detailed investigation of the slide was done.
- Rehabilitation issue: As the area falls under the forest department there were issues regarding the settlement of the displaced people.
- Lack of proper coordination among the line departments was also highlighted.
- Though the local authority was prompt in response yet they are unaware of the mitigation fund that can be used to mitigate the risks of landslide in the area. Issues of unawareness about mitigation funds and shortage of expertise to prepare DPR at grassroots level need to be addressed.
- The early warning system established by the IIT Mandi was vandalised a couple of times. The proper safety of such important instrument is utmost important.

5. STUDIES CARRIED OUT ON KOTRUPI LANDSLIDE

A number of researchers and relevant organisation working on the landslides in the country studied the probable causes and suggested potential mitigation/ remedial measures for the Kotrupi Landsldie. Some of the investigations are discussed below:

A team of Geological Survey of India, the nodal agency for the landslide study in the country visited the landslide after its reactivation and their observations were as followed:

Prima facie it appears that the slide has occurred due to few or combination of following geo-scientific causes: Sheared/ Thrusted rock mass; Old slide debris; poorly drained slope – Possibly no surface drainage system was there. Ingress of water and development of tension cracks that got widened to about >1ft as per the villagers; Perennial ingress of rain water and surface water in the cracks – its accumulation and development of pore water pressure inside the old slide debris. It must be noted however, that as per the local residents, the driver of Manali - Katra HRTC Bus has noted some movement of slope material in the slide affected slope and stopped the bus for sometime and could escape just after the debris flow started. Detailed field studies is required to ascertain the cause[6].

Sharma, P. et al. (2018) conducted Geotechnical and chemical soil investigation of Kotrupi landslide. Based on the results obtained, mitigation of Kotrupi landslide using helical soil nails was suggested. The following conclusions were derived from the study[9]:

- Soil nailing is an appropriate treatment for the slope as factor of safety (FOS) with soil nail is 1.67. In absence of soil nail FOS is <1 which indicate collapsing of slope.
- For the unreinforced and reinforced slopes, the deformation of the initial Kotrupi slope decreases from 0.13 to 0.06 m, respectively. Furthermore, the numerical analysis of a helical soil-nailed Kotrupi slope revealed that slope displacements are within allowed limits, providing clear evidence of the viability of helical soil nail performance under serviceability conditions.
- It may be determined from the nail force distribution that nail forces create tensile forces, indicating effective reinforcing action of placed helical nails.

Singh, N. et al (2020) carried out analysis of Kotrupi landslide reactivation using satellite data [10]. In their study, they analysed various parameters such as seismic, hydro-meteorological, soil moisture, geology and lineaments which were likely responsible for triggering the Kotrupi landslide. According to the

research conducted by authors on the seismic link to landslide initiation, about 55% of the earthquakes occurred at shallow depth during 1970-2019. Since 1997, a surge have been observed in the frequency of earthquakes within 50 km radius of the landslide. Due to presence of major and local thrust and fault, the rocks are highly crushed and weathered rock that also depict stress accumulation within the region, which has repeatedly vented out in form of slope failure.

To have a better understanding of influence of rainfall and soil moisture in triggering the catastrophe, the authors also investigated daily soil moisture and rainfall data for the months of July and August from 2010 to 2018. The continuous rainfall prior to the main event resulted in increased pore water pressure leading to decrease in strength of the slope. The augmenting trend of rainfall in the future could be an alarm of more such events of slope instability. The conclusion of the research was that a combination of factors such as development of tension cracks, sheared/thrusted rock mass having poorly drained slope, antecedent rainfall, and rise in soil moisture content as well as increased seismic activities resulted in the failure of the slope.

A satellite-based analysis of Kotrupi landslide was carried out by the **Roy, P. et al (2018)**. The extensive runout zone of the slide strongly shows that heavy rain was the primary cause of the disaster. Pre-existing scars on steep slope faces are possible places for massive future landslides, as demonstrated by the occurrence of this landslide. These scars not only indicate the instability of the slope material, but also expose bare soil from where rainwater seeps in. This increases pore pressure of the soil, eventually leading to a complete slope failure [11].

