

Community-Driven Landslide Risk Awareness, Preparedness, And Mitigation In Himachal Pradesh: A Case Study Of Sirmaur District

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Abstract

Landslides are among the most destructive natural disasters affecting the hilly regions of India, particularly in Himachal Pradesh. This study focuses on the district of Sirmaur, a highly landslide-prone area in the Shivalik range, to assess community awareness, preparedness, and participation in risk mitigation. Emphasizing a community-driven disaster risk reduction (CBDRM) approach, the research explores how local knowledge, traditional practices, and community engagement can enhance resilience and reduce vulnerabilities.

A mixed-methods research design was adopted, involving both primary and secondary data. Primary data was collected through a structured questionnaire administered to a statistically determined sample of 400 respondents using Yamane's formula. The questionnaire covered personal demographics, awareness levels, government relief efforts, and the roles of NGOs and community members. Secondary data from academic sources and government reports supported the analysis.

Findings reveal that while there is general awareness of landslide risks, there is a significant gap in community training, emergency preparedness, and healthcare infrastructure. The study identifies key challenges such as unplanned construction, deforestation, and lack of interest in community participation. It highlights the potential of integrating indigenous knowledge with modern technologies for effective risk mitigation.

The research underscores the urgent need for policy interventions that institutionalize community participation, improve infrastructure, and promote sustainable practices to build long-term disaster resilience in vulnerable regions like Sirmaur.

Keywords- CBDRM, Landslide, Community, Landslide, Sirmaur

1. INTRODUCTION

Landslides are among the most destructive natural hazards in mountainous regions, particularly in the fragile ecosystems of the Himalayas. They cause significant loss of life, destruction of infrastructure, environmental degradation, and disruption of livelihoods (UNDRR, 2020). In India, Himachal Pradesh is especially vulnerable due to its complex geology, steep slopes, heavy rainfall, and increasing anthropogenic pressures. The Sirmaur district, located in the southern part of the state in the Shivalik range, frequently experiences landslides triggered by both natural factors—such as intense rainfall and seismic activity—and human-induced activities like deforestation, unplanned construction, and the use of heavy machinery for road building (National Disaster Management Authority [NDMA], 2019).

Traditional top-down approaches to disaster risk management, often led by government agencies, have shown limitations in addressing localized vulnerabilities in remote and scattered communities. As a result, there is growing recognition of the need for **Community-Based Disaster Risk Management (CBDRM)**, which emphasizes the active participation of local populations in identifying risks, developing preparedness strategies, and implementing mitigation and recovery efforts (Shaw & Izumi, 2014). Communities, being the first responders

during disasters, often possess invaluable local knowledge, including historical awareness of hazardous zones, indigenous mitigation practices, and effective coping strategies (Gaillard & Mercer, 2013). Such knowledge, when combined with scientific understanding, can significantly enhance the effectiveness and sustainability of disaster risk reduction (DRR) initiatives.

However, despite the potential of community-driven approaches, challenges such as limited education, poor access to information, lack of institutional support, and weak infrastructure often hinder community

involvement in formal disaster preparedness and mitigation programs (Twigg, 2015). In regions like Sirmaur, where terrain and climate add further complexity, these gaps can have life-threatening consequences.

This study aims to assess the level of community awareness, preparedness, and participation in landslide risk reduction in the Sirmaur district of Himachal Pradesh. Using a mixed-methods approach involving structured questionnaires and analysis of secondary sources, the research evaluates the effectiveness of current interventions by government and non-governmental organizations (NGOs), identifies the barriers to community engagement, and proposes strategies to enhance resilience through community empowerment and policy integration. By focusing on the practical implementation of CBDRM principles in a high-risk context, the study contributes to the broader discourse on sustainable and inclusive disaster risk management.

2. LITERATURE REVIEW

Landslides are a frequent and devastating hazard in mountainous regions worldwide, particularly in the Himalayas, where the combination of steep slopes, fragile geology, heavy rainfall, and anthropogenic pressures creates highly unstable terrain (Petley, 2012). In India, Himachal Pradesh is among the most landslide-prone states, with several districts, including Sirmaur, consistently reporting slope failures that result in significant damage to infrastructure, agriculture, and human life (NDMA, 2019).

