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Monographic issue

Earthquake Risk Profile of Nepal: A Review on Earthquake Risk Reduction and Management Initiatives in Nepal

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Letter from the Editor

The Emergency and Disaster Reports is a journal edited by the Unit for Research in Emergency and Disaster of the Department of Medicine of the University of Oviedo aimed to introduce research papers, monographic reviews, and technical reports related to the fields of Medicine and Public Health in the contexts of emergency and disaster. Both situations are events that can deeply affect the health, the economy, the environment, and the development of the affected populations.

The topics covered by the journal include a wide range of issues related to the different dimensions of the phenomena of emergency and disaster, ranging from the study of the risk factors, patterns of frequency and distribution, characteristics, impacts, prevention, preparedness, mitigation, response, humanitarian aid, standards of intervention, operative research, recovery, rehabilitation, resilience and policies, strategies, and actions to address these phenomena from a risk reduction approach. In the last thirty years has been substantial progress in the above-mentioned areas in part thanks to a better scientific knowledge of the subject. The journal aims to contribute to this progress by facilitating the dissemination of the results of research in this field.

This monographic issue provides an overview of Nepal's natural hazards, vulnerability, capacity, and risks, along with efforts undertaken by the government and other stakeholders to enhance disaster risk reduction and management. As a landlocked country located in the Hindukush Himalayan Region, Nepal is exposed to active tectonic processes, complex geology, and a range of climatic conditions. Coupled with an increasing population, unplanned settlements, low socioeconomic status, and limited awareness, Nepal is at high risk of multiple natural hazards. Earthquakes remain a significant threat throughout the country due to the presence of continental-sized geologic faults. Nepal's high risk is further indicated by its high ranking in the 2021 INFORM global risk index and vulnerability ranks of 4th, 11th, and 30th for climate change, earthquakes, and floods, respectively. The monograph evaluates disaster incidents and losses in Nepal from 1971 to 2017 using the DesInvetar database maintained by the National Society for Earthquake Technology-Nepal (NSET), with quantitative analysis summarized through tables, figures, and graphs. The monograph also presents a case study assessing the severity of the 2015 Gorkha Earthquake using Yew's Disaster Severity Index, which utilizes pre-identified markers of vulnerability and exposure.

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ORIGINAL RESEARCH

Contents

Earthquake Risk Profile of Nepal: A review of Earthquake Risk Reduction and Management (ERRM) initiatives in Nepal

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KEYWORDS

Disaster preparedness
Community Response
Awareness
Disaster analysis

ABSTRACT

The risk profile is a review and case study of Nepal, as well as its general observation and descriptive analysis of the seismic risks, vulnerabilities, exposures, and capacities. The information source mainly used is PubMed, google scholar, and all the handpicked documents published by the government and the related stakeholders working for Disaster Risk Reduction in Nepal. This review has considered the DesInvantar database as the main referral for the disaster analysis for the period of 1971-2017. In addition to data analysis, desk review of relevant pieces of literature, DRRM acts, policy, guidelines, and case studies, interaction and consultations with subject matter experts were carried out. Zotero was utilized as an online library and reference manager. The risk's severity was estimated using Yew's Disaster Severity Index using pre-identified markers of vulnerability and exposure.

Based on a narrative review and synthesis of the literature search, recommendations have been put forth. Nepal has exhibited several encouraging instances, with established responses, policies, and coordination mechanisms, along with active participation in global endeavors toward sustainable development. Despite this, a multitude of gaps and obstacles present additional complexities to policy implementation. Nevertheless, persistent improvements may equip Nepal to effectively confront future calamities.

1. Introduction

Nepal at a glance

With a total area of 147,516 km^2, Nepal is located on the southern slopes of the Central Himalayas. The southern Tarai flatland occupies 14% of the total land area, while hills and high mountains cover about 86% of it. The elevation ranges from about 67 meters above sea levelto 8,848.86 meters, to the Mount Everest, the top of the world (1), (2). This diversity in geography, climatic variation and fragile geology makes the country.