6. KOTRUPI IN THE NEWS

20 साल बाद..वही 13 1977... 1997 और अब ...2017

By: *divyahimachal* Aug 14th, 2017 12:15 am

उरला— दुनिया में 13 नंबर को अशुभ माना जाता है। कुछ इस पर विश्वास करते हैं कुछ नहीं, लेकिन मंडी-पठानकोट एनएच पर कोटरूपी के लिए 13 तारीख मनहूस ही रही है। ऐसा इसलिए की इस स्थल पर इससे पहले भी दो बार 13 तारीख को भू-स्खलन हुआ है। हालांकि इस बार की 13 तारीख ऐसे जख्म दे गई, जिसे लोग ताउम्र न भूल पाएंगे। कोटरूपी हर 20 साल बाद 13 अगस्त को ही प्रकृति के प्रकोप का शिकार हो रहा है। यह अजीब संयोग की बात है कि शनिवार देर रात जहां भारी भू-स्खलन हुआ वहां हर 20 साल बाद उसी महीने उसी तारीख को दो बार भू-स्खलन हो चुका है। हालांकि ताजा घटना क्रम में पूरा का पूरा पहाड़ अपने साथ कई जिंदगियां लील गया। जानकारी के अनुसार सबसे पहले मंडी-पठानकोट एनएच-154 पर कोटरूपी में 13 अगस्त, 1977 को पहली बार भू-स्खलन हुआ था। उस समय में भी काफी नुकसान क्षेत्र में हुआ था। हालांकि उस दौरान किसी जानी नुकसान की जानकारी सामने नहीं आई। इसके बाद ठीक 20 साल बाद 13 अगस्त, 1997 एक बार फिर कोटरूपी में भू-स्खलन हुआ और इसमें रवा पुल का नामोशिन मिट गया था। उस समय उख्त रोड पर आवाजाही करीब तीन दिन तक पूरी तरह ठप रही थी। इसके बाद एक बार फिर 13 अगस्त, 2017 को जब पहाड़ दरका तो कई जिंदगियां दफन कर गया। यह अब तक के कोटरूपी व प्रदेश के इतिहास का भयावह भू-स्खलन साबित हुआ। इस बार अगस्त की 13 तारीख कई जिंदगियों के लिए मरण का 13वां दन गई।

Business Standard

Himachal landslides: Met predicts heavy rains may hamper rescue operations

There are chances of heavy rainfall in Mandi and Kangra districts: Meteorological office director

IANS | Shimla August 14, 2017 Last Updated at 12:24 IST

The mangled remains of vehicles after two buses and other passenger vehicles were swept away by a massive landslide at Kotrupi in Mandi district on Saturday night. Photo: PTI

Several parts of Himachal Pradesh, including Mandi district where a massive mudslide claimed 46 lives, may experience heavy rainfall on Monday, a weather official warned.

हिमाचल प्रदेश के मंडी में भूस्खलन, अब तक 46 लोगों के शव बरामद

वहीं मनाली जाने वाली बस पूरी तरह पानी में बह गई. पानी का बहाव इतना तेज था कि बस खाई में जा गिरी. बताया जा रहा है कि ये पूरी बस यात्रियों से भरी थी.

मनजीत सहगल
मंडी, 13 अगस्त 2017, (अपडेटेड 14 अगस्त 2017, 7:44 AM IST)

हिमाचल प्रदेश के मंडी में भूस्खलन की चपेट में आने से मरने वालों की संख्या 46 हो गई है. हादसा इतना भयानक है कि अभी और लोगों के दबे होने की आशंका जताई जा रही है. रविवार देर शाम तक रेस्क्यू ऑपरेशन के बाद राहत बचाव का काम रोक दिया गया है. सोमवार सुबह एक बार फिर रेस्क्यू शुरू किया जाएगा.

ये हादसा शनिवार देर रात हुआ था. जब एक बस चंबा से मनाली जा रही थी, जबकि दूसरी मनाली से जम्मू की तरफ जा रही थी. बताया जा रहा है कि मंडी-पठानकोट राजमार्ग पर कोटरूपी के पास रोडवेज की दो बसें रुकी हुई थीं. इसी दौरान बादल फटने और भूस्खलन के चलते एक बड़ा पत्थर मनाली से कटरा जाने वाली बस के ऊपर आ गिरा. जिसके चलते ये बस लुढ़कते हुए 200 मीटर गहराई में जा गिरी.