2.1. Understanding Landslide Risks

According to the United Nations Office for Disaster Risk Reduction (UNDRR), a landslide is defined as the downward movement of rock, soil, or debris under the influence of gravity, often triggered by rainfall, earthquakes, or human activities (UNDRR, 2020). Natural causes such as intense precipitation and seismic tremors are often compounded by anthropogenic actions like deforestation, unregulated infrastructure development, and mining (Kumar & Bhattacharya, 2021). The NH707 highway and other ongoing development projects in Himachal Pradesh have exacerbated the frequency of landslides, particularly due to soil destabilization and slope cutting without adequate geotechnical assessment.

2.2. Shift Toward Community-Based Disaster Risk Management (CBDRM)

Traditional disaster management approaches have predominantly been top-down, with centralized agencies handling emergency response and recovery. However, such models often fail to address local needs or tap into community knowledge systems. As a result, there has been a global shift towards **Community-Based Disaster Risk Management (CBDRM)**, which emphasizes the participation of local communities in identifying, analyzing, and mitigating disaster risks (Shaw & Izumi, 2014). The rationale behind CBDRM is that communities are the first responders in any disaster and possess critical knowledge about their environment, hazards, and historical vulnerabilities (Maskrey, 1989).

CBDRM has been successful in several disaster-prone regions across Asia, particularly in Bangladesh, Nepal, and the Philippines, where local residents are actively involved in preparedness drills, hazard mapping, and early warning dissemination (Gaillard & Mercer, 2013). The approach encourages community ownership, enhances local capacity, and builds long-term resilience.

2.3. Role of Indigenous Knowledge and Local Practices

One of the strengths of community participation lies in the use of **indigenous and traditional knowledge systems**, which are often overlooked in formal disaster planning. In Himachal Pradesh, for instance, local farmers and herders have long relied on their understanding of soil types, vegetation, and slope stability to avoid hazardous zones (Chauhan & Rana, 2020). Incorporating such localized knowledge into scientific frameworks can improve the accuracy of hazard assessments and the effectiveness of mitigation strategies. Research suggests that the integration of community knowledge with modern tools such as **Landslide Early Warning Systems (LEWS)**, hazard mapping, and Geographic Information Systems (GIS) enhances preparedness and reduces vulnerability (Mercer et al., 2010). However, this integration requires institutional support, trust-building, and continuous community engagement.

2.4. Challenges in Implementing CBDRM

Despite its benefits, the implementation of CBDRM faces multiple challenges. These include poor awareness levels, lack of training, weak institutional frameworks, inadequate resource allocation, and

socio-cultural barriers to participation—particularly among women, marginalized groups, and older adults (Twigg, 2015). In remote and rugged areas like Sirmaur, these issues are further complicated by poor road connectivity, limited access to healthcare, and insufficient emergency infrastructure.

Studies also point to a lack of political will and coordination between local governments, NGOs, and national agencies as a barrier to sustaining community participation in DRR efforts (Barua et al., 2013). Moreover, community fatigue and declining interest can arise if engagement is sporadic or only reactive during disaster seasons.

2.5. Research Gaps and Justification for the Study

While there is extensive literature on the theory and benefits of CBDRM, fewer empirical studies exist that examine its application in the specific context of **landslide risk in the Indian Himalayan Region (IHR)**. Moreover, very few studies focus on district-level data or incorporate large-scale primary data collection on public awareness and preparedness, particularly in Sirmaur. This research seeks to bridge that gap by offering field-based insights into the status of community awareness, preparedness, and mitigation practices in the region. It also evaluates the effectiveness of government and NGO-led interventions and identifies strategies to better integrate local communities into formal disaster management systems.

3. RESEARCH METHODOLOGY

This study adopts a **mixed-methods research approach**, combining quantitative and qualitative data collection to assess the awareness, preparedness, and participation of communities in landslide risk reduction efforts in Sirmaur district, Himachal Pradesh. The methodology is designed to capture both statistical patterns and deeper community insights regarding disaster risk management practices.

The study was conducted in **Sirmaur district**, located in the southern part of Himachal Pradesh in the Shivalik range of the Himalayas. Covering a geographical area of 2,825 sq. km, Sirmaur has a population of approximately 529,855 people. The district is divided into five sub-divisions and seven blocks, comprising 259 panchayats and 968 villages. The region is predominantly rural, with most inhabitants relying on agriculture, and is highly vulnerable to landslides due to its terrain, rainfall patterns, and development activities along National Highway 707.