Nepal's new constitution comprises three levels of government namely, Federal 7 Provincial, and 753 Local Governments. There are 77 districts in addition to the provinces and local governments.

The country had a total population of 31 million and a population density of approximately 201 people per square kilometer. Much of the population is concentrated in urban areas.
Nepal is a developing country, and about one-quarter of its population lives below the poverty line. Agriculture is the mainstay of the economy, providing a livelihood for almost two-thirdsof the population but accounting for only one-third of GDP.

Objectives

This research is an effort to present an overall picture of Nepal regarding hazard, vulnerability, and risk, and current initiatives for Disaster Risk Reduction and Management in Nepal.

Methodology

The current study utilized the DesInvantar database as the primary data source for disaster analysis during the timeframe of 1971 to 2017. Along with data analysis, a comprehensive review of pertinent literature, disaster risk reduction and management acts, policies, guidelines, and case studies was conducted. Consultations with subject matter experts were also conducted to gather valuable insights. Zotero was employed as an online library and reference manager. To assess the severity of the risks, Yew's Disaster Severity Index was applied, utilizing predefined indicators of vulnerability and exposure.

2. Nepal: A Multi-hazard Risk Country

Nepal is at 20th topmost disaster-prone country in the world because of its fragile geology anddiverse physiography (3) Among 200 countries, Nepal ranks 4th, 11th, and 30th with regard torelative vulnerability to climate change, earthquake, and flood hazards respectively (4). It faces high magnitudes and intensities of natural hazards such as floods, landslides, earthquakes, fires, cold waves, hailstones, windstorms, thunderbolts, cloudbursts, droughts, Glacier Lake Outburst Floods (GLOF), avalanches, and epidemics.

The number of people who have died or gone missing because of 18 different disaster events over the past 46 years. More than 8,800 people were killed in the Gorkha Earthquake in 2015,a single incident.

Table 1Disaster impact in Nepal by type of events, 1971-2017. disasters between 1971 to 2017

Name of Disaster	Sum Dead People	Sum of Missing People	Sum of Injured People	Sum of Destroyed Houses
ACCIDENT	2222	320	1033	56
AVALANCHE	249	70	118	82
COLD WAVE	940	0	87	0
DROUGHT	0	0	0	0
EARTHQUAKE	9718	0	29360	639817
EXPLOSION	33	0	101	6
FAMINE	10	0	0	1
FIRE	1466	11	1666	77969
FLOOD	3796	1000	553	90545
FOREST FIRE	91	7	64	2150
FROST	7	0	0	0
HAILSTORM	60	0	92	217
HEATWAVE	51	0	20	0
LANDSLIDE	5099	738	1858	19064
SNOWSTORM	130	34	48	106
STORM	56	2	284	1023
STRUCT.COLLAPSE	440	8	706	1273
THUNDERSTORM	1514	0	2974	355
	25882	2190	38964	832664

3. Earthquake Hazard and Risk Analysis

Earthquake Risk:

The potential loss of life, injury, or destroyed or damaged assets that could occur to a system, society, or community in a specific period of time, is determined probabilistically as a functionof hazard, exposure, vulnerability and capacity (5). Thus, risk used to be commonly expressedas:

RISK = HAZARD*VULNERABILITY*EXPOSURE/CAPACITY

In case of an earthquake, the hazard cannot be controlled or modified, therefore the only way to achieve reduced risk is by minimizing vulnerability, reducing exposure, and increasing capacity. The experts (6) have expressed that more than 95 percent of deaths were due to damaged/collapsed structures the in 2015 Gorkha Earthquake in Nepal to by other reasons such as secondary hazards, nonstructural components, inappropriate actions taken during shakingand delay in response, etc.

