International Journal of Latest Engineering and Management Research (IJLEMR)
ISSN: 2455-4847
www.ijlemr.com || Volume 07 - Issue 08 || August 2022 || PP. 50-57

Environmental Hazards and Main Mitigation Risk Reduction Strategies for Environmental Hazards in Shimla District of Himachal Pradesh

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Abstract: The Shimla district has been facing widespread and extensive damages almost every year because of environmental hazards flood, cloud burst , flash floods, earth quake, landslides and droughts etc. which have been taking its toll of human lives, cattle heads, destruction of public utilities, roads, bridges, footpaths, culverts, landslides and washing away of drinking water supply and irrigation schemes and damage to public and private properties making a dependent into the already fragile economy of the district. The losses sustained are so serve that relief and restoration operations without adequate financial resources are not possible despite best efforts of the district to cope up with the emergent situation out of the available scanty resources. This paper focuses on analyzing the environmental hazards in Shimla district of Himachal Pradesh and also describes the main risk reduction strategies for environmental hazards. In the present paper the data was collected through primary and secondary sources. The primary data has been collected by observation and field survey method. The Secondary data was collected from records, reports, relief manual, action plan and memorandum of the state revenue department and other department which are concerned with disaster management.
Key Words: Environmental hazards Flood, Cloud burst, Flash floods, Earth quake, landslides.

Introduction:

Shimla district lies in the North-Western ranges of the Himalayas. It is located 31.60 N 77.100 E with an average altitude of 2397.59 meters (7866.10 ft) above mean sea level. The city is spread on a ridge and its seven spurs. The city stretches nearly 9.2km. from east to west. The highest point in Shimla at 2454 meters is the Jakhoo hill. Shimla is a Zone 4 (High Damage Risk Zone) per the Earthquake hazard zoning of India. Weak construction techniques and increasing population pose a serious threat to the already earthquake prone region. There are no bodies of water near the main city and the closest river Sutlej, is about 21 km. away. Other rivers that flow through the Shimla district, although further from the city are Giri,Pabbar(both are tributaries of Yamuna). The green belt in Shimla district planning area is spread over 414 hectares (1023 acres).

The main forest in and around the district are that of Pine, Deodar,Oak and Rhododendron.

Environmental degradation due to the increasing number of tourists. Every year without infrastructure to support them has resulted in Shimla losing its popular appeal as an ecotourism spot. Another rising concern in the region are the frequent number of landslides that often take place after heavy rains.

Hazard Profile of District Shimla

Shimla District is prone to various hazards mainly 16 Out of total 25 hazards for which the State of HP 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:

Natural Hazards

A) Meteorological: (1) Flash Floods (ii) Cloud Bursts **(**iii) Hailstorm (iv) Lightening **(**v) (Drought vi) Forest Fires.

B) Geological: (i) Earthquake (ii) Landslides.

C) Biological: (i) Epidemics.

Man Made/Human Induced (A) Accidents (i) Road/Rail/Air accidents (ii) Building Collapse **(**iii) village house fires (iv) Fall from Hills.

B) Industrial: (i) Hydro power Reservoir collapse (ii) Northern Grid power failure (iii) Industrial accidents.

History of Hazards In District Shimla

Flash Floods: Shimla district's geographical location is such that it spreads from mid Himalaya to greater Himalaya and the river Satluj , Andhra, Pavvar,Nogali ,Ganaviand other manysmaller khuds/rivulets flowing through it makes the area and the people living around these more vulnerable to the floods /flash floods as is evident from the history as narrated below in the table:

Table 1
Occurrence of flash floods in district Shimla

Sr.No	Occurrence of Major Flash Floods	Extent of Damages Caused
1	8th July 1973	Lake was formed at Satluj river due to fall of Nathpa rock and caused a loss of property in lacs.
2	24th Feb1993 ,At Jhakari due to major landslide alongwith fall of rock river Satluj was blocked.	About 1 km of NH-22 was damaged badly along with other forest land causing huge loss to the public property and land owners.
3	31st July and 1st August 2000 At Rampur and other areas besides river Satluj	Due to flash flood in the river Satluj the water level rose above 60feet to the normal level and caused devastating damages to the human life and property located on both banks of the river. At least 140 people died alongwith 1673 cattles and 12400sq km area affected in Shimla District. Various roads/bridges were washed away and it trook about three months to normalize the human life.
4	26th June 2005 doe to busting of Parchu Lake in Tibet	Due to the bursting of the artificial lake At Parechu the water level in the Satluj rose about 40 feet high and caused the washing away of various roads , bridges and village bridges.
5	July 2005 Flash floods in Pabbar River	Due to the heavy rains the inundation in Pabbar River caused washing away of SH Rohroo to chirgaon along with various foot bridges, govt buildings and houses causing huge ;loss to human life and property.

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 flash floods .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.