कोटरूपी में आपदा से निपटने को कड़ा पहरा

By: *स्टाफ रिपोर्टर—पद्धर*
Aug 31st, 2020 12:23 am

पद्धर प्रशासन ने मंडी-पठानकोट रोड पर लगवाए टैंट; दिन-रात ड्यूटी दे रहे होमगार्ड जवान, हादसे वाली जगह लाइट का भी किया प्रबंध

स्टाफ रिपोर्टर—पद्धर-उपमंडल पद्धर के कोटरूपी में आने वाली आपदा से निपटने के लिए पद्धर प्रशासन ने तैयारी कर ली है। प्रशासन ने इस वर्ष भी दोनों ओर मंडी-पठानकोट जोगिंद्रनगर की तरफ व मंडी-पठानकोट मंडी की तरफ टैंट लगा दिए गए हैं और होमगार्डों की तैनाती भी कर दी गई है। यह होमगार्ड कोटरूपी में आने वाली आपदा से निपटने के लिए रात दिन 24 घंटे लोगों को जागरूक करते रहेंगे। कोटरूपी में हादसे वाले स्थान पर विद्युत बोर्ड द्वारा लाइटों का भी प्रबंध कर दिया गया है। बताते चलें कि इस मुद्दे को पद्धर मीडिया द्वारा उठाया था और मीडिया में आने से इस मुद्दे को मंडी उपायुक्त ने कड़ा संज्ञान लेते हुए एसडीएम पद्धर को रिपोर्ट सौंपने के आदेश दिए थे, जिसमें आदेशों का पालन करते हुए एसडीएम पद्धर शिव मोहन सैणी ने तुरंत कार्रवाई करते हुए कोटरूपी का दौरा कर घटनास्थल के दोनों ओर यातायात को सुचारू बनाए रखने के लिए वह किसी भी आपदा से निपटने के लिए 24 घंटे होमगार्ड की तैनाती कर दी है।

Wednesday, 17 March 2021

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HIMACHAL PRADESH

46 dead as landslide buries two buses in Mandi, rescue ops to resume tomorrow

SHIMLA/DHARAMSALA: Forty-six people were killed after a massive landslide buried two Himachal Pradesh roadways buses at Kotrupi in Mandi district on the Mandi-Pathankot national highway. The toll is likely rise as more than 50 passengers were travelling in the two buses that were hit by the landslide, triggered by a cloud burst.

Updated At: Aug 14, 2017 01:43 AM (IST)

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Rescue work underway on the Mandi-Pathankot national highway after a landslide struck two buses on Sunday. Photo: Jai Kumar

Disaster At Kotrupi

By: *divyahimachal* Aug 19th, 2017 12:30 am

Sunil Sharma (cover story)

The disaster that struck Kotrupi village in Mandi district on the night intervening August 12 and 13 claimed 46 lives besides leaving many locals homeless and landless. Two buses of Himachal Road Transport Corporation, one vehicle and one motorbike were buried under a massive landslide (shown above) from a hillock. The ill-fated buses were plying on Manali-Katra and Chamba-Manali routes when the tragedy struck. Eyewitnesses said boulders started falling from the hill two hours before the landslide. Twenty members of five families had a providential escape as they quickly moved to a safer place just before the impending disaster. Landslides are common sites during rains in Himachal that is witnessing climate change. However, the state has so far failed to put in place a proper disaster management plan. The unscientific cutting of hillocks for construction of roads is another reason cited for increasing landslides resulting in loss of lives. Knowledgeable person feel that hillocks are being razed with dynamite explosions thus weakening already fragile strata. Serious thinking has to be done for evolving a developmental model suitable for hills to prevent such tragedies, they add.

7. NATIONAL INTERVENTIONS FOR LANDSLIDES MANAGEMENT

The stability of slopes have always been under the menace from the landslides, one of the major hydro-geological hazards which affects a large part of India from the mighty Himalayan range in the north to the coastal areas of the south. North and North-east states residing in the lap of the Himalayan ranges are highly landslides susceptible regions in the country.

7.1 High Power Committee, 1999

The High Power Committee constituted in the year 1999 endeavoured to provide a new conceptual framework to diminish the impacts of the disasters. The committee exhorted focusing on the preparedness for the prevention and reduction in addition to mitigation of the disasters[12]. The natural as well as man-made disasters were classified under five categories. Landslides were placed under the "Geological Disasters" group. The committee highlighted that landslides are predictable and the adverse impacts posed by them can be minimised or even averted with proper and systematic studies. Priorities were given to landslide hazard identification, improved mapping, assessment to identify the existing/potential slope failures, landuse patterns, control measures and development of reliable risk assessment beside sensitizing the community about the threats of landslides and the possible solutions to minimize them it they are unavoidable. They also emphasised to encourage the R&D on prediction and forecasting of landslides, especially for old landslides that have potential for reactivation, recurring landslides, and those occurring in the areas known to be hazardous.