Nepal belongs to one of the most earthquake-prone areas since it sits on the astride boundaryof two active plates i.e., the Indo-Australian plate and Eurasian Plate (7). The Earthquake HazardMap of Nepal was created as part of the 1994 National Building Code Development Project(**Figure 3)**. Most of the nation is in an area with a high risk of earthquakes. According to thisseismic hazard zonation map (8), the western part of the country has the highest seismic hazard or 0.42g; however, the Kathmandu Valley has the maximum seismic hazard i.e., >0.6g; in thecountry due to its location, local geology, and deposited lacustrine soil(9).

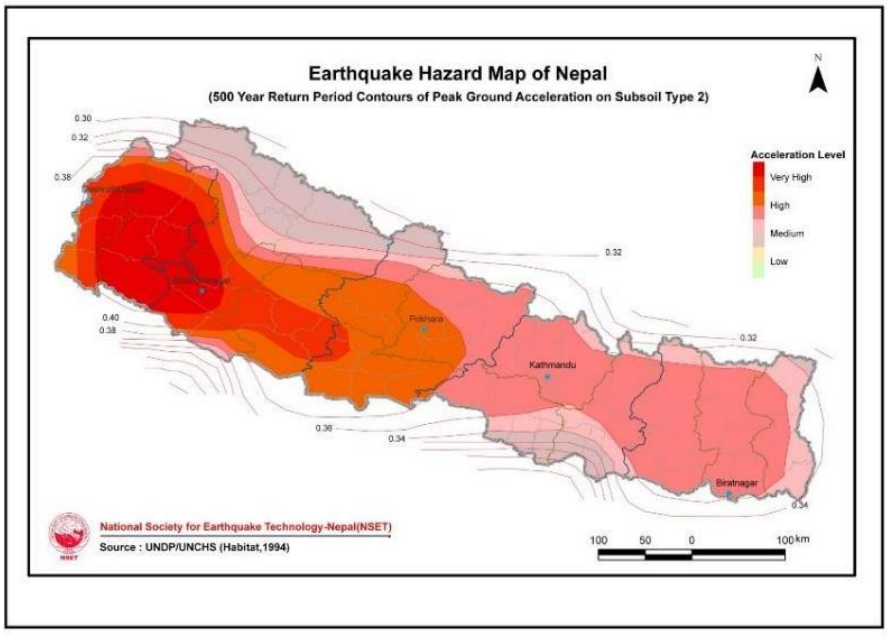

Figure 1Earthquake Hazard of Nepal
Source: National Society for Earthquake Technology Nepal (NSET)

History shows that Nepal has experienced several devastating earthquakes including the first recorded earthquake in 1255, which killed one-third of the population of Kathmandu (10). More than 8,000 people lost their lives and more than 80,000 buildings got collapsed in 1934.

Earthquake of 8.4 magnitudes. Similarly, the 1980 Earthquake of 6.5 magnitudes killed 178 people and destroyed 40,000 buildings (11). In 1988, again 6.5 magnitude earthquake hit the country, killing 721 people and destroying a large number of buildings (12). A 6.9 magnitude earthquake in 2011 killed 6 people and destroyed more than 10,000 buildings. The most recent big shaking in Nepal was the 2015 Gorkha Earthquake with 7.6magnitudese followed by many aftershocks including one powerful shock measuring 6. magnitudes (10), (12)

Seismic Vulnerabilities of Nepal

Vulnerability is the term used to describe how exposed and susceptible a system is to the damaging effects of a specific hazard. It is the level of degradation that a community can experience when exposed to potentially dangerous situations. There are three categories of vulnerabilities according to Anderson and Woodrow (1989). These vulnerabilities will highlight in the context of the seismic vulnerability of Nepal.

1. Physical/Material Vulnerability

The three most popular types of construction in Nepal sustained varying degrees of damageduring the 2015 Gorkha Earthquake and aftershocks. Extensive damage was sustained by RCframe structures with masonry infills and the Unreinforced Masonry (URM) wall constructions. Wood frame construction functioned admirably, except for occasions where slope collapse occurred.. (13)

Building Code Implementation in Nepal: Nepal National Building Code (NBC) was first drafted in 1994 following the lessons learned from the 1988 Earthquake. The NBC was approved by the government in 2003 and is a legally binding document in all 130 municipalities(14). However, NBC is currently the subject of much interest, not only in terms of implementation and compliance but also in technological suitability(13). Seismic vulnerability is increasing because of the deterioration of the built environment and a lack ofresources, particularly for the poor, such as education and training. These activities put more people in danger, making them more vulnerable to seismic risks. Generally, earthquake fatalities are more prevalent because of collapsing structures.