Hail Storms: Due to the climatic change the hailstorm is causing threat to the agro/horticulture products of district Shimla.

Lightening: In this district there are intermittent incidents of the lightening and many lives have been lost in such incidents . Many times it has caused the damages to the live stocks as the people generally rear animals and for grazing them they have to go for higher reaches where the lightening is the common event. However the documentation of such events is not there.

Table 2
Occurrence of cloud bursts in District Shimla

S.No	**Date and place of Occurrence of the Events**	**Extent of Damages caused**
1	11th August 1997 At Chirgaon and Rampur.	Due to cloud burst at the top of the hill near Rohal village in Chirgaon Tehsil the Andhra river which is originated from the same mountain was inundated in the inordinary way due to the heavy rains i.e. cloud burst ,occurred in the night and the people and property situated along the Andhra River and thereafter Pavvar were washed away till Rohru.

		About 124 people died alongwith 456 cattles washed away. Roads and bridges houses, fishery tanks and school buildings situated at Chirgaon were completely washed away. The above cloud burst also caused damages towards Rampur side and killed 19 people,464 cattles 105 houses damaged and agriculture; land measuring 40 hectare damaged.
2	On 10th August 2001 at Murali Danda, Devidhar Chirgaon.	The sudden heavy rains i.e. cloud burst occurred in Devidhar area of tehsil Chirgaon causing the complete washing away of the Harizan Basti, village paths, roads, about 8 village bridges, cattle sheds etc causing devastating damages to the human property.
3	August 2003 and 2007 at Ghanvi Rampur.	The flash floods caused due to the cloud bursts in Ghanvi Area caused the death of 7 human beings and washed away houses, cattle sheds and other human property and damaged the public property.

The sub division wise detail of hailstorm along with the affected area is mentioned below:

Table 3
Occurrence of hail storm in district Shimla

Year	Name of the Sub- Division (Apple Crop Area Affected In Hectares)						
	Shimla (U)	Shimla (R)	Chopal	Rohroo	Theog	Rampur	Dodrakawar
2007	.....	.....	473	6202	950	705	.....
2009	.....	.....	231	1231	432	321	32

Drought: Due to the climatic change in the climate the drought is causing threat to the agro/horticulture products of district Shimla . The sub division wise detail of hailstorm along with the affected area is mentioned below:

Table 4
Drought occurrence in district Shimla

Year	Name of the Sub- Division (AGR. Crop Area Affected In Hectares)						
	Shimla (U)	Shimla (R)	Chopal	Rohroo	Theog	Rampur	Dodrakawar
2002	.....	767	10225	890	7977	8191	79
2006	.....	4278	4630	696	6076	5890	.....

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.

Earthquake: The District Shimla as a whole lies between mid Himalaya and greater Himalaya and due to the tectonic movements of the Indo Australian Plate and Eurasian plate the Himalaya is Still rising and giving rise to tremors in the Himalayan region.

History of Earthquake Encountered by District Shimla

Table 5
Major Earthquake in Shimla District

Date	**Magnitude / Intensity**	**Damages**
05 / 03 / 1842	VI / VII	House were damaged
07 / 04 / 1856	VII / VIII	Loss to life and property but not exactly reported

09 / 07 / 1860	V	Loss not reported
05 / 10 / 1869	V	Loss not reported
28 / 02 / 1906	6.5	Approximately 26 people died and 45 injured and 73 dwelling houses destroyed

Source: H.P. State Disaster Management Plan -2012

Landslides: Landslide is most risk oriented hazard found in district Shimla affecting the human life and property in many ways like damages to the houses, roads , communication network agriculture Etc.

Table 6
Forest Fire Affected Area of Shimla District

Year	Name Of Forest Division	Name Of Fire Incidents	Area Affected (In Hect)	Estimated Loss In RS Lac.
2008-09	SHIMLA	37	1760	10
	THEOG	0	0	0
	ROHROO	11	87	1.5
	CHOPAL	11	165	2.0
	TOTAL	59	2012	13.5
2009-10	SHIMLA	147	3810	67
	THEOG	035	0260	06
	ROHROO	032	0393	23
	CHOPAL	033	0692	03
	TOTAL	247	5165	99
2010-11	SHIMLA	60	555	23
	THEOG	24	055	00
	ROHROO	42	252	04
	CHOPAL	33	256	00
	TOTAL	159	1118	27
2011-12	SHIMLA	15	409	09
	THEOG	0	0	0
	ROHROO	21	060	08
	CHOPAL	02	128	02
	TOTAL	38	597	19
2012-13 (Up To 30-11-2012)	SHIMLA	147	2050	25
	THEOG	005	0007	00
	ROHROO	020	0062	00
	CHOPAL	006	0023	02

	TOTAL	178	2142	27

Source: Report Complied By the Compiled By the Conservator of Forest Shimla

Table 7
Roads and Landslides

Name of the Road	Areas Vulnerable	Total Length
NH-22 Ambala – Kalka Shimla – Kaurik	Rampur Leori	25 K.M.
SH-01 Lal Dhank – Paonta- Rajban-Sungri - Narkanda	Sungri Narkanda Sector	15K.M.
Shimla – Chaupal	Theog – Sainj Sector	15K.M.
Shimla – Rohroo – Chirgaon	Rohroo – Chirgaon Sector	12K.M.