3.1 Population and Sampling

The target population includes residents of landslide-prone villages and towns in Sirmaur district. The **sample size** was calculated using **Yamane's formula** for finite populations:

$$n = \frac{N}{1 + N(e)^2} \quad \text{Where:}$$

- n = sample size
- N = population size (500,000)
- e = margin of error (0.05 or 5%)

This yielded a sample size of **400 respondents**.

A **stratified random sampling** technique was employed to ensure that the sample was representative across various parameters, including:

- Gender and age groups
- Educational background
- Occupation (especially agriculture, labor, and informal sectors)
- Geographic diversity (villages near rivers, hillsides, or active landslide zones)

3.2. Data Analysis

Quantitative data from the questionnaires were tabulated and analyzed using **descriptive statistics** (percentages, frequencies, and cross-tabulations) through tools like **Microsoft Excel** or **SPSS**.

Qualitative data from open-ended responses and observations were subjected to **thematic analysis** to identify common patterns, challenges, and recommendations related to community awareness and participation.

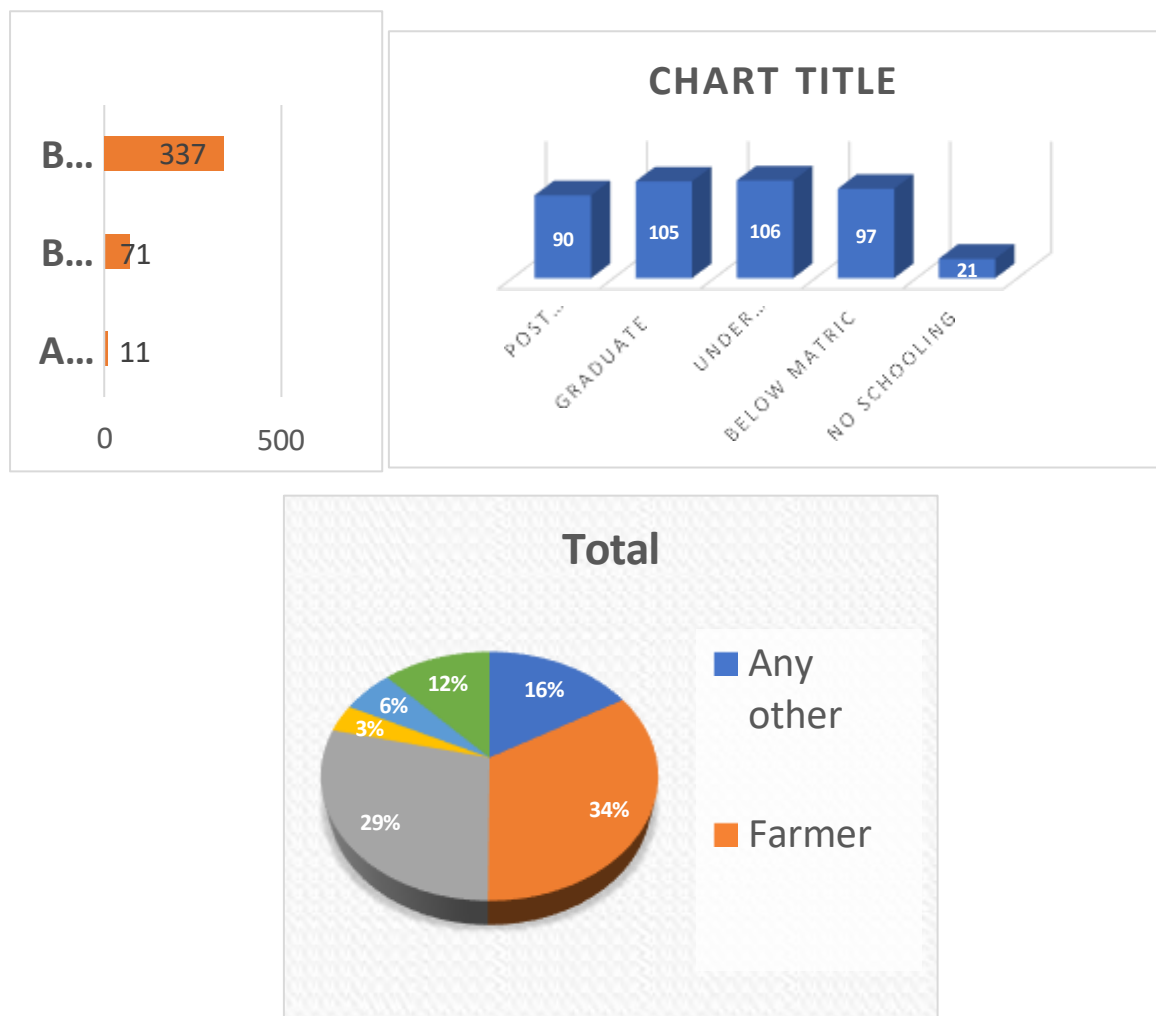
4. RESULTS AND DISCUSSION

The research involved primary data collection from 400 respondents across landslide-prone areas in

Himachal Pradesh, using a structured questionnaire approved by the university. The questionnaire was divided into five main sections: Personal Details, General Awareness, Relief Provided by Government, and Role of Government and NGOs. The findings of the survey offer insight into how local communities perceive and engage with landslide risk, as well as their experience with disaster preparedness and institutional support.

Demographic and Background Information

The surveyed population included a balanced mix of genders and age groups. Most respondents had a basic level of education, with a significant number having completed secondary school. Employment status varied, with agriculture and informal labor being the predominant occupations. Importantly, very few respondents reported having any qualifications or training related to disaster preparedness or response, highlighting a gap in local capacity-building efforts.