2. Social/Organizational vulnerability

Governmental and nonprofit groups are engaged in disaster management in Nepal,

however,there is a lack of transparency regarding their roles, the beneficiaries they are covering, local

level collaboration with village development committees, and accountability (15). There are many actors working in the catastrophe field locally with dispersed resources since there is alack of a clear institutional mandate. The local government workforce has a relatively limitedcapacity for disaster management. The emergency response plans are significantly influencedby outside factors, with external factors mostly including (donor-driven plans).

3. Attitudinal/Motivational vulnerability

According to a study on earthquake risk, the entire nation is vulnerable to earthquakes (16). The Nepalese community is unwilling to recognize vulnerability since they have no otheralternatives. Even if there are programs to relocate the vulnerable group, they refuse to live there. The vulnerability and risk context for each local government varies due to size, physiography, and, sociocultural and economic capacities (17).

4. A case study: 2015 Earthquake Gorkha Earthquake

On Saturday, 25 April 2015, a powerful earthquake measuring 7.6 magnitudes struck an area, Barpak of Gorkha, about 85 Km northeast of the capital City Kathmandu at 11:56 local time. More than 300 aftershocks followed it (18). A state of national emergency was declared by the Government of Nepal (GoN) and an international appeal was made within hours of the first earthquake (19).

About 9,000 people were murdered, with approximately 55% of those dead being women, and over 100,000 people were injured. In total, eight million people have been affected, accountingfor about one-third of Nepal's population (20). Over 500,000 homes were destroyed and another 269,000 damaged, including World Heritage Sites. In addition to lost or damaged infrastructure, livelihoods have been severely disrupted. According to the UN, World Bank,and EU Post Disaster Assessment, the overall worth of the disaster's damages and losses wasassessed at US$7.1 billion.(21).

Disaster Severity Index (DSI) of the 2015 Gorkha Earthquake Nepal

The impact of the Gorkha Earthquake and its severity is assessed with the help of the Yew Disaster Severity Index (DSI). The Yew Disaster Severity Index (DSI) is a simple, quantitative mathematical technique that aims to simultaneously measure the size of natural catastrophesinfluencing humanitarian needs now of disaster. This instrument, which iscomparable to the Modified Mercalli Intensities (MMI) Scale, coupled the mathematical method with the real aftermath effect seen at the catastrophe impact location (22).

The DSI formula is based on a total of 17 indicators as well as the Penny On-Trust working model. This is done by multiplying three due to three ordinal scores of minimums, median, and maximum. (22).

The Disaster Severity Index (DSI) is an index of the greatest vs. smallest disaster scores ranging from zero to 255, with DSI 8 having the best-fit score of 255 and an interval range of33 on each scale. The Low DSI ranges from 1-3; the Moderate DSI stands at 4-5; and the High DSI runs from 6-8. (23).

DSI with 17 Indicators	**2015 Nepal's Gorkha Earthquake**		
Requirement Title	Score	Fit Xtd	Fit %
Time Occurrence	3	9	100
Impact Time	5	15	167
Topography	3	9	100
Radius from the Impact Site	5	15	167
Accessibility to the Impact Site	1	3	33
Population Density	5	15	167
Main Economy at the Impact Site	5	15	167
Public Infrastructure	4	12	133
Communication	1	3	33
Type of Country	5	15	167
Corruption Perception Index	1	3	33
Water and Sanitation Hygiene	4	12	133
Food Security	5	15	167
Shelter	4	12	133
Healthcare Capacity	3	9	100
No. of Affected	1	3	33
No. of Deaths	3	9	100
GRAND TOTAL		174	114%
DSI	**6.27**		

Table 2 Disaster severity Index of the 2015 Gorkha Earthquake

According to Yew's DSI, the Gorkha Earthquake was a high level of disaster and Nepal had to ask for international assistance and could not recover on its own capacity. Even though Nepal is very susceptible to natural disasters, there were several efforts from the government and other stakeholders mainly in policy development, preparedness and response capacity development and building code development, etc.