7.2 Guidelines on Management of Landslides and Snow Avalanches, 2009

Apprehending the enormous destructive potential of the landslides and the need of reducing the resultant losses of lives and economy, National Disaster Management Authority, Government of India in the year 2009 materialized "National Disaster Management Guidelines on Management of Landslides and Snow Avalanches". The guidelines incorporated time bound regulatory and non-regulatory framework to institutionalise the landslide hazard mitigation efforts apart from enhancing the capacity of society to take appropriate measures to avoid/reduce the risks and costs associated with the hazard[13]. To address the challenges against the landslides risk reduction and resilience, nine major areas were acknowledged for systematic, synchronized and effective management of landslides hazards.

Major Elements for Effective Management of the Landslides

Source: National Disaster Management Guidelines on Landslides, 2009

7.3 National Landslide Risk Management Strategy, 2019

To address all the odd challenges of the landslides at national as well as local level, National Disaster Management Authority, Government of India formulated a strategic document that also accomplish the fifth target of Sendai Framework for Disaster Risk Reduction (2015-30) i.e., Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020[14]. National Landslide Risk Management Strategy laid recommendations on all the major components of landslide disaster risk reduction and management. The components which were focused are, landslide hazard mapping, monitoring and early warning system, awareness generation programmes, capacity building & training, mountain zone regulations & policies and mitigation of landslides & creation of special purpose vehicle for landslide management. The recommendations laid by the strategy document included:

- As most of landslide hazard zonation maps available are at small scale (1:50000), they have limited efficacy in any development activities. Hence, the need of hour is to produce maps at macro and meso scale using advanced scientific state-of-the art tools such as Unmanned Aerial Vehicle (UAV), Terrestrial Laser Scanner, and very high resolution Earth Observation (EO) data.
- To foster the R&D for development of early warning system based on rainfall threshold, earthquake induced landslide modelling and Wireless Sensor Network (WSN) based instrumentation.
- To promote the culture of awareness generation and preparedness by involving and educating the local communities specially the youth about the landslide management as well as other hazard of their respective areas.
- Identifying the target groups from national to grass root level and enhancing their capacity for landslides risk reduction through training programmes having upgraded and simplified contents with new technological inputs.
- To review and revised existing codes/ standards/ guidelines for landslide management and to update and enforce building regulations and bye laws by State Governments/ Local bodies.
- To identify most problematic landside sites and identifying suitable control measures for site specific landslide stabilization and mitigation of problematic landslides.
- To establish a national level centre dedicated only for landslide research studies and management.

8. LESSONS LEARNT

Himalayan states have always been highly vulnerable to the landslide disasters. Kotrupi landslide was one of the major landslides in the history of Himachal Pradesh. The disaster again raised many questions which we need to solve for landslide risk reduction and resilience. Some of the key take aways from the incident can be categorised as:

- The landslide at Kotrupi was first initiated in August 1977 and reactivated in August 1997. The occurrence of this landslide exemplifies that pre-existing scars on steep slope faces are potential areas for large future landslides. These scars not only indicate the instability of the slope material, but also expose bare soil from where rainwater seeps in. So, there is need to study such pre-existing scars and their potential to turn into major disaster.
- Local Community was well aware about the instability of the slope and as a precautionary measures used to abandon the area at night during the monsoon season. There is need to incorporate the local knowledge in development planning process. The crucial role of local people in reducing the impacts of disaster is unanimously reiterated on many platforms. The indigenous knowledge and wisdom would certainly strengthen our strategies for a resilient future.
- The persistent monitoring of such slopes need to be carried out so that appropriate actions can be taken for any impending disaster. To be able to monitor fragile slopes, we need to focus on developing indigenous low-cost Landslide Early Warning Systems that will have paramount societal relevance for the temporal prediction of landslide disasters.
- Warning signs on the slopes having pre-existing scars should be placed to caution commuters.
- Before any construction activities we need to check the slope health status, whether the proposed construction is feasible or not, if not what should be the measures to ensure the safety of the slope.
- The capacity of Local administration needs to be enhance in terms of preparing DPRs. Also, we need a better coordination among line departments for sustainable development. All stakeholders from different streams dealing with the landslide disaster must collaborate under one umbrella to enhance each other capacity by sharing their experiences and wisdom with each other.
- Documentation of such events is crucial in strengthening the strategies to reduce the adverse impacts/risks of the landslides in the hilly slopes.

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