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Hazard and Vulnerability Assessment of Himachal Pradesh University Campus

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Abstract: Himachal Pradesh University (HPU), a premier institution of teaching and research in the country, is situated at Summer Hill, a suburb of Shimla at a distance of 5 km from the main town. HPU has a multi-hazard /multi-disaster prone campus and it's mainly because of its geo-climatic complexities and anthropogenic factors being the capital city of Himachal Pradesh massive development is going on in and around Shimla. Seismic hazard wise HPU and the surrounding areas in Summer Hill are quite vulnerable. It falls in the Zone IV of the seismic zonation map of India. Based on the past earthquake evidences, active tectonics or study of fault planes along which movement is still going on and seismic vulnerability studies indicate one conclusion, that is an earthquake of magnitude of 1905 Kangra earthquake is overdue in the region. Apart from earthquake, flood, fire and landslide are also the major disasters in Shimla and in the recent years they have wreaked havoc in the region. Shimla have been found more prone to disasters and are at high risk in terms of lives and property. Building bye-laws have not been followed in the city Man and man-made structure stands no chance against the awesome power and furry of such disaster when they strike. Therefore, a mechanism is needed to safeguard against massive and unwarranted loss of life and property in the event of such calamity. Solution to counter these trends exists and the knowledge and technology necessary to apply them are widely available. Disaster reduction is the sum of all the action which can be undertaken to reduce the vulnerability of a society to natural hazards. The solution includes proper land-use planning, aided by vulnerability mapping, to relocate people in safe areas, the adaptation of proper building codes in support of disaster resilient engineering, based on local multi hazard risk assessment/maps. In this paper, Hazard and Vulnerability assessment of HPU Campus is assessed. This study will serve as an initiative which can be used for managing both natural and human-induced hazards in the campus.

Keywords: Himachal Pradesh University (HPU), Human Resource Development Centre (HRDC), Hazard and Vulnerability.

1. INTRODUCTION

Himachal Pradesh University (HPU), a premier institution of teaching and research in the country, is situated at Summer Hill, a suburb of Shimla at a distance of 5 km from the main town. It lies in the North-Western ranges of the Himalayas and is located 31.60 N 77.100 E with an average altitude of 2397.59 meters (7866.10 ft) above mean sea level.

It covers 200 acres of lush green land and offers a panoramic view with its distinctive architectural style. The main forest in and around the campus are that of Pine, Deodar, Oak and Rhododendron. It was established in 1970 by an Act of the Himachal Pradesh Legislative Assembly. The University has 12 Faculties and 30 Teaching Departments covering various programs such as Management, and Vocational Studies; Commerce ; Engineering and Technology; Languages; Law; Life sciences and Physical Sciences; Social Sciences; Ayurveda, Dental, and Medical Sciences; Information Technology, Computer Science, Performing and Visual Arts. As many as two hundred seventy colleges/institutions (govt./private) from within the State are affiliated to the University in addition to Centre of Distance Education (ICDEOL), Evening Studies, Legal Studies and Regional Centre at Dharamshala. In addition to above the University also has UGC-Human Resource Development Centre (HRDC) on the second and third floor of Library Building. HPU has a multi-hazard prone campus and it's mainly because of its geo-climatic complexities and anthropogenic factors Seismic hazard wise like earthquake, landslide, avalanche and forest fire. HPU and the surrounding areas in Summer Hill are quite vulnerable. The vulnerability of the geologically young and unstable steep slopes in various Himalayan ranges, has been swiftly increasing in recent decades due to inappropriate activity, such as deforestation, road cutting, terracing and changes in agriculture pattern requiring more intense watering. During the last century the state has been shaken by a number of micro as well as macro earthquakes. Some of the prominent earthquakes that rocked the state are Kangra earthquake of 1905 (M=8.0) in which 18,815 people were killed, Kinnaur earthquake of 1975 (M=6.7) in which 60 people lost their lives and Dharamshala earthquake 1986 (M5.7). Besides these major earthquakes the state has been rocked by about 250 earthquakes with magnitude 4.0 and 62 earthquakes with magnitude more than 5.0. Another form of the natural hazards in Shimla is the occurrences of landslides. The hills and mountains of Himachal Pradesh are liable to suffer landslides during monsoons and also in high intensity earthquakes. The vulnerability of the geologically young and not so stable steep slopes in various Himalayan ranges, has been increasing at a rapid rate in the recent