Lessons from the 2015 Gorkha Earthquake

Importance of Preparedness: Experiences from the 2015 Gorkha Earthquake

Prior planning and preparedness may have a significant impact on the success of the disasterresponse. The policies, tactics, institutional structures, and capacity-building initiativesimplemented in recent decades benefited disaster management efforts in the early aftermath of the Gorkha Earthquake. Following the Gorkha Earthquake, the National Emergency Operation Center (NEOC) organized a meeting of the Central Disaster Relief Committee (CNDRC)

within two hours, and the Cabinet held an emergency meeting within four hours (24). Thesesessions could quickly resolve to declare an emergency in 11 crisis-affected districts, and releaseNRs. 500 million to the CNDRC and seek foreign assistance. The previous formation of theNEOC and the National Disaster Response Framework was extremely beneficial (25).

Gorkha Earthquake Response: Search and Rescue (SAR)

In Kathmandu, on April 25, 2015, all security forces mobilized their respective responders within two hours of the earthquake. In remote areas community people were the first respondersto help others in disaster. They responded spontaneously using traditional knowledge and locally available resources such as water, food, and shelter. Together with responders from national security forces, there were a large number (26) of community responders spontaneously.

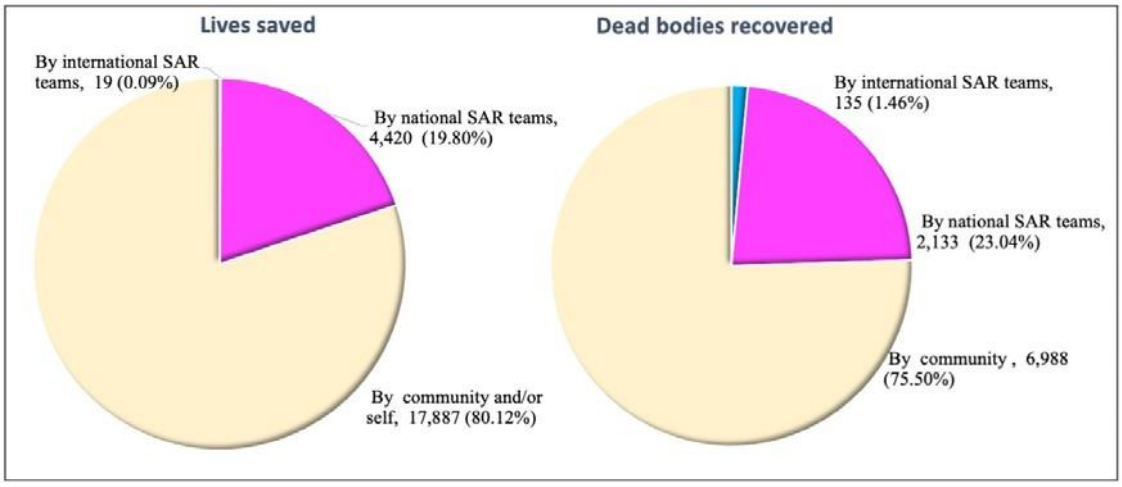

Figure 4: Achievements of Search and Rescue (SAR) operations by different levels of SAR teams in the 2015 Gorkha Earthquake
Source: Jimee, G.K. and Lizundia, Bret (2016). Chapter 8: Emergency Response, EERI Earthquake Reconnaissance Team Report: ***Mw7.8 Gorkha, Nepal Earthquake on April 25, 2015, and its Aftershocks,*** *Earthquake Engineering Research Institute, 499 14th Street, Suite 220, Oakland, California, 94612-1934. pp 8:1 -19.*

got involved in the SAR operation. Out of 22,326 injured people, 19 victims were rescued by international SAR teams, 4,420 victims were rescued by national teams, and the remaining 17,887 live victims were rescued by either community responders and/or by self-rescue (13)**.** This demonstrates that most victims were rescued by community responders, followed by national security personnel, and last by foreign SAR teams. In this scenario, preparing community responders with basic lifesaving/SAR skills and tools/equipment in local areas is critical.