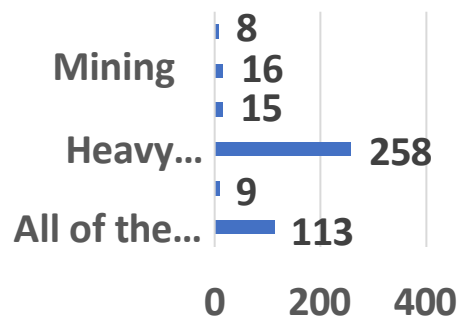


General Awareness of Landslide Risks

Section 2 of the questionnaire revealed that while general awareness about landslides is relatively high—due to frequent past experiences—detailed understanding of risk factors remains low. Respondents largely associated landslides with heavy rainfall and deforestation, which is consistent with the known triggers in the region. However, scientific awareness about the causes of slope failure, early warning systems, and mitigation strategies was limited.

Notably, most respondents had never received formal training on disaster response, nor had they participated in mock drills. While some awareness campaigns had been conducted by local authorities or NGOs, these were infrequent and lacked continuity. This indicates a reactive rather than proactive approach to disaster risk management among the population.

Q7. According to you what are the reasons of landslide induced disasters?

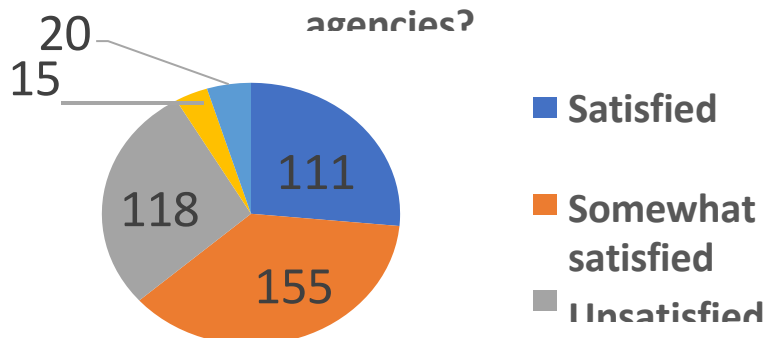


Relief Provided by Government

Responses from Section 4 indicate mixed experiences with government relief measures. While temporary shelters, food aid, and basic healthcare were provided during recent landslides, many respondents reported delays in assistance, especially in more remote or less accessible areas. There were also concerns about the adequacy and timeliness of the support offered, particularly for vulnerable groups such as the elderly and disabled.

Although some coordination was seen between district authorities and local leaders, respondents emphasized the need for faster response mechanisms, better communication systems, and stronger involvement of local volunteers who are familiar with the terrain. This echoes broader concerns raised in disaster management literature about the effectiveness of top-down relief efforts in mountainous regions.

Q19. In your opinion are you satisfied by the response of govt agencies?

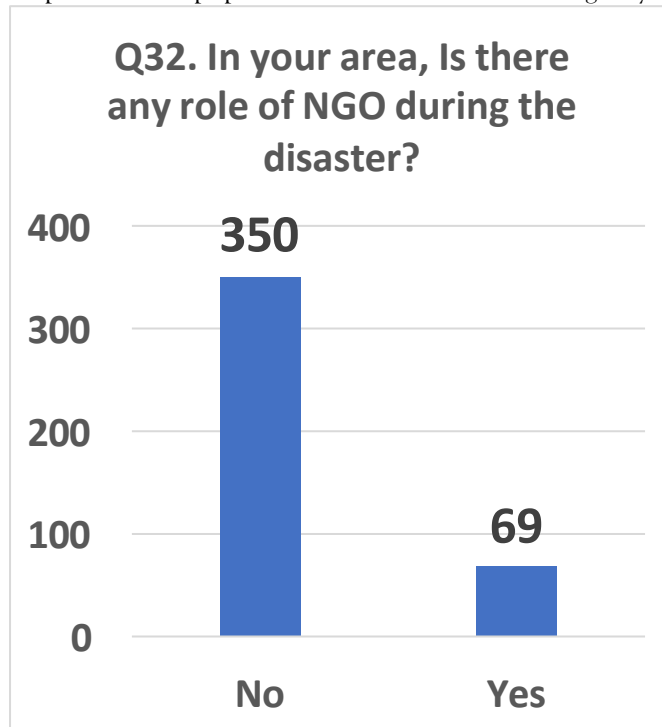


Role of Government and NGOs

Section 5 of the questionnaire explored community perceptions of institutional support from government and non-governmental organizations. While a majority of respondents acknowledged that both sectors play a role in disaster management, many felt that NGOs were largely absent from long-term preparedness efforts. Most NGO activity was concentrated during or immediately after a disaster, with limited follow-

up on recovery or resilience- building programs.

Additionally, there was a clear desire among the respondents for greater inclusion in disaster planning processes. Many believed that their local knowledge—particularly regarding hazardous zones, soil conditions, and traditional construction practices—was not adequately recognized by officials. This reinforces the need for a **community-based disaster risk management (CBDRM)** approach, which empowers local populations to contribute meaningfully to risk assessment and mitigation efforts.



Emerging Themes and Implications

The results highlight several recurring themes. First, while awareness of landslides exists, **preparedness remains low**, and there is minimal integration of traditional knowledge with formal disaster planning. Second, **relief efforts are often reactive and delayed**, particularly in remote areas where road access is poor. Third, **government and NGO engagement lacks continuity**, focusing primarily on emergency relief rather than long-term capacity-building.

From a policy perspective, these findings underscore the importance of promoting **localized, community-driven strategies** for landslide mitigation. Training programs, early warning systems, and community awareness campaigns need to be institutionalized and scaled across high-risk regions. There is also an urgent need to establish better coordination between stakeholders, improve infrastructure in vulnerable areas, and foster trust between local communities and disaster management authorities.

5. CONCLUSION

The findings of this study highlight the critical need for strengthening community-based disaster preparedness in the landslide-prone regions of Himachal Pradesh, with a focus on Sirmour district. While the surveyed population demonstrates a fair level of general awareness regarding the causes and impacts of landslides, there exists a significant gap between awareness and actual preparedness. Most respondents lacked formal disaster management training, had limited exposure to mock drills, and were unaware of scientific methods such as early warning systems or slope stabilization techniques.

The study further reveals that while government agencies do play a role in providing relief during disaster events, the responses are often delayed, inconsistent, and insufficient— particularly in remote and hard-to-reach areas. Non-governmental organizations (NGOs), although present during emergencies, are not systematically involved in long-term resilience building. Importantly, local communities expressed a strong desire to be more involved in disaster planning and risk reduction efforts, suggesting untapped

potential for participatory approaches.

Given the terrain, vulnerabilities, and community structure of the region, it is evident that a top-down disaster management model alone is inadequate. Instead, a shift towards an inclusive, community-driven model—rooted in local knowledge, participation, and empowerment—is essential for sustainable disaster risk reduction.

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