Community-Based Landslide Risk Reduction in Himachal Pradesh, India

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Abstract

Himachal Pradesh is very susceptible for the Landslide induced disasters due to its geographical and seismic characteristics. Its high seismic activities, fragile mountains and anthropogenic activities are significant contributor of occurrence of landslides. In recent years, the state has experienced numerous catastrophic events that has resulted in loss of lives, environment degradation, and substantial geographical alterations. In many incidents, due to its rugged terrain, inadequate infrastructure and adverse circumstances have often stalled government/ other agencies rescue efforts. Many villages in the state lack road connectivity, leaving residents isolated and reliant on self-help during landslide induced disasters. In these circumstances, Local community volunteer to conduct the necessary action before any aid is received. Essential machineries or equipment are also of not any use as they cannot be transported to these far-flung areas due to either no connectivity or poor quality of roads, or road blockage due to landslips. The absence of adequate quality infrastructure often results in failure of response mechanism, no matter how effective it is resulting in losses to lives and damages to infrastructure. In this scenario, the capacity building and empowerment of community in preparedness and mitigation is paramount to make them disaster resilient. Local community has invaluable geographical and traditional knowledge enabling them to immediate response to the incident and rescue the people and live-stokes. Conducting regular training and mock drills, installing landslide early warning systems, use of modern technologies and artificial intelligence in all three phases of disaster, constructing tunnels bypassing highly vulnerable areas, constructing Heli-pads and restrict use of heavy machineries will facilitate community in managing landslide induced disasters. Community-Based Disaster Management (CBDM) is a proactive and inclusive approach that engages local populations in preparedness, response, and mitigation domains.

Key words– Disaster management, landslide-induced disaster, Community – Based Disaster Management, preparedness, Risk Mitigation

1. INTRODUCTION –

The mountain region of India is susceptible to various types of landslides, especially the mountain slopes of the North-Western Himalayas and the Sub-Himalayan terrain of the North-East and Western-Eastern Ghats. About 0.42 million km^2, covering nearly 12.6% of the land area of our country, is prone to landslide hazards, posing a threat to life and livelihood (NLRMP, 2025) as shown in Fig 1. In India, disaster management observed the traditional top-down practices and relief-oriented involving govt agencies and external organizations to contain the disaster. However, these top-down approaches were not fully successful to mitigate the effects and vulnerabilities of communities. Later, the need of community involvement was felt to focus on bottom–up approach, ensuring that disaster risk reduction (DRR) strategies are localised, sustainable and need their active participation. According to the UNDRR, Community-Based Disaster Management (CBDM) involves local communities in all phases of disaster risk reduction, from prevention and preparedness to response, recovery, and reconstruction, empowering them to assess hazards, vulnerabilities, and capacities, and to participate in local action planning and implementation. It requires proactive approach to disaster risk reduction that empowers communities to take charge of their own disaster preparedness, response, and recovery efforts. It is based on the principle that local communities, being the first responders in any disaster, possess valuable knowledge, resources, and skills that can be leveraged to enhance resilience. CBDM by its very nature demands a decentralized bottoms-up approach with intensive, micro interventions at the local Panchayats, ward or village level with the intention of generating confidence, awareness, knowledge, partnership, and ownership for planning and rolling out local disaster management plans encompassing all levels of disaster management continuum (Bhagat).

India is vulnerable, in varying degrees, to a large number of natural and human-induced disasters. The Himalayan Mountain range is vulnerable to landslides and mass movements related to processes caused due to monsoon rainfall and frequent seismo-tectonic activities. The mountain range consists of tectonically unstable younger geological formations that have seen significant seismic activities. This terrain falls in the maximum earthquake-prone zones (Zone-IV and V; BIS 2002) where earthquakes of Modified Mercalli intensity VIII to IX can occur, and thus, are also prone to earthquake-triggered landslides (GIS, 2025). Here the landslides are massive and many as compared to the Western Ghats region, which is geologically stable but has uplifted plateau margins influenced by neo-tectonic activities.
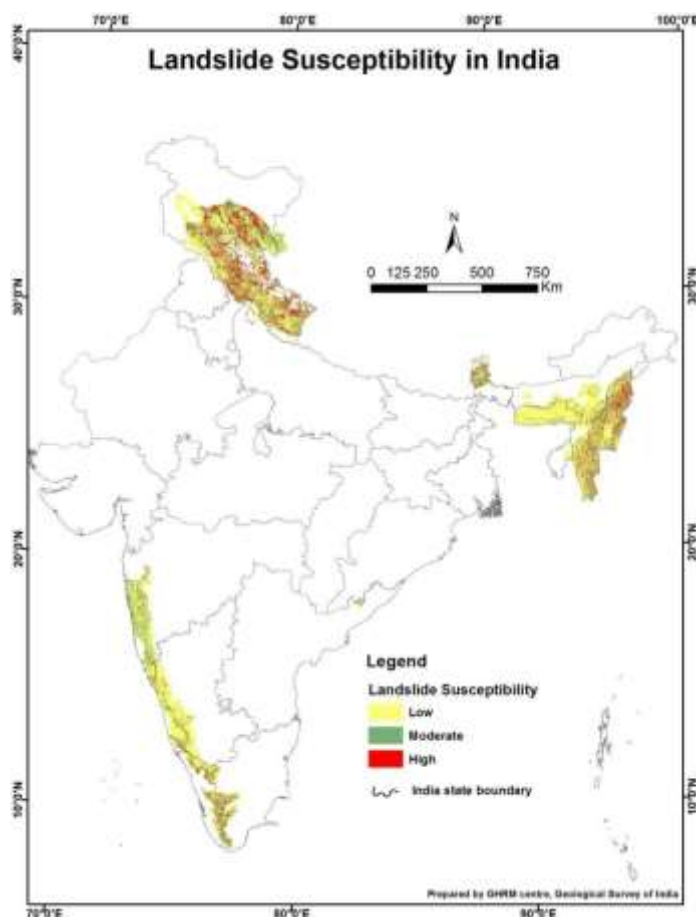