Lessons learned from the 2015 Gorkha Earthquake response.

The Gorkha Earthquake presented an opportunity to analyze the nation's ability to respond to big earthquakes. After the earthquake, the stakeholders' coordination system was unable to function properly for six months. The horizontal coordination at multiple levels was not sufficiently maintained (27), (28).

Most of the Local Governments, (LGs) didn't have DRRM plans prior to Gorkha Earthquake (29). Moreover, due to a lack of clear understanding and defined responsibility, they could not help significantly while implementing it on the real ground (30). So, whatever response they provided, it was on an as-needed basis and under the supervision of the District Disaster Relief Committees (DDRC). As a result, elected leaders at LGs were widely recognized as essential for making quick, sensible choices, mobilizing local resources, and cooperating with the people. Based on the document review (31), (32), (29)the following gaps have been identified;

- People's vulnerability during an earthquake was enhanced because of a lack of adequate awareness, which prevented them from seeing the effects of the earthquake on their environment and from being ready for emergency situations.
- There were also major gaps in understanding among key stakeholders of recently implemented policies, plans, and Standard Operating Procedures (SOP) (33).
- Most crucially, there was a lack of horizontal coordination at the local level, which made it impossible for towns to help one another (34).
- Lack of a defined policy for NGOs' field mobilization for disaster response operations led to uncertainty, duplication, oversight, and inefficient response activities (29).
- As in other earthquakes, the main source of risk was weak structures (35). The national SAR teams' lack of coordination and mobilization at the field and central levels resulted in overlapping and/or overlooked SAR activities in the impacted areas (36) (30).
- International SAR teams arrived later than expected; some continued to arrive

up untilday nine (37). As a result, they were unable to assist earthquake victims who needed rapid expert assistance that was beyond the scope of national responders.

- Many lives may have been saved if there had been a trained and enough number of national SAR and medical teams, as well as the right TEAs (tools, equipment, and accessories).
- Weak mechanisms for information gathering, analysis, and distribution led to misunderstandings among the general public about further safety precautions and personal accountability, as well as among specialists and donors regarding impact assessments for more countermeasures (30).
- The security system failed to keep security concerns including theft, sexual harassment, and human trafficking under control in the impacted rural villages and emergency shelters (38).

5. Initiatives for Disaster Risk Reduction and Management in Nepal

5.1 Efforts of the Government of Nepal

The administrative and governance systems of Nepal may play an important role in increasing resilience to catastrophe risk (39). GON has prioritized the establishment of more dynamic and contemporary policies, legislative measures, and supporting guidelines for effective and efficient DRRM, primarily directed by the Constitution. Some of the important DRR legislative instruments and policies (40) that have lately been supported are as follows:

- Disaster Risk Reduction and Management Act, 2017
- Local Government Operational Act, 2017
- Nepal Government (Work Division) Regulations, 2017
- National Policy on Disaster Risk Reduction, 2018
- Public Health Act, 2018
- Disaster Risk Reduction National Strategic Plan of Action (2018-2030)
- Private Housing Rebuilding Grant for the Flood and Landslide Victims 2017
- Public Housing Program Implementation Sample Guidelines, 2018
- Guidelines for the Relocation and Rehabilitation of High-Risked Settlements, 2018

5.2 Key DRRM Policies

5.2.1 Natural Calamity Relief Act (NCRA), 1982

NCRA was probably the very first attempt toward the DRRM. NCRA, 1982 does not

describe the duties and responsibilities of all the disaster management-related agencies other than theMinistry of Home Affairs (MOHA). Consequently, during disaster victims did not get immediate, efficient, and effective rescue and relief services.