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decade due to inappropriate human activity like deforestation, road cutting, terracing and changes in agriculture crops requiring more intense watering etc. Various forms of landslides are slumps; debris or rock slides, debris falls or rock falls. Various factors influence the landslides: steepness of slopes, saturation by heavy rains or melting snow and ice, rocks vibrations, excess load from embankments, fills and waste dumps, changes in water content, frost effect, weathering of rocks, effect of ground water, and change in vegetal cover. The hills and mountains of Himachal Pradesh are liable to suffer landslides during monsoons and also in high intensity earthquakes. The destruction caused as a result of avalanches in the past in Himachal Pradesh though not widespread is confined to the higher reaches of the state only. The higher hills comprising the districts of Kinnaur, Lahaul & Spiti, Chamba, and Kullu are particularly vulnerable to the hazards of avalanches. Avalanches have also the history of damage in Shimla. The forests of Himachal Pradesh known for their grandeur and majesty are like a green pearl in the Himalayan crown. This life supporting systems are presently under great stress due to impact of modern civilization, economic development and growth in human and cattle population. The forests of Himachal Pradesh are rich in vascular flora, which forms the conspicuous vegetation cover. Out of total 45,000 species of plants found in the country as many as 3,295 species (7.32%) are reported in the State. More than 95% of species are endemic to Himachal and characteristic of Western Himalayan flora, while about 5% (150 species) are exotic introduced over the last 150 years. Over the years the forest wealth of the State is being destroyed by the incidences of fire attributed to both anthropogenic and other reasons. The destruction of rich flora and fauna of the State due to forest fires will have serious repercussions on the ecological balance of the State. With the increase of road connectivity and number of vehicles plying on these roads in the State, the number of road accidents and loss of precious human lives is increasing day by day. The data from 2001-02 to 2009-10 would show an increasing trend in the number of accidents and the victims. The hilly terrain of the State and rash and negligent driving are the major cause of these accidents. Man and man-made structure stand no chance against the awesome power and furry of such disaster when they strike.

Therefore, a mechanism is needed to safeguard against massive and unwarranted loss of life and property in the event of such calamity. Solution to counter these trends exists and the knowledge and technology necessary to apply them are widely available. Disaster reduction is the sum of all the action which can be undertaken to reduce the vulnerability of a society to natural hazards. The solution includes proper land-use planning, aided by vulnerability mapping, to relocate people in safe areas, the adaptation of proper building codes in support of disaster resilient engineering, based on local multi hazard risk assessment/maps. The proposal of this assignment is to perform Hazard and Vulnerability assessment of HPU Campus. This study will serve as an initiative which can be used for managing both natural and human-induced hazards in the campus.

2. REVIEW OF LITERATURE

The geographical location of Himachal Pradesh is such that it lies in Himalayan region between latitude 300 22.40 N to 330 12.20 N and longitude 750 45.55 E to 790 0.4.20 E. Shimla district of Himachal Pradesh, lies between the longitude 77.00” and 78.19” East and latitude 30.45” and 31.44” North, having its headquarters situated at Shimla, where the Himachal Pradesh university situated. The climate in H P University Shimla is predominantly cool during winters and moderately warm during summer. Temperatures, typical range from 4 degree to 31 degree centigrade over the course of year. The average temperature during summer is between 19 degree and 28 degree centigrade, and in winter 1 degree and 10 degree centigrade respectively. Monthly precipitation varies from 15ml in November to 434ml in August. It is typically around 45ml per month during winter and spring and 175ml in June. The average total precipitation is 1575ml which is less than other hill stations. Snowfall in this region has been happening in January or early February every year for the last fifteen years.

The University is nestled amidst tall and lush green trees of deodars, oats, pines and rhododendrons. The location of the University presents a panoramic natural view among the woods, settled around Summer Hill. The campus where one half bathes in the fresh sun towards the east and another half in the grandeur of unique sunset on the West. Overlooking snow peaked Majestic Mountain ranges add to the lofty ideals and vision of the university. Its salubrious climate and calmness presents congenial atmosphere to pursue higher studies. The University campus has been designed to possess a distinctive architectural style multi-faculty-

- Integrated Himalayan Studies
- Application of Biotechnology in Forestry, Agriculture and Horticulture
- Mycorrhizal Technology, Ecology, Taxonomy, Ethno Botany, Biodiversity, Wood Science, Honeybees, Cytogenetics, Plant and Animal Physiology, etc.
- Polymer Chemistry, Analytical Chemistry.
- Computer Applications in Software Development.
- Computational Physics, Nuclear Physics, Condensed Matter Physics, Solar Neutrino Physics.
- Hydro-dynamic and Hydro-magnetic Stability, Plasma Physics, Fuzzy Algebra, Motion of Non-newtonian Fluids.
- Sustainable Development, Poverty, Tribal Studies, Human Resource Development.
- Human Geography, Remote Sensing, Population Studies, Environment.
- Trade and Commerce, Tourism, Export Marketing, Banking, Rural Development, Agricultural and Horticultural Studies.
- Cultural Studies, Folk Literature, Handicrafts.
- Clinical Psychology, Post-colonial and Subaltern Perspectives on History, Art, Culture and Media.
- Women Studies, Canadian Studies, Teacher Education, Adult Education and Extension.

Accelerated pace of development brings with it the perils

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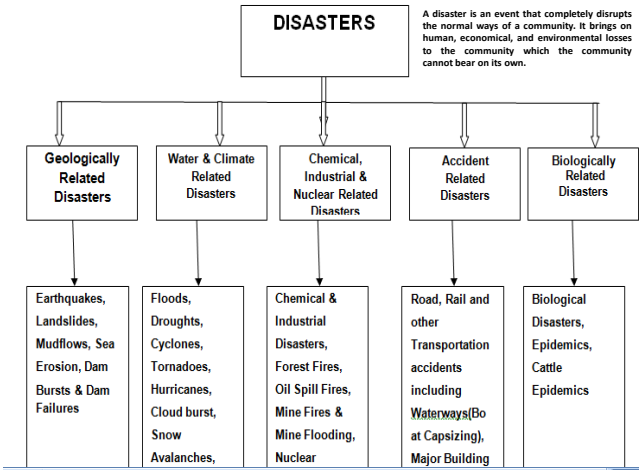
of unsafe living, pressures on non-renewable resources, densely populated spaces and environmental degradation among others. As a consequence, the frequency of catastrophes such as earthquakes, floods, cyclones, landslides, droughts, and fires has gone up. We hear of disasters so often that we as individuals are sadly becoming immune to them. We display concern and anxiety when these calamities happen, but by and large depend on the concerned stakeholders to do the needful, who on the other hand, have a reactive rather than pro-active approach to disasters. Stitching up of loose ends takes place after an event and then because of lack of follow-up in terms of reconstruction and rehabilitation, the affected areas are rendered further vulnerable to such events that keep happening, leading to enormous loss of human resources in particular

HPU has a multi-hazard prone campus and it's mainly because of its geo-climatic complexities and anthropogenic factors Seismic hazard wise like earthquake, landslide, and avalanche and forest fire. HPU and the surrounding areas in Summer Hill are quite vulnerable. The vulnerability of the geologically young and unstable steep slopes in various Himalayan ranges, has been swiftly increasing in recent decades due to inappropriate activity, such as deforestation, road cutting, terracing and changes in agriculture pattern requiring more intense watering. According to Disaster management report of Shimla the Disasters can be clasified into five categories as shown in figure below



Shimla District is prone to various hazards mainly 16 Out of total 25 hazards for which the State of H P is identified to be prone(out of 35 types of hazards in India which are identified by the High Powered committee ,Government of India)and these are categorized into the following five groups:

1) NATURAL HAZARDS

A) Meteorological- Floods, Cloud Bursts, Hailstorm, Lightening, Drought, Forest Fires
B) Geological- Earthquake, Landslides
C) Biological- Epidemics.

2) MAN MADE/HUMAN INDUCED

A) Accidents- Road accidents, Building Collapse, village house fires, Fall from Hills

B) Industrial- Hydro power Reservoir collapse, Grid power failure, Industrial accidents

Land Slide

The hills and mountains of Himachal Pradesh are liable to suffer landslides during monsoons and also in high intensity earthquakes. The vulnerability of the geologically young and not so stable steep slopes in various Himalayan ranges, has been increasing at a rapid rate in the recent decade due to inappropriate human activity like deforestation, road cutting, terracing and changes in agriculture crops requiring more intense watering etc. Various forms of landslides are slumps; debris or rock slides, debris falls or rock falls. Various factors influence the landslides: steepness of slopes, saturation by heavy rains or melting snow and ice, rocks vibrations, excess load from embankments, fills and waste dumps, changes in water content, frost effect, weathering of rocks, effect of ground water, and change in vegetal cover.

Cloud Bursts

It has been noticed that sudden heavy rains are occurring in some part of the district during the last two decades causing the situation of flashfloods. Landslides resulting in devastating huge loss to the human life and property which is being attributed to the climate change caused due to the large human interference with the nature activities like deforestation, developmental activities like construction of roads, bridges, hydel projects, buildings etc.

Avalanche

The destruction caused as a result of avalanches in the past in Himachal Pradesh though not widespread is confined to the higher reaches of the state only. The higher hills comprising the districts of Kinnaur, Lahaul & Spiti, Chamba, and Kullu are particularly vulnerable to the hazards of avalanches. Avalanches have also the history of damage in Shimla.

Forest Fires

Shimla district is under thick forest cover and the flora varies from the pine tree to oaks to cedar . However during the hot dry spell sometimes the human negligence the unattended small spark in the forest triggers forest fire which spreads to the whole forest and becomes difficult to control resulting in huge loss to the natural resources of the district i.e. flora and fauna and to the extent that some time the fire enters the nearby villages causing huge loss to human life and property.

Earthquakes

Himalaya being a nascent mountain range and due to the continuous ongoing movement of tectonic plates , the Himalaya is still rising making this region vulnerable to the earthquake .The whole area of Himachal Pradesh falls into two earthquake zones viz. Zone IV and Zone V as per the BIS Zoning map of the Himachal Pradesh. Consequently the Shimla District is also located in the Zone IV and V (about 99.62% area falls in Zone IV and 0.38% falls in Zone V) making the region liable to experience the earthquake of intensity MSK VIII or more. Now a days due to the increasing developmental activities like construction of roads, houses and other developmental

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infrastructural activities, the unscientific construction methods and ways used for the disposal of debris , the landslides are on the rise causing huge loss to human life and property. Further the Shimla District being enriched with the green cover, during summers the incidents of forest fire have increased manifold and hence irreparable loss is being caused to the natural resources of the state every year .Hence there is a need to prevent, mitigate the danger or threat of such disasters and to prepare the community by way of capacity building to respond in a better way to such disastrous situation if arises at any time.

Road Accidents

With the increase of road connectivity and number of vehicles plying on these roads in the State, the number of road accidents and loss of precious human lives is increasing day by day. The data from 2001-02 to 2009-10 would show an increasing trend in the number of accidents and the victims. The hilly terrain of the State and rash and negligent driving are the major cause of these accidents. The department of PWD has identified numerous back spots and the department is in the process of improving them to reduce road accidents. A table containing figures on road accidents in Himachal Pradesh is given below.

Soil Erosion

Soil erosion is like tuberculosis which slowly eats out the fertility of soil and turns the land barren. It is a natural process which is very dangerous and deteriorating to the environment and society inhabiting a region. Loss of top soil due to erosion removes high proportion of organic matter and free mineral fraction from the soil that provide nutrient for the plant growth. It is a part of the process of demolition responsible for changing the landscape. Soil erosion becomes hazardeous when it crosses the safety limit. Water and wind are two agents causing soil erosion. Human activities accelerate soil erosion beyond the safety level and thus cause great damage.

3. OBJECTIVES OF THE STUDY

1. To identify the potential hazards (both Natural as well as Manmade) affecting Himachal Pradesh (HP) University campus area.
2. To assess the likelihood of the hazard occurring in the immediate vicinity of HP university area.
3. To identify damages or losses to university property and loss of life as the results of the event/hazard.
4. To know the awareness level among the students & staff regarding the current hazard management plan in HP University Campus
5. To know which hazard is most significant and must be addressed in all hazards Plan.

4. RESEARCH METHODOLOGY

4.1 RESEARCH METHOD

The study is based on both primary as well as secondary sources of data. The primary data has been collected through a survey by way of questionnaire. The secondary source of data has been collected through literature review, reports published by institutes like HPSDMA Report, 2011, NDMA and IGNOU Report.

All the items in the checklist were assigned equal weights, where "1 point" has been assigned for availability of the item and "0 point" for the non-availability of the same. This type of criterion has been used by other researchers in Das (2007) and Gupta et al. (2003). T-test as been used

4.2 RESEARCH SAMPLE

The sample of the study comprises of 50 respondents which consist of 43 students and 7 employees of the university campus area. The selection is made in such a way so as to maintain students and employees ratio.

4.3 TOOLS AND TECHNIQUES

- We have used various techniques such as
- One sample t test and
- Various ratios to know the significance of data.
- For these we have used the following computer software.
- Statistical Package of Social Science
- Microsoft Excel etc.

4.3 HYPOTHESIS OF THE STUDY

Null hypotheses here are indicated as H0 and alternate hypotheses are indicated as H1.

$H0_1$: None of the selected hazards are significant

$H1_1$: All the selected hazards are significant

$H0_2$: Significant hazards are not vulnerable.

$H1_2$: Significant hazards are vulnerable.

5. DATA ANALYSIS AND FINDINGS OF THE STUDY

This section analysis the likelihood of the event / hazard occurring in the vicinity of the university campus area and the damage they can cause to the university property and loss of personal life and to find out whether the selected hazards are significant or not.

Table 1 Hazard identification and their Ranking

Hazard	Nos.	%	Ranking
1. Earthquake	38	76.60	II
2. Cloud Burst	23	46.90	VIII
3. Land Slide	24	49.00	VII
4. Avalanche	06	12.20	XI
5. Soil Erosion	24	49.00	VII
6. Heavy Snow Fall	24	49.00	VII
7. Building Collapse	26	53.10	VI
8. Accident	23	46.90	VIII
9. Fire	33	67.30	III
10. Monkey Menace	46	93.90	I
11. Demonstration: A Public Protest.	30	61.20	V
12. Economic Emergency:	20	40.80	IX
13. Strike/Lockout:	32	65.30	IV
14. Sabotage/Vandalism	14	28.60	X

FINDINGS OF THE STUDY:

As shown in the above table the biggest harzard identified in the university campus area is that of "Money Menance" followed by Earthquake at Second Place and Fire on Third Place. All the other harzards are also significantly affecting the university campus area and they are: Strikes/Lockouts (IV), Demonstration (V), Building Collapse (VI), Landslide (VII), Soil Erosion (VII), Heavy

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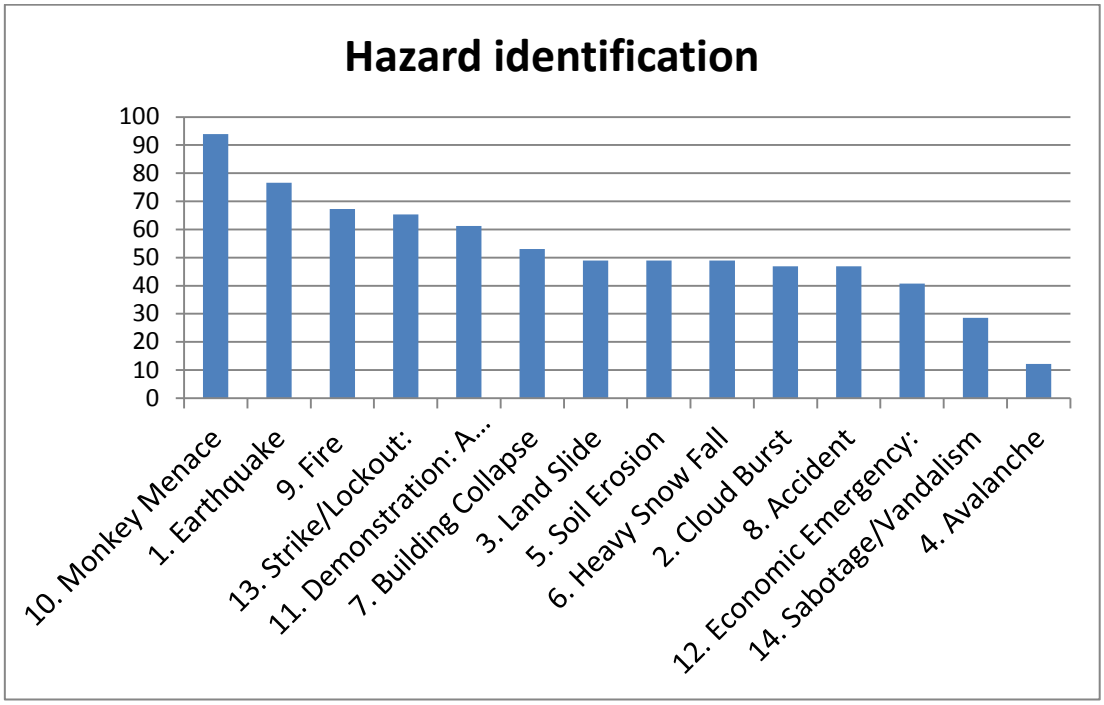

Snowfall (VII), Accident (VIII), Cloud Burst (VIII), Economic Emergemcy (IX) and Sabotage/Vandalism (X). All the hazards except "Avalanche" (having p value 0.013) is not significant at 1% level of significance. Further we have applied t-test to measure our hypothesis and to know the level of significance of the hazardous event.

5.1 TEST OF SIGNIFICANCE

Table 2 One-Sample Test

	Test Value = 0			
	t	df	Sig.	Mean Diff
1. Earthquake	12.877	48	.000	.776
2. Cloud Burst	6.516	48	.000	.469
3. Land Slide	6.788	48	.000	.490
4. Avalanche	2.588	48	.013	.122
5. Soil Erosion	6.788	48	.000	.490
6. Heavy Snow Fall	6.788	48	.000	.490
7. Building Collapse	7.366	48	.000	.531
8. Accident	6.516	48	.000	.469
9. Fire	9.950	48	.000	.673
10. Monkey Menace	27.129	48	.000	.939
11. Demonstration: A Public Protest.	8.706	48	.000	.612
12. Economic Emergency:	5.754	48	.000	.408
13. Strike/Lockout:	9.505	48	.000	.653
14. Sabotage/Vandalism	4.382	48	.000	.286

For knowing the significance of the hazardous event, we have applied one sample't' test and received the table 2 as under:

From the above table we can conclude that the significance values (p values) at 1% level of significance show that all the hazards except "Avalanche" (having p value 0.013) are significant.

5.2 AWARENESS OF CURRENT DISASTER MANAGEMENT PLAN IN HP UNIVERSITY CAMPUS

We collected the data regarding awareness of respondents regarding the awareness of Current Disaster Management Plan in HP University Campus. And obtained the results as under:

Satisfied with Hazard Mgmt

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	30	61.2	61.2	61.2
	Yes	19	38.8	38.8	100.0
	Total	49	100.0	100.0	

From the above table we come to know that 61.2% of total respondents are not satisfied with the current Hazard Management system in Campus of HP University. So, we recommend that the university should develop the well built Disaster Management Plan in the campus of the university campus. And the university administration should also spread awareness regarding the developed system among students and staff of the university.

6. CONCLUSION

- Man and man-made structure stand no chance against the awesome power and furry of such disaster when they strike. Therefore, a mechanism is needed to safeguard against massive and unwarranted loss of life and property in the event of such calamity.
- Solution to counter these trends exists and the knowledge and technology necessary to apply them are widely available.
- Disaster reduction is the sum of all the action which can be undertaken to reduce the vulnerability of a society to natural hazards and man-made hazards.
- The likely solution are proper land-use planning, aided

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by vulnerability mapping, to relocate people in safe areas, the adaptation of proper building codes in support of disaster resilient engineering, The proposal of this assignment is to perform Hazard and Vulnerability assessment of HPU Campus.

- This study will serve as an initiative which can be used for planning for both natural and human-induced hazards in the campus.

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