Figure 1 Landslide Susceptibility in India

The Himalayan regions are vulnerable to high precipitation, which has increased by climate change. These regions experience frequent occurrence of landslide phenomenon usually triggered by extreme climate events like high-intensity, short-duration rainfall, cloudburst, GLOF, etc. (NDMA, 2025). State and National Highways along the Himalayan region being unstable and prone to various landslide disasters is of major concern in the region. Unplanned excavation of the slopes has caused instability among the slopes leading to rock and soil failure (Institute, 2020). The shallow landslides in Himalayan region are usually by high-intensity rainfall occurred in a short duration and deep-seated landslides are due to rainfall lasting for extended period. In the recent past, short-duration, high-intensity rainfall like cloudburst event has become common in many areas of the Himalayas. Cloudbursts accompanied by flash floods during heavy rainfall are the leading cause of landslides in the Himalayan region. Cloudbursts may also cause flash floods and breaches of the glacial lake moraine dam, which causes the occurrence of GLOF events. The prolonged rainfall causes water to seep into the rocks, fractures and surfaces allowing wat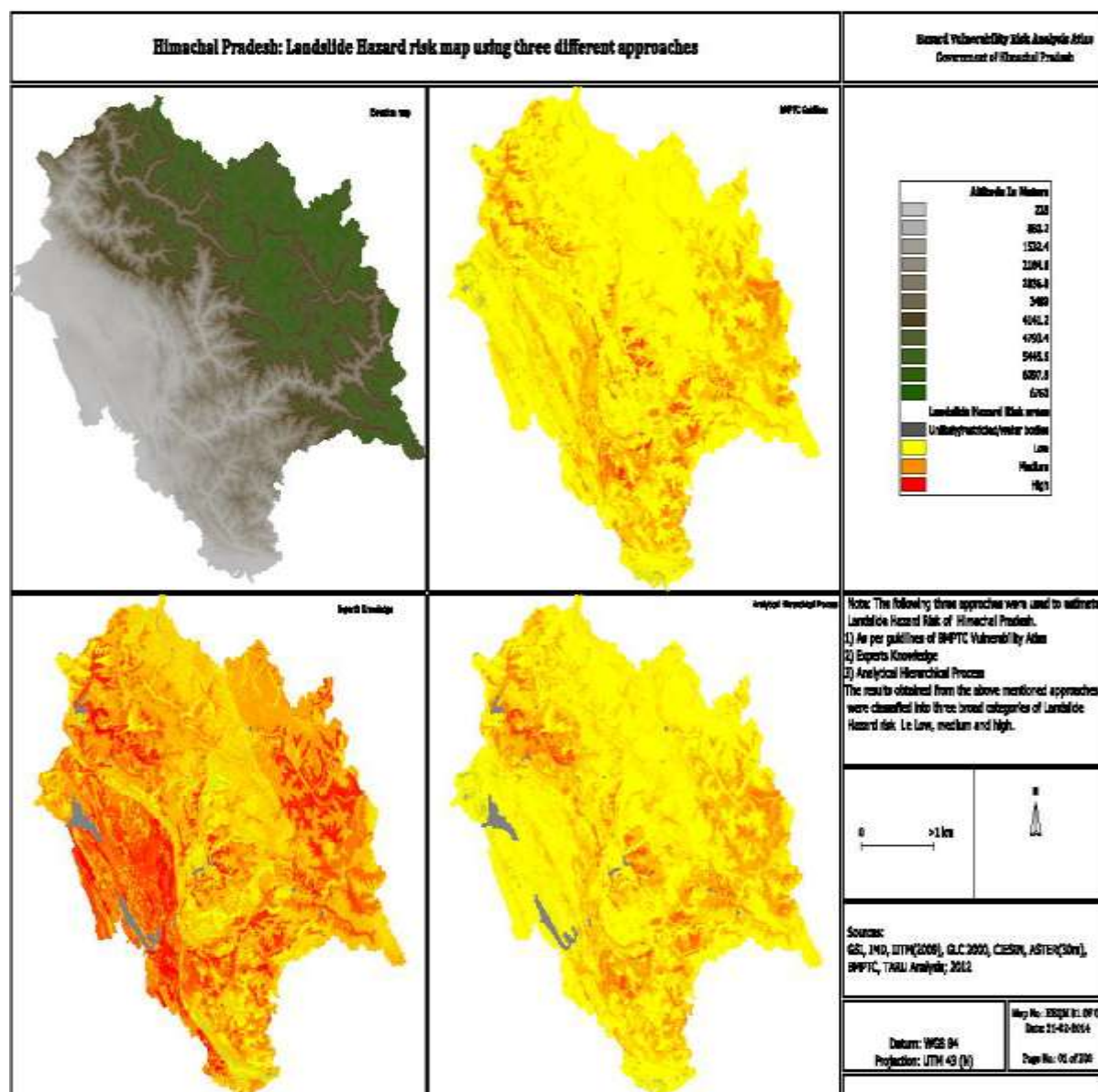er to percolate. This increases the pressure on the slopes and these features combined with surface runoffs cause landslides in the regions. From July to August 2023, the Indian Himalayas, particularly the state of Himachal Pradesh in the northern part of the country, experienced an unprecedented number of cloudbursts which triggered thousands of devastating landslides (Ashutosh Kumar, 2023).

Earthquake-induced landslides have been recognized as a potential hazard in mountainous regions as they amplify the structural damage and economic losses due to their seismicity. The majority of landslide- prone areas in the Himalayan region are located in the earthquake-prone seismic Zone IV and V (GIS 2002). Thus, these areas are also prone to earthquake-triggered landslides e.g. Sikkim Earthquake 2011 (GIS, 2025).

Figure 2: Landslide Hazard Risk Zone Map of Himachal Pradesh   *Source:*
HP State Disaster Management Authority

2. Importance of the Community Based Disaster Risk Reduction (CBDRR) in Himachal Pradesh

Community-based Disaster Risk Reduction (CBDRR) is the active engagement of the community in identification, analysis, assessment, monitoring, implementation and evaluation of disaster risks to reduce their vulnerabilities and enhance capacities (CBDM, 2024). Disasters are undoubtedly threat to the resource investment made by the government and public towards the goal of sustainable development and poverty reduction in the country. Community is mostly affected by the effect of Disaster. Disaster risk reduction measures are most successful when they involve the people exposed to hazards, and investment in community-based preparedness and early warning systems, which have been proven to save lives, protect property, and reduce economic losses. CBDRR has emerged as a key priority area in disaster risk management especially with reference to prevention, preparedness, mitigation and response (Etkin, 2012). CBDRR approach aims to actively engage communities in identification, analysis, assessment, monitoring, implementation and evaluation of disaster risks as well as reducing their vulnerabilities and enhancing capacities (CBDM, 2024). In recent past, community has remarkable role in preventing human and property losses. Thus, the

communities are not left to fend for themselves; opportunities are explored for the other players, including specially equipped forces to work closely with the communities. Communities are best sources of indigenous knowledge, local geography and innovation against hazards and their mitigation. As India is increasingly trying to develop a system of community-based disaster risk reduction and management in the country, it is important to understand how Odisha has tackled recent disasters with the community at the forefront (Boss, 04 Sep 2020). The govt, NGO and other stakeholders must work with the communities in training and capacity building. In normal pre-disaster times, community should be empowered with information on modern early warning systems, artificial intelligence, sensors and governance mechanisms etc.