5.2.2 Local Self-Governance Act, 1999

The Local Self Governance Act (LSGA),1999 legislated for the decentralization and democratization of governance within the country. The LSGA authorizes to undertake certainly. Functions with respect to DRR by local bodies. Control of natural calamities, prevention of infectious diseases and epidemics, and operation and management of fire brigades are some of theassigned tasks.

5.2.3 Nepal National Building Code (1994)

A building code is a set of rules that specify the minimum standards for constructed objectssuch as buildings and non-building structures. The Nepal National Building Code was developed in 1994. Now the Government has made it mandatory to follow in urban areas. Implementation of building code which in turn describe the implementation of seismic resistant design for all types of buildings is of utmost need.

5.2.4 Prime Minister Relief Fund Regulation (2007)

Money received from GON or other national and international sources for the purpose of relief is deposited into this fund. The funds cannot be spent on any other overheads including facilities and allowances to civil servants or to provide donations.

5.2.5 National Strategy for Disaster Risk Management (NSDRM), 2009

NSDRM was approved and published in 2009. It has identified 29 strategic activities within the priority areas. The sectors are broadly divided into nine areas, namely, agriculture and food security, health, shelter, infrastructure and physical planning, livelihood protection, water and sanitation, SAR, and damage.

5.2.6 Local Government Operation Act (2017)

The Local Government Operation Act, 2017 outlines the roles and responsibilities of Urbanand Rural Municipalities, District Councils/District Coordination Committees, and Provincial Coordination Councils. This Act entrusts the local level units with the responsibilities of formulating their own laws, by-laws, and regulations; levying taxes; and raising funds.

5.2.7 National Emergency Operation Centre (NEOC)

The National Emergency Operations Centre (NEOC) was established in 2010 under MOHA to work as a coordination and communication point for disaster information across the country. District Emergency Operation Centers (DEOCs) have been established in all 77 districts.

5.2.8 Disaster Risk Reduction and Management Act (2017)

Nepal needs a proactive disaster management Act and policy to cover the whole gambit of disaster management. The DRRMA 2017 replaced the NCRA 1982. It has

made the provision of a National Council for Disaster Risks Reduction and Management (NCDRRM) upon the Chairmanship of the Prime Minister.

5.3 International Commitment of the Government of Nepal

5.3.1 Sendai Framework for Disaster Risk Reduction (SFDRR) in Nepal

Nepal has signed the Sustainable Disaster Reduction and Disaster Reduction (SFDRR) 2015- 2030 and Hyogo Framework for Actions-HFA 2005. Nepal has already stated its intention to meet the SFDRR targets by 2030. It has clearly defined its priorities through action plans and has begun phased execution.

5.3.2 Nepal Risk Reduction Consortium (NRRC)

In May 2009, a consortium was created to assist the GoN in developing a long-term DRR Action Plan based on the NSDRM, 2009.

6. Efforts from Humanitarian Agencies for DRRM in Nepal

Nepal has been experiencing frequent earthquakes, even though with small intensities, but this is enough to make us more concerned about the safety of our own self and family. Being preparedis the key, being prepared will always lessen the impact of the disaster. Along with preparedness, it's also important to stop increasing risk and reduce existing risk (Figure 8).