Table 8
Major landslides in district Shimla Place year Damages

Place	Year	Damages
Jhakari	1993	NH-22 was washed away due to flash floods and could be restored only after two months
Chirgaon	1995	Road Rohroo to chirgaon was wased away due to flash floods and could temporarily restored after 15 days.

Source: H.P State Disaster Management Plan 2012

Accidents: In Shimla district the presence of rail, airport, helipads and roads make it prone to all these types of accidents. The district wise data as tabulated below shows that in the year 2010-11, total no of people killed were 430 and injured were 801 in total accidental cases numbering. The main causes of the road accidents are :- (1) Drunken driving (2) Over speeding (3) Listening to phone call on mobile while driving (4) Poor training (5) Bad road conditions (6) Poor maintenance of the vehicles etc.

Industrial Hazards:

This district has come up as hydro project district with the one mega project Nathpa Jhakari hydro project 1500mw along with Rampur hydro power project 431mw, Luri Power Project mw, Kuddu Sawra Power Project---mw and around 30 mini and micro projects thus making the district prone to bursting of the water reservoir, other accidents.

Table 9
Assessment of Risk for Multi Hazards in District Shimla

Risk Assessment Based Upon Probability Model													
Natural And Human Induced Hazards													
Event	**Probability**				**Risk**					**Preparedness**			**Total**
	High	MED	lOW	None	Life Threat	Health / Safety	High Disrup-tion	Mod Disrup-tion	Low Disrup-tion	Poor	Fair	Good	Risk
Score	3	2	1	0	5	4	3	2	1	3	2	1	
Flash Floods	3	0	0	0	5	0	0	0	0	3	0	0	45
Cloud burst	3	0	0	0	5	0	0	0	0	3	0	0	45
Drought	0	2	0	0	0	0	0	0	1	0	2	0	4

Hailstorm	0	2	0	0	0	0	0	0	1	0	2	0	4
Lightening	3	0	0	0	0	4	0	0	0	3	0	0	36
Forest Fires	3	0	0	0	5	0	0	0	1	3	0	0	45
Earthquake	3	0	0	0	5	0	0	0	0	3	0	0	45
Landslide	0	2	0	0	0	0	3	0	0	3	0	0	18
Epidemic	0	2	0	0	0	4	0	0	0	0	2	0	16
Accidents	3	0	0	0	5	0	0	0	0	3	0	0	45
Village fires	3	0	0	0	5	0	0	0	0	3	0	0	45

Main Risk Reduction Strategies (Flood):

Mapping of the flood prone areas is a primary step involved in reducing the risk of the region. Warning can be issued looking into the earlier marked heights of the water levels in case of potential threat. Flood hazard mapping will give the proper indication of water flow during floods.

Land use control will reduce danger of life and property when waters inundate the flood plains and the coastal areas. In areas where people already have built their settlements, measures should be taken to relocate to better sites so as to reduce vulnerability. No major development should be permitted in the areas which are subjected to high flooding. Important facilities should be built in safe areas. In urban areas, water holding areas can be created in ponds lakes or low lying areas.

Construction of engineered structures in the flood plains and strengthening of structures to withstand flood forces and seepage. The building should be constructed on a elevated areas. If necessary build on stilts or platform.

Flood proofing reduces the risk of damage. Measures include use of sand bags to keep flood water away, blocking of sealing of doors and windows of houses etc. Houses may be elevated by building on raised land. Buildings should be constructed away from water bodies.

Main Risk Reduction Strategies-Landslide:

Hazard mapping will locate areas prone to slope failures. This will permit to identity avoidance of areas for building settlements. These maps will serve as a tool for mitigation planning, **land use** practices such as:

- Areas covered by degraded natural vegetation in upper slopes are to be afforested with suitable species. Existing patches of natural vegetation (forest and natural grass land) in good condition should be preserved.
- Any developmental activity initiated in the area should be taken up only after a detailed study of the region and slope protection should be carried out if necessary.
- In construction roads, irrigation canals etc. proper care is to be taken to avoid blockage of natural drainage.
- Total avoidance of settlement in the risk zone should be made mandatory.
- Relocate settlements and infrastructure that fall in the possible data of the landslide.
- No construction of buildings in areas beyond a certain degrees of slope.

Retaining walls can be built to stop land from slipping (these walls are commonly seen along roads in hill stations). It's constructed to prevent smaller sized and secondary landslides that often occur along the portion of the larger landslides.

Surface Drainage Control Works:-. The surface drainage control works are implemented to control the movement of landslides accompanied by infiltration of rain water and spring flows.

Engineered Structures with strong foundation can with stand or take the ground movement forces. Underground installations (Pipes, Cables etc.) should be made flexible to move in order to withstand forces caused by the land slide.

Increasing vegetation cover is the cheapest and most effective way of arresting landslides. This helps to bind the top layer of the soil with layer below, while preventing excessive run-off and soil erosion.

I**nsurance** will assist individuals whose homes are likely to be damaged by landslides or by any other natural hazards. For new constructions it should include standards for selection of the site as well as construction technique.

Main Risk Reduction Strategies – Earthquakes:
Engineered Structures (designed and built) to with stand ground shaking. Architectural and engineering inputs put together to improve building design and construction practice.

Follow Indian Standard Codes for construction of buildings. Enforcement of the byelaws including land use control and restriction on density and heights of buildings.

Strengthening of important lifeline buildings which need to be functional after a disaster. Upgrade level of safety of hospital, fire service building etc.

Public Awareness, sensitization and training programmes for architects, builders, contractors, designers, engineers, financiers, government functionaries, house owners, masons etc. Reduce possible damages from secondary effects such as like fire, floods, landslides etc. e.g. identify potential landslide sties and restrict construction in those areas.

Main Risk Reduction Strategies: Drought:
Drought monitoring is continuous observation of rainfall situation, water availability in reservoirs, lakes, rivers and comparing with the existing water needs of various sectors of the society.

Water Supply Argumentation and conservation through rainwater harvesting in houses and farmers' fields increases the content of water available.

Land Use based on its capability helps in optimum use of land and water and can avoid the undue demand created due to their misuse.

Livelihood planning identifies those livelihoods which are least affected by the drought. Some of such livelihoods include increased off – farm employment opportunities, collection of non-timber forest produce from the community forests, raising goats, and carpentry etc.

Drought Planning:
The basic goal of drought planning is to improve the effectiveness of preparedness and response efforts by enhancing monitoring, mitigation and response measures. Planning would help in effective coordination among state and national agencies in dealing with the drought.
Watersheds: for water supply augmentation & conservation watersheds are geographic area where the water flows to a common point. To mitigate the drought impact, all kinds of soil and water conservation measures are taken up with the involvement of the local communities.

Checkdams (Bhanadaras)
These are check dams or diversion weirs built across rivers, a traditional system found in Maharashtra, their presence raise the water level of the rivers so that it begins to flow into channels. They are also used to impound water and form a large reservoir where a bandhara was built across a small stream, The water supply would usually last for a few months after the rains.

Main Risk Reduction Strategies – Avalanche:
1. **Planting:** Avalanche prevention forest protect show cover form movement by resistance of tree trunks and branches, increase the stability of snow cover by uniformly distributing it and control quick changes in snow cover.
2. **Stepped Terraces:** Stepped terraces area provided for stabillising the snow cover on slope by reducing or dividing the sliding force of the snow cover with steps cut into dividing the sliding force of the snow cover with steps cut into the slopes.
3. **Avalanche Control Piles:** Avalanche control piles are assemblies and single piles driven into slops in avalanche zones to control surface layer avalanches.
4. **Avalanche Control Fence:** Avalanche control fence is installed on slopes of avalanche zones to prevent full depth and surface layer avalanches.

5. **Suspended Fences:** These are used in steeps lopes or in areas where foundations cannot be properly installed because of poor ground conditions and useful in small area.
6. **Snow Cornice Control Structures:** These structures are installed at tops of mountains areas to prevent the development of snow cornices that can cause avalanche. These are two methods of prevention, one is a collector snow fence, which collects snow on the windward side of the top of the mountain, and the other is a blower snow fence which controls the development of snow cornice by blocking winds on the ridge.

Conclusion:

The role of media, awareness and training in hazard management in Shimla district needs to be addressed at priority. The NGOs, CBOs, VOs, Arm Forces, Home Guards, Police, Medicos Para Medical and other officials, Non officials' related to hazard management and community should be well trained to manage comprehend the situation. Community should be trained in the grass root level. Hazard awareness and training programmes are impossible for want of funds. It is necessary that the central govt. should help state govt. and administration by providing funds to these programmes. Therefore, it can be said that govt. and administration both should make more efforts in the sense of media awareness and training to related hazard & hazard management system. Thus, there should be an urgent need for interaction with Mahila Mandals, Youth Mandals, SHG, PTAs, Members of citizen councils, PRIS, Religious Organizations, Private organization an*d* other Societies in hazards management system. The govt. and administration should give them training, resources, funds and other inventories to handle any hazards situation as they can play effective role in any hazard situation.

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