Himachal Pradesh is prone to various disasters, both natural as well as man induced. In harsh climate, emergency services and aid providers face significant challenges in reaching the disaster sites, restricting crucial aid and support. The isolated parts of the state located far from main towns/cities and roads exacerbates the already dire situation, as food, medical supplies, and other essential resources become increasingly scarce. Many areas which remain isolated for months by either snowbound or landslides result in delay disaster response and development works thereafter. The soil of Lahaul & Spiti valley is loose and sandy and as such roads and irrigation channels get damaged even with slightest rain, melting of snow landslides, falling of boulders and avalanches (Dist, 2025). In this scenario, it becomes very essential to make the community of the state disaster resilient. Villagers have no choice other than to rely on their own ingenuity and limited resources to cope with the disasters. Hill communities face dual challenges of food and energy shortages and have become more vulnerable to weather variabilities and susceptible to natural disasters, attributed to climate change (Ravi Shankar Behera, Ranjit K Sahu, 2019). During landslides, heavy rainfall, heavy snow, cloudbursts, and forest fires, villagers face significant challenges in responding to emergencies. Establishing alternative shelters for themselves, their livestock, the elderly, and patients under such dire circumstances is particularly difficult. Patients often succumb to their conditions while being transported on foot to the nearest hospitals, which are located at miles in town/cities from villages. The geographical isolation of these areas often means that health facilities are sparse and difficult to reach, and the available services are frequently under-resourced (Devi, 2024). Considering the complex and challenging circumstances in rural areas of the state, being the first responder, it is very essential to strengthen the capacity building and resilience of local communities through various training programs and training, swiftly respond to various disasters. It will certainly enhance the capabilities of communities to withstand, respond and recover from various hazards and but also contributes to the overall sustainable development of the nation.

3. PRINCIPALS OF CBDM

3.1. Community Participation

Community ownership also fosters effective and meaningful participation of various groups within the community in the design of interventions and management of disaster. The concept of disaster risk management aims at reducing vulnerabilities of the affected populace, and is most effective at the community level where specific local needs can be met (Walia, 2008). The community members must be engaged in DRR programmes at every step, from identification of risks to making strategies and solutions for reducing them by addressing the principal causes of vulnerability. Especially in relation to traditional early warning signs, locations of safe and vulnerable areas, experiences of past disasters, traditional coping mechanisms and social relations. People themselves identify risk reduction measures that will reduce vulnerabilities and enhance capacities. These risk reduction measures are then translated into a community disaster risk management plan (Kafi, Aug 2013). Hazard assessment is done by community members to identify potential risks and hazards in their

Fig 3 Community participation in Sirmauri Tal, Sirmaur Dist, HP
Sources: Punjab Kesari, Thursday, Aug 10, 2023

villages and identify appropriate measures to bring resilience to the society (IGNOU). Robust technology, social media and other effective alarm system shall inform surrounding people immediately to extend the help in terms of response, search and rescue thus will save the lives and economy of the individual, community and exchequer. The National Disaster Management Authority (NDMA) has implemented a Scheme of Aapda Mitra on pilot basis to train 6000 community volunteers (200 per district) in 30 flood prone districts of 25 States/UTs in disaster response with a focus on flood, so that they can respond to the community's immediate needs in the aftermath of a disaster. More than 5500 volunteers have been trained under the pilot scheme (PIB, 2022). Empowering community in landslide preparation and response by using local knowledge and promoting cohesiveness, quicker reporting and dissemination of information, conducting training and mock drills, resource mobilization and collaborating with all stakeholders shall certainly enhance community disaster resilience. Active Community Participation for enhancing ecological sustainability – by involving community in investigating causes and consequences of disturbance regimes, promoting conservation of native and endemic elements, and understanding glacier and river system dynamics (HPCCC).

3.2. Social Equity and Partnership

According to United Nations Office for Disaster Risk Reduction "Social equity and partnership are crucial elements of effective disaster management" (UNDRR, 2025). As disaster has the disproportionate effect, therefore special attention is to be given to the vulnerable groups such as the economically weaker sections, elderly, women and children, and the differently-abled. Inclusion of women as equal partners in disaster management process not only would reduce their plight as a victim but also make them stronger to handle the risk, would keep them motivated to actively participate in all development activities and also improve their status in the society (Bali, May 2021). Social equity of these vulnerable groups ensures their say in decision making in disaster management. It also promotes the fair distribution of the resources, such as shelter, drinking water, medical aid etc. These groups need to be meaningfully included in CBDRR interventions for effective design and implementation, which must ensure their social inclusion and realization of optimum human potential (CBDM, 2024). Community based disaster risk reduction (CBDRR) interventions for effective design and implementation ensures inclusion of all society groups and utilization of their optimum potential. Working in partnership of government agencies, NGOs, private sectors with communities at risk lead to building of local capacity and will strengthen the coping mechanisms. Increasing awareness of risks within communities inspires more people to get involved to prevent the loss of their own livelihoods. Local government should maintain the data of these groups and share among the relevant groups for ready reference which can be utilised in emergency situations. Government, through its various schemes has instructed the concerned departments/organization to empower the vulnerable groups and facilitate their survival in critical situations, such as making the accessible path in the offices for elderly and differently abled persons. The community living in the vulnerable area is mostly economically poor. In South East Asia they are the poorest in the society (Kafi, Aug 2013). Continued efforts in collaboration with vulnerable groups will enhance their resilience and reduce vulnerability, and also ensures the transparency and accountability in distribution of resources among them rationally. However, challenges remain as presence of vulnerable groups lives in small hamlets scattered in villages remotely located in Himachal Pradesh. Government agencies face difficulties providing the necessary aid and resources to these villages. In India, attempts are being made to reduce the vulnerability of the groups through various schemes such as food for work program, health and nutrition care, Integrated Child Development Scheme, micro financing and capacity building by government agencies, NGOs and private sectors.

3. Mainstreaming the Disaster Risk Reduction into developmental activities and sustainability

Mainstreaming disaster management into the development planning process essentially means looking critically at each activity that is being planned, not only from the perspective of reducing the disaster vulnerability of that activity, but also from the perspective of minimizing that activity's potential contribution to hazard specific vulnerability. In order to mainstream DRR appropriate policy interventions and adequate financial allocation would be required (NDM India, 2024). Mainstreaming disaster management into developmental activities involves integrating disaster risk reduction (DRR) measures into community development plans and programs. This approach ensures that development initiatives are resilient and sustainable, minimizing vulnerabilities and risks associated with disasters. Pont no.8 of PM's 10 point agenda on Disaster Risk Reduction emphasizes on **"Build on local capacity and initiative to enhance disaster risk reduction"** (PM agenda, Nov 2016)**.** This point explains the strengthening of local capacities and initiatives and specific actions have to be designed and implemented locally. Such efforts reduce risk and create opportunities for local development and sustainable livelihoods. Localization of disaster risk reduction will also ensure that good use is made of the traditional best practices and indigenous knowledge. In its 2009 report, the UN Global Assessment Report on Disaster Risk Reduction pointed out that disaster risk is fundamentally associated with poverty at the global and local level and identified vulnerable rural livelihoods, poor urban governance, ecosystem decline and climate change as the

Figure 3 Theoretical framework for mainstreaming disaster risk reduction (MDRR) in Bangladesh
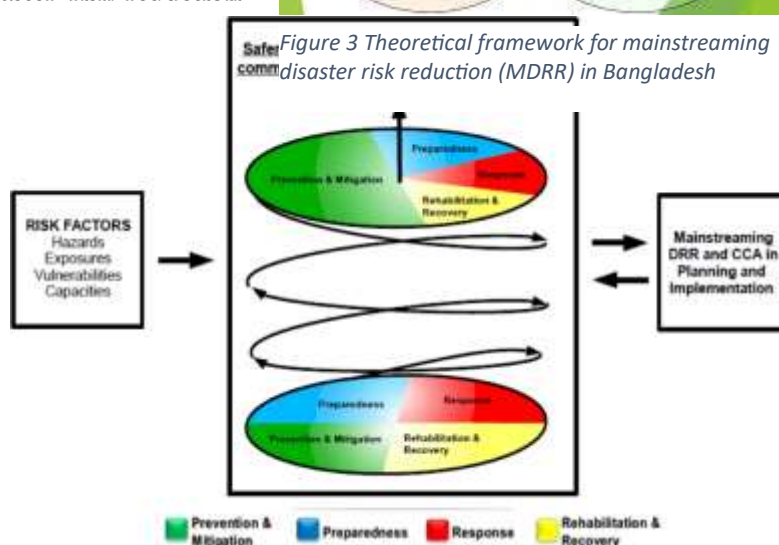

Figure 2 Mainstreaming Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) in Comprehensive Development Planning of the Cities in Nueva Ecija in the Philippines

drivers of the disaster risk-poverty nexus (MoHA). The Government departments are organised around identified sectors, in case of a cross-cutting issue like disaster that spans numerous sectors, the only appropriate option available is to mainstream DRR into all the development programmes and projects across all the critical sectors that have a bearing on the nature and extent of damage and loss resulting due to disasters (NIDM). The mainstreaming of DRR and CCA to local development planning aims to reverse the vicious cycle of disasters and deter economic and environmental instability (GArneil & Casimiro, 2021). Communities should be aligned in mainstream Government development programmes and schemes to address their various risks. Dr Amrita Bajaj of SBS College, Delhi on her case study on Kinnaur, Himachal Pradesh emphasized on integrating Disaster Risk Reduction (DRR) with climate adaptation strategies. She highlighted some aspects of DRR including comprehensive and collective efforts of private and public institutions in disaster management in terms of policy making and ensuring mass accessibility to the policy (Bihar, CU South, Sep 2024). She also highlighted various gaps which are necessary to be filled to enhance disaster resilience and decrease risk in Kinnaur which included lack of community participation, lack of training of the exposed, lack of synchronization in the working of the relevant government agencies, and gap between government and NGO efforts (Bihar, CU South, Sep 2024). It needs to be strategically ensured that all the ongoing development efforts are planned with a DRR perspective; this would ensure that development investments are sustained and lead to long-term vulnerability reduction. A holistic approach for Mainstreaming Disaster Risk Reduction (MDRR) into livestock and other sectors through a theoretical framework could turn to be the most effective

mitigation (T Chowhan, F Sultana, 2017). In Himachal Pradesh, while planning for the construction projects, the concept of slop stability should be considered. Dr Krishna Kumar of IGNOU advocated for the planned development, where slop stability should be taken into consideration before any construction (Bihar, CU South, Sep 2024). Recognising the potential of vetiver grass, the Himachal Pradesh State Disaster Management Authority, in collaboration with Vetiver Foundation-Climate Resilience and Sustainability Initiatives (CRSI), Tamil Nadu, undertook the project to develop sustainable mitigation strategies against landslides (TOI, 2025). Moving towards sustainability is a societal challenge that involves national and international legislation, urban and regional development, transport and other sectors, and that equally involves engagement with local and individual ways of life, and, especially in an increasingly urban world, positive choices to promote more ethical consumerism (Ramesh Ananda Vaidya, Jan 2019).

3.4. Local knowledge and traditional coping mechanisms

Indigenous and traditional knowledge is a kind of skill, understanding, philosophy developed and transmitted through their past generations and used by communities based on a long period of living and interaction with their surrounding environment (Gopal Krishna Panda et al , May 2023). CBDRR processes capitalize on existing capacities and traditional coping mechanisms deeply rooted in cultural practices of the community. Communities in an area with low flooding and with a strong socio-economic base such as education and income were more likely to cope with flood impacts compared to those communities in areas with high and sudden flooding and weak socio-economic base (Emmanuel Mavhura et al, Sep 2013). When threatened by a hazard, communities often respond by making use of all the traditional knowledge, resources, shared values, coping mechanism and local practices, which have evolved over generations. It is based on the bottom-up approach involving community needs and safeties. These are critical building blocks for systemic solutions to local hazards and
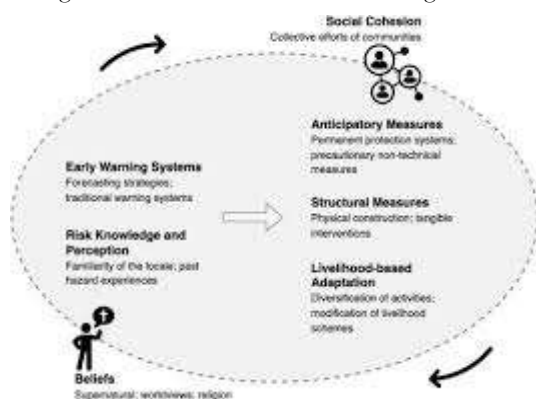
Figure 4 The interconnectedness of the different forms of LIK (local & Indigenous Knowledge) as derived from the synthesis of fieldwork-based studies. Source: Where does local and indigenous knowledge in disaster risk reduction go from here? A systematic literature review, 2022

must be included in response preparedness actions at the community level. Uncertainties pose particular hardships for the poor who are chronically vulnerable in terms of their access to resources. Rural households have developed a range of strategies and livelihood choices to deal with local seasonal stresses that are endemic, even in "normal" years (Bangladsh CP). Communities mobilise a plethora of LIK (local and indigenous knowledge) which highlights their ingenuity to come up with self-help measures to protect themselves and their assets in the face of hazards (Arvin Hadlo, 2022). Local and Traditional knowledge intertwined with modern technology will boost the disaster preparedness and response mechanism of community and local government by providing time-tested tricks and hazard specific.   It is community-driven approach which enhances disaster preparedness, response, and resilience by providing context-specific, time-tested solutions to reduce disaster risks in the region. Combining indigenous and local knowledge with external expertise is vital for resilience (Ramesh Ananda Vaidya, Jan 2019). Recognising the potential of vetiver grass, the Himachal Pradesh State Disaster Management Authority, in collaboration with Vetiver Foundation-Climate Resilience and Sustainability Initiatives (CRSI), Tamil Nadu, undertook the project to develop sustainable mitigation strategies against landslides (TOI, 2025).

4. Community Capacity Development

Disaster Risk Management (DRM) programme aims to: a) focus on building community capacities, community-based planning; b) partnership with all stake-holders in DM like governments, professional bodies, training institutions, peoples' representatives, technical institutions, etc; and c) boost capacities at all levels with special emphasis on women to address disasters through an integrated approach for reducing vulnerabilities (CBDRR, 2024). The main focus is on education, training and capacity building for better preparedness and mitigation in terms of DRM and recovery at community, district and state level by strengthening linkages with SDMAs

and DDMAs. Capacity building also needs to be made a more regular exercise with Resident Welfare Associations and Panchayats/ Gram Sabhas, to answer identified local hazards. The NDMA has formulated policy guidelines to enhance capacity in emergency medical response and mass casualty management and the department will use these guidelines for medical preparedness (HPSDMA, 2011). Community training programmes for enhancing the capacity of communities, as they are the first capacities of women, children, the elderly, SC/ST and Persons with Disabilities (PwDs). Capacity building also needs to be made a more regular exercise with Resident Welfare Associations and Panchayats/ Gram Sabhas, to answer identified local hazards.

5. Essentials of CBDRR

The community-Based Disaster Risk Reduction (CBDRR) emphasises to reduce landslide risks by enabling communities to understand, identify, and mitigate these hazards. Engaging local communities in monitoring terrain stability, mapping hazard zones, and developing early warning systems promotes self-reliance and resilience. Local administrations must be prepared to involve both setting up early warning systems and educating communities to effectively respond to landslide risks.

5.1 Installation of Early Landslide Warning System (ELWS), Sensors and Monitoring Tools:

Install rain gauges, soil moisture sensors, and other monitoring tools to track environmental changes. These
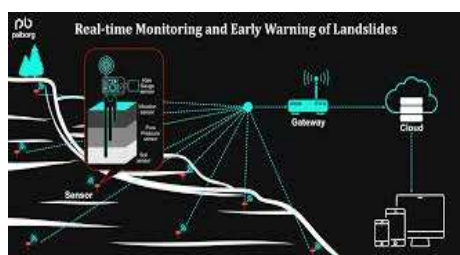

Figure 4 IoT-based Early Warning Landslide Detection System

systems collect real-time data on rainfall, soil movement, and slope conditions, which can help issue timely alerts. The distribution and training to these community regarding this technology will help in early response, and search and rescue operations. An EWS generates and shares timely information to mitigate the impacts of disasters like landslides, involving risk knowledge, monitoring and warning, dissemination and communication and response capability (Rohini, 2024). Early landslide warning systems are crucial for mitigating the risks associated with landslides, especially in vulnerable regions. These systems typically involve monitoring environmental factors like rainfall, soil moisture, and seismic activity to predict potential landslides. GSI has also initiated the R & D activities and the ground work for developing regional Landslide Early Warning System (LEWS) in other test areas like Uttarakhand, Kerala, Sikkim from 2021 and also has a plan to add five additional states (e.g., Himachal Pradesh, Karnataka, Assam, Meghalaya, Mizoram) by 2022 (MoES, 2021). Geological Survey of India (GSI) is also developing and empowered implementing Early landslide Warning Systems which help communities receive timely alerts about potential landslide events so that it will allow them to take precautionary measures. IIT Mandi is developing this low cost ELWS and installing at vulnerable locations starting in Himalayan regions. But now scientists from the Indian Institute of Technology (IIT) in Himachal Pradesh's Mandi district have found that with some modifications, it can be used as a low-cost early warning system for landslides (BBC, 2019). After the devastating 2023 monsoon season, which caused heavy loss to lives and property, Himachal Government is actively developing the landslide early warning systems and deploying in the deadly landslide areas. The Shimla Municipal Corporation has announced an early warning system (EWS) for landslides to prevent disaster-like situations in the future. This initiative follows the devastating 2023 monsoon season, which saw heavy loss of life and property due to landslides caused by torrential rains (Rathore, 2025). A framework of MoU was signed on 27th December 2023 between Himachal Pradesh State Disaster Management Authority (HPSDMA) and Geological Survey of India (GSI) for institutional cooperation and collaboration for implementation / validation of Experimental Regional Early Warning Forecast System for rainfall induced landslides (GSI, 2025).

5.2 Risk Assessment and Monitoring:

This process involves hazard assessment, vulnerability assessment and capacity assessment. In doing the assessments, people's perception of risk is considered (Kafi, Aug 2013). Community can be utilised to assess the landslide risks based on rainfall patterns, soil stability, slope conditions, and historical data. Regularly monitor conditions in high-risk zones to detect changes that might indicate an increased risk of landslides. Community-based landslide risk reduction actions are related with the capacity to anticipate or to cope with

future landslide events, which in turn depend on the availability of resources, opportunities, networks, and institutional or governmental support (Ciurean et. al., 2022). The local authorities can play the role of a facilitator, enabler and resource provider; can facilitate participatory disaster risk assessment with the involvement of local people, community leaders and subject experts; can identify local resources in forms of private sectors or organizations like teachers' associations, women union, religious associations and youth unions (CBDRR, 2024). An effective multi-hazard community based Early Warning System (EWS) & a Response System (RS)will support the state road agencies: to alert the road users prior to any event to prevent them from any danger; to provide necessary structural & non-structural measures to safeguard the transport infrastructure and communities during an event; and to be prepared with roles & responsibilities to handle emergencies during a disaster (HPSRTP, May 2019).

5.3 Community-based Early Warning Systems:

According to the United Nations International Strategy for Disaster Reduction (UNDRR, 2025), an early warning system is the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organisations threatened by a hazard to prepare and act appropriately and in sufficient time to reduce the possibility of harm or loss. The most serious damage caused by cloud-bursts is on the hill population, crops and cattle apart from washing away of homes, link roads, bridges, especially the small foot-bridges and ropeways which residents use to cross nullahs and rivers (Sharma, 2020). Government should establish community-based systems on priority to disseminate early warnings. (Vijay Chaudhary, 2024) It is to be ensured that alerts from monitoring tools are communicated promptly to at risk communities through sirens, messaging systems, or other means. Rainfall and Soil Moisture Monitoring: Regularly monitor rainfall and soil moisture levels to determine when landslide risks are elevated. Issue warnings when conditions reach critical thresholds that may lead to landslides. Use effectively social media, robots and drones etc. to disseminate the disaster warning among all effected people. The current method of dissemination of extreme weather warning to all nodal agencies is through mail/fax and SMS being sent from Meteorological Office, Shimla, to government departments. The information is also disseminated to general public through local media (print, radio and television). General public are unable to translate the forecast into warning or actionable points (Taru, May 2014). DMR has set up landslide warning networks for both local and regional areas in the high-risk areas throughout the country. The network has been set through a series of seminar meetings for capacity building of the local community with the supply of efficient equipment for the network group to be able to monitor rainfall and landslide in their areas (Thialand, 2013). As climate change continues to impact weather patterns, the region must adapt to these challenges through sustainable practices, improved infrastructure, and effective community engagement (Shivani, 2024).

5.4 Public Awareness Campaigns and training to community:

Community should be made aware by conducting regular community education programs with focus on landslide warnings, soil movement and cracks in the ground, People should know the respective signs and actions to be taken when these signs appear. Train local volunteers and community members in basic search and rescue techniques, first aid, and emergency shelter management. Community engagement in the design and development process: Helps build awareness and a sense of ownership, leading to resilience building (MV Ramesh et. al., 2024). Sikkim has started a rescue training programme to

Figure 5 IUCN organizes community training on Disaster Risk Reduction in Apr 2018 in Kullu Dist, HP

strengthen disaster response. Volunteers are trained in emergency management skills to tackle natural calamities. Certified volunteers will be officially recognised as a government-backed rescue team, receiving essential tools and gears and Rs 15 lakh insurance package, with 10% coverage for medical expenses, ensuring financial security for volunteers (Pradhan, 2025). IUCN is implementing a project on 'Coping with Uncertainties: Building Community Resilience and Ecosystem Based Adaptation to Climate Change in the Indian Himalayan Region (CwU) in three Himalayan States, one of which is Himachal Pradesh. As an effort to build community resilience to disasters risks, IUCN organised a three-day training programme on Disaster

Risk Reduction (DRR) for the local community in the project site of Fozal Watershed (IUCN, 2018). Effective implementation of landslide resilience and risk governance initiatives incoherence with science, practice and policy is required for coherent action for a sustainable mountain ecosystem towards landslides (NLRMP, 2025). IIT Mandi, Himachal Pradesh, in collaboration with the NDMA conducted five-day training programme for all stakeholders on **'Landslide Mitigation and Detailed Project Report (DPR) Preparation'** on August 31, 2018. The programme brought together key groups, including geo-technical engineers, civil engineers, geologists, disaster managers, etc., which work towards developing, adopting, implementing and enforcing mitigation measures in their concerned States (PIB, 2018).

5.5 Emergency Preparedness Planning:

Emergency preparedness requires that emergency plans be developed, personnel at all levels and in all sectors be trained, and communities at risk be educated, and that these measures be monitored and evaluated regularly (WHO, 1999). Disaster preparedness refers to measures taken to prepare for and reduce the effects of disasters. That is, to predict and—where possible—prevent them, mitigate their impact on vulnerable populations, and
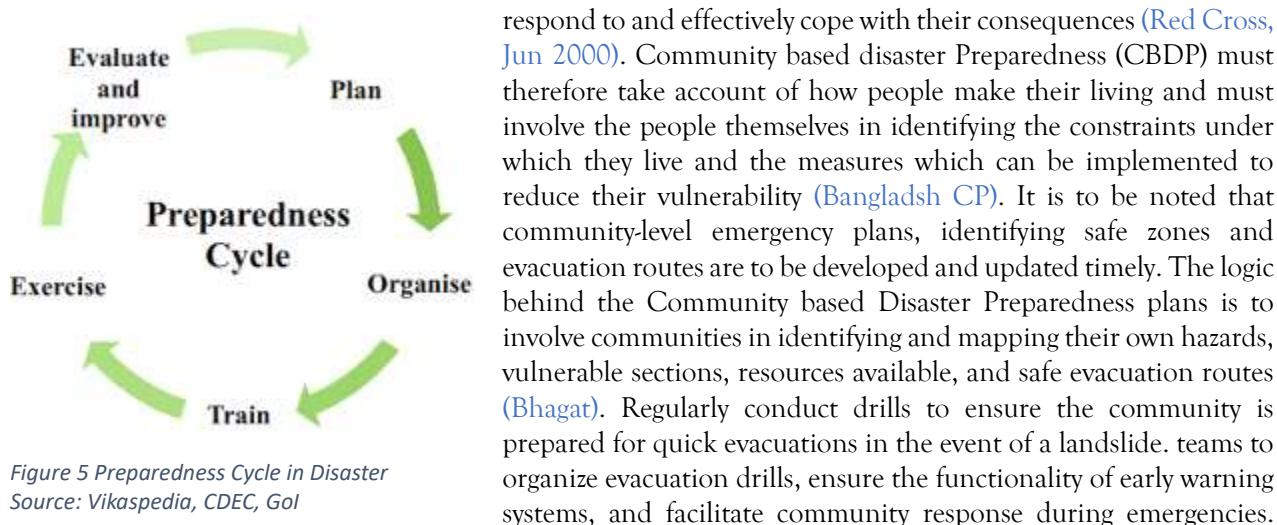

Figure 5 Preparedness Cycle in Disaster Source: Vikaspedia, CDEC, GoI

respond to and effectively cope with their consequences (Red Cross, Jun 2000). Community based disaster Preparedness (CBDP) must therefore take account of how people make their living and must involve the people themselves in identifying the constraints under which they live and the measures which can be implemented to reduce their vulnerability (Bangladsh CP). It is to be noted that community-level emergency plans, identifying safe zones and evacuation routes are to be developed and updated timely. The logic behind the Community based Disaster Preparedness plans is to involve communities in identifying and mapping their own hazards, vulnerable sections, resources available, and safe evacuation routes (Bhagat). Regularly conduct drills to ensure the community is prepared for quick evacuations in the event of a landslide. teams to organize evacuation drills, ensure the functionality of early warning systems, and facilitate community response during emergencies.

Disaster preparedness from a developmental perspective, discusses the issues and problems concerning sustainability, replication/ adaptation of disaster preparedness practice and integration of risk management plans with government and non-government development plans (Dr Ravikant Singh, 2013). Emergency preparedness aims at community centric approach for better understand and participate to make the community disaster resilient. It aims at people to build on combined strengths,s by working together to identify local priorities and develop mutual goals and solutions (EVM, 2023) .

6. Response

Effective, efficient and timely response relies on disaster risk-informed preparedness measures, including the development of the response capacities of individuals, communities, organizations, countries and the international
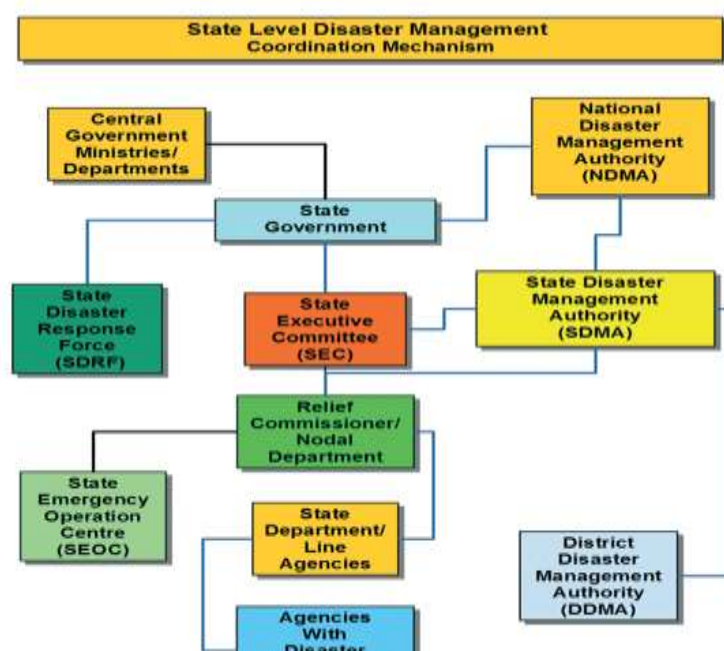

Figure 6 Institutional Arrangement for Disaster Management of HP Source: DM Plan, Dept of Police, Govt of HP

community (UNDRR, 2025). Casualties and damages can be significantly reduced with quick and effective response. Communities must be trained, empowered and prepared to act immediately after landslide for swift action and coordination people. Emergency response should extend beyond immediate relief, focusing on a holistic approach that empowers local communities, reduces dependency and fosters resilient infrastructure (E Jafar, AK Gupta, 2024). Emergency operation centres should be immediately activated by local authorities at district level to manage and coordinate all response actions. It acts as centre point of to manage and communicate with all responding agencies. Emergency services, NGOs and community and provide regular updates to ensure coordinated efforts. NDMA has issued guidelines aiming at minimising loss of lives and property by strengthening and standardising the disaster response mechanism in the country. The Incident Response System (IRS) is an effective mechanism for reducing ad-hoc measures in response. It envisages a composite team with various Sections to attend to all the possible response requirements (IRS, 2025). As a first responder, local people initiate the search and rescue operation and help the rescue team in locating, provide first aid and transport needy people to medical facilities. Although community participation is now widely acknowledged as critical to disaster response and preparedness, very little effort is made to clearly delineate what community participation means, or to define and articulate the approach to community participation (P.V., Parasuraman S. Unnikrishnan)

Emergency Operation Center plays a vital role in the Emergency Operation activation. It coordinates the flow of information with respect to activities associated with relief operations. As per the Government of India national framework for disaster management, the States are being assisted to set up control rooms/emergency operations centres at State and district level (HPSDMA, 2011). With the support of community, govt make the temporary shelter ensuring all basic facilities such as food, drinking water, medical facilities and sanitation etc. Eco-friendly materials for shelters and effective waste management practices can ensure that temporary solutions do not leave lasting environmental impacts (E Jafar, AK Gupta, 2024). Special attention is to be given to vulnerable

Figure 7 Emergency Operation Center, HP Source: HPSDMA, Shimla

groups, including women, children, the elderly, and persons with disabilities in terms of safety, privacy, and access to services. Local government has to deploy relevant agencies to emergency services such as clear the roads and restore the access to isolated community enabling the relief supplies, facilitate medical evacuation and support ongoing operations. During author's visit to this cite soon after the incident occurred in landslide incident at Rajpur in dist Sirmaur in Sep 2024, local community helped local govt in response, search and rescue operation, and locate the man missing under the debris. The prompt alert and suitable action by the community saved many people and livestock, and reduced damage by immediate alerting the people downstream the flow.
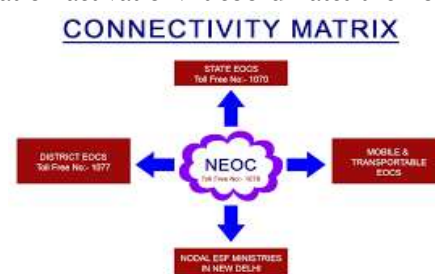
7. Recovery and Reconstruction

Recovery post disaster is very cumbersome task. Disasters affect the community badly. Landslide recovery efforts should prioritize restoring normalcy and reducing the long-term impact on affected communities, while incorporating measures to build resilience against future disasters. Community plays a central role in recovery and reconstruction phase. With the help of local leaders, Panchayati Raj Institutions (PRIs) and NGOs, govt authority ensure local ownership, rational resource distribution and sustainable resilience-building. Community indigenous knowledge help local administration in identifying damages, losses and priorities in this phase. The 15th Finance Commission has recommended three funding windows within the NDRF and SDRFs, which are dedicated to the following functions: (i) Response; (ii) Recovery and Reconstruction; and (iii) Preparedness and Capacity-building (R & R, 2024). Post-disaster recovery is often plagued by significant time-gaps, a lack of continuous attention by international and national partners, and declining resource commitments (UNWC, Mar 2015). A key attribute of a successful recovery programme is to build back better. According to the United Nations in The Sendai Framework for Disaster Risk Reduction (DRR) 2015-2030 the "use of the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical

infrastructure and societal systems, and into the revitalization of livelihoods, economies and the environment" (R & R, 2024).

Thorough assessment is required to be conducted after the landslide's impact on homes, infrastructure, and livelihoods. Local govt has to consult with affected communities to identify priority areas for rehabilitation and ensure that recovery plans address both immediate and long-term needs. Shri Ashwani Singla, Gram Panchayat Pradhan Rajpur, in Sep 2024 landslide incident accolades the community role in shouldering with the govt in restoring damaged electric and water supply to two panchayats. During the disaster, temporary shelters are to be set up for the affected people and livestock who have lost their homes. These shelters should be located in safe zones, away from landslide-prone areas, and designed to offer sufficient space, sanitation, and security, ensuring that displaced families can live in dignity. A High-Level Committee (HLC) led by Union Minister Amit Shah approved ₹1,280.35 crore additional Central assistance to Bihar, Himachal Pradesh, Tamil Nadu and Puducherry, affected by flood, flash flood, cloudburst, landslides, cyclonic storm, during 2024 out of which Himachal Pradesh was allotted Rs 136.22 Crore (Koshy, 2025).

Affected people and their assets are to be counted and recorded, and extend financial assistance, agricultural recovery support, and job creation initiatives to help communities recover their livelihoods. The reconstruction involves building the confidence, self-respect, self-esteem, self-dependency, mutual support, and mutual trust and rebuilding of communities (Jayaraj, 2015). Recovery and Reconstruction Programs should focus on diversifying income sources and building local capacity, ensuring that communities are better equipped to withstand future economic hardships. People are be sensitized not to build the houses in unsafe slopes. Ensure implementing effective slope stabilization techniques like retaining walls and slope terracing before constructing homes and infrastructure. Additionally, rebuilding efforts should be guided by risk assessments and land-use plans to ensure that new structures are situated in safe locations, minimizing exposure to future landslide risks. IRP (International Recovery Platform) supports progress against Priority 4 of the Sendai Framework for Disaster Risk Reduction 2015-2030, enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction (IRP, 2025).

8. Mitigation

Mitigation is the action taken to reduce or eliminate the risk or impacts of disasters through long-term, proactive measures. According to (UNDRR, 2025) , "Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness". It is mainly of two types-structural and non-structural. Structural mitigation includes the physical interventions such as earthquake-resistant buildings, flood dikes, shelters, building by-laws, capacity building. Non-structural includes the hazard zone mapping, enforcing building codes, community awareness program, early warning system. Special emphasis is to be given on training of communities in awareness propagation, evacuation, first aid, search and rescue operations etc which will help immediate response and save the lives and further make the operation smooth. A paradigm shift has now taken place at the national level from the erstwhile response centric approach to holistic and integrated management of disasters with emphasis on prevention, mitigation and preparedness (Mitigation, NDMA, 2025). Central government has initiated various schemes covering disaster prevention strategies, mitigation and R&D of the different kinds of disasters, such as Landslide Risk Mitigation Scheme, Flood Risk Mitigation Scheme etc.

To identify the landslide prone zones, Landslide Hazard Risk Assessment and Mapping is to be conducted for detailed topographical and geological surveys. These maps should be widely disseminated among communities, local governments, and planning authorities to ensure that high-risk areas are recognized and avoided. Incorporating hazard mapping into community awareness campaigns can empower residents to make safer decisions about land use and development. Government should enforce land-use regulations that prohibit construction, farming, and other high-risk activities on unstable slopes. Development plans must integrate landslide risk assessments to ensure that new structures and infrastructure are sited in safe locations, reducing future exposure to hazards. Ongoing enforcement of these regulations is critical to safeguarding communities from preventable disasters.

Government with the help of relevant agencies and community should strengthen in engineering interventions such as retaining walls, slope terracing, and vegetation planting to stabilize landslide prone areas. HP state govt is initiating a bio-engineering project to mitigate the effects of landslide by cultivating deep and dense rooted vativer grass that stabilises soil and prevent erosion. The roots can grow 3-4 meters deep forms a strong hold with the soil, reducing the risk of landslides (THE PRINT, 2025). Local residents should be encouraged to adopt similar kind of forestation in unstable areas. Drainage system is an important project to control water flow and prevent accumulation near slopes, which can trigger landslides. Regular clearing of drainage channels and designing drainage systems that account for seasonal variations in rainfall will reduce the risk of soil saturation and slope instability. Local monitoring teams are to be established to monitor high-risk areas and identify early warning signs of potential landslides, such as cracks in the ground or leaning trees and promptly reporting to local authorities to enable swift action. Engaging communities in monitoring efforts fosters ownership and vigilance, ensuring ongoing risk reduction.

9. Findings and discussions:

Himachal Pradesh has a long history of landslides, mainly triggered due to heavy rains and high intensity earthquakes. All 12 districts of Himachal Pradesh have figured on a list prepared by the National Remote Sensing Centre (NRSC) of locations prone to landslides where socio-economic reasons play a key role for the onset of the calamity (Choudhury, 2023). 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 (HPSDMA, Landslides Hazards, 2025). It causes massive loss of life, environment and infrastructure. Roads, railways and bridges are damaged resulting in disruption in movement, supply and operations, leaving the affected community detached from the other villages/towns. In this scenario, community face scarcity of electricity, water, food items and medical services. In case of medical emergency, they have to travel miles on foot carrying patients on shoulders through difficult terrain to reach hospitals. Sometimes patient breadth his last without getting medical aid before reaching the hospital. Shri Daulat Ram of Khijewadi village of Rast Panchayat of Sirmaur dist, while narrating this tragic incident of losing six members of family in landslide incident in Sep 2022, told that lives of his son and grand daughter could have been saved had the medical facility could have been provided in time. Landslides caused by the Heavy rains blocked the roads and pathways and both these father daughter duo could not be transported to the hospital and breadth their last midway.

There is an urgent need to strengthen the disaster resilient capacity of community, especially leaving in remotely located villages from the towns/cities. Building awareness among communities about their physical, economic, or social vulnerabilities and mapping these vulnerabilities can help communities stay alert, be ready in case of worst-case scenarios and undertake mitigation measures to avoid losses (MV Ramesh et. al. , 2024). Early warning system and mitigation measures are very effective in protecting the local people from landslide induced disasters. Empowering community through community-centric awareness programs, training and participatory planning is pivotal in disaster management. Community must be involved in risk assessment and identifying hazard-prone areas. Community plays very important role in early warning dissemination through local network and are first responder in providing immediate rescue, first aid and support before external aid arrives. Government should prepare a plan to encourage the local to opt for volunteer, establish village task force, integrate it with the school/college curricula to instil the sense of preparedness. Updating school disaster documents is needed so that school community members are aware of disaster management updates that have been implemented (Sela Septikasari et. al, Feb 2024)

Local people should be engaged in pre-disaster drills, mock drills and identifying danger signals and alerts help prevent loss of lives and property. Enforce implementation of building codes and standards for constructing buildings ensuring they can withstand potential landslide hazards and not to construct on susceptible areas and near the river or nallas. Effective coordination among government agencies, NGOs, communities and private sectors is important to implement landslide risk reduction measures and building resilient communities. Landslide prevention measures such as planting vegetation, constructing create wire wall in

landslide prone areas, blanketing the slope surface for soil erosion control help in reducing the effects of landslide hazards.

In very susceptible areas of the state, where roads are usually disrupted due to landslide, government should find the alternative so that the road connectivity is maintained in all weather. One of the solutions for this problem is constructing the tunnels bypassing these landslide prone areas which will facilitate unrestricted moment of vehicles in all seasons. Capacity of community will be enhanced and get regular supply of food and essential items, and transport patients timely to the nearest hospitals. Medical facilities are to be improved and strengthened ensuring basic medical facilities and medicines. PHC and Hospitals need to be provided with sufficient staff and medicines and equipped with essential equipment. State government should consider and plan to construct Heli Pads in remote hilly areas, where feasible to facilitate the local people in emergencies. Local people can utilise these services in medical as well as in other adverse circumstances. Capacity building measures in collaboration with the community is to be initiated to make the villages disaster resilient. Unplanned construction and deforestation are increasing the landslide hazards. Rampant use of heavy machineries in road construction and mines in the hilly regions are loosening the soil and making it more vulnerable to the landslides. Local people are very scared by Illegal and unchecked mining activities as the area is losing its

10. CONCLUSION

Himachal Pradesh being the mountainous hilly terrain experiences unpredictable weather every year and thus increases disaster risks. Large number of people live in the far-flung areas where basic amenities are either not available or negligible. During the landslides, medical emergencies are distance dreams and many casualties happen due to non-availability of basic medical facilities in the villages. Villagers, using indigenous tactics carry the patient miles on foot manually to the hospitals. During the adverse climate in heavy rains, frequent landslides at places disrupt the roads making very cumbersome for villagers to carry the patient to hospitals, thus sometime loss the life also. Government should focus on improvement in road connectivity and making good quality hospital equipped with essential medical equipment, medicines and sufficient doctors. Unplanned and use of heavy machines in road and infrastructure construction increase the landslide chances. State government should find the alternate to the construction of road in high- risk zones such as constructing the tunnel, constructing bridges and helipads. Concept of making helipads will provide the opportunity to the people to connect with cities in emergency situations. In adverse circumstances, when the frequent landslides block the roads, serious patients can be easily air lifted to the hospitals in shortest time and can save the lives. People and mesons are to be sensitized through the awareness programmes about the landslide risks to avoid any construction. Building capacity of Community is to be prioritised and continuous spreading awareness, early warnings, imparting knowledge, skill and involving community in these activities will imbibe the habit of disaster preparedness in the people. Conducting mock drills regularly, training volunteers in search and rescue, early warning system, encouraging women to participate in disaster awareness campaigns have proven very effective. There is need to improve coordination among the various govt agencies, NGOs and community for better preparedness and response. Central and State government has to ensure strict enforcement of relevant laws, building codes, check the unplanned construction and ban the use of heavy machineries in mines and road construction. Capacity building and empowering the community will certainly ensure faster response times, effective resource mobilization and improved post-disaster recovery. Strengthening these community-driven initiatives is essential for enhancing disaster resilience across the state.

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