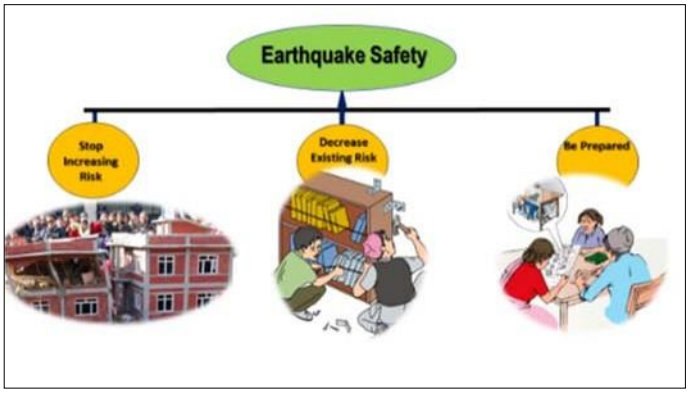

Figure 2 Measures for Earthquake safety

Source: National Society for Earthquake Technology Nepal (NSET)

***Stop Increasing Risk**:* Building codes and good construction practices are critical to ensuring a building/structure does not collapse when the ground shakes. To stop the increasing risk, whatever additional structural and/or non-structural components we add to our environment should be earthquake resistant.

Reduce the existing risk: This can be achieved by ensuring that newly constructed structures are earthquake resistant as well as reducing existing risks associated with them.

Getting Prepared: Getting prepared at all levels, from individual to national level, is important for achieving earthquake safety. Developing preparedness and response plans, developing emergency response capacity, and conducting periodic drills/exercises are crucial to be taken at the community level. If individuals in the community or neighborhood are well prepared, the community can effectively manage the emergency through mutual assistance.

Figure 3 Earthquake Go Bag: prepositioning emergency supplies for individual

Current initiatives for developing emergency responders in Nepal.

Before NDRRM Act 2017, Nepal's response

The mechanism was governed by the Natural Calamity Relief Act (NCRA) of 1982 (41), whichwas primarily concerned with reaction and relief actions after a disaster rather than preparation before a disaster. However, the DRRM Act of 2017 became a milestone for DRRM shifting focus from response to preparedness.

General Emergency Response in Nepal

The success of saving lives and property is always inversely correlated with the effectiveness of the response, which is always directly connected to skills and resources. The response-centered disaster management approach requires significant financial outlays to respond to disasters, even if just a few lives are saved.

Figure 4 Community Search and Rescue (CSAR) Training

Source: National Society for Earthquake Technology Nepal NSET

Program for Enhancement of Emergency Response (PEER)

PEER is a South Asian initiative led by the National Society for Earthquake Technology-Nepal (NSET). Since 1998, PEER developed disaster response capacity-building initiatives in fourstages, focusing on Collapsed Structure Search and Rescue (CSSR), Medical First Response(MFR), Hospital Preparedness for Emergencies (HOPE), and Community Action for Disaster Response (CADRE). PEER in Nepal made a significant contribution during the Gorkha Earthquake. PEER-trained responders, primarily from security forces, Nepal Red Cross Society (NRCS), and NSET, were immediately mobilized for SAR operations. The earthquake had alarge impact, and many professional and community responders were involved in SAR; nonetheless, most national SAR efforts were led by PEER-certified rescuers.

7. Gaps in DRRM in Nepal

- Nepal's new legal instruments recognize the incorporation of DRR into developmentplans. However, what is expressed and highlighted in the plans and operations of allthree levels of government is not substantiated in their annual programs and budgets.
- One reason for this is a lack of instruments for assessing the contribution of development investments to a community's and/or nation's disaster resilience.
- Another problem is recognizing our risk in varied geographies, communities, dangers,and economic activities when scientific risk evaluations are restricted. At this stage, another problem is a lack of common understanding between and within the new governing system.
- DRRM has got less priority among other activities by GON.
- Horizontal coordination among the stakeholders is less efficient.
- Local context-specific analysis of DRRM and planning is required.

Challenges

- A lack of information, technology, and expertise on the practical elements of DRRM.
- Inadequate coordination in several national and international mechanisms
- The occurrence of new types of disasters, urbanization, and unexpected disaster.
- Aligning the DRRM landscape with political change
- Risk uncertainty as a result of climate change.
- The nature of the risks is transboundary, necessitating bilateral and multinational initiatives.

- Ensuring inclusion for DRRM, as well as justice and equity.
- Effective use of financial and other resources, as well as internal and external capabilities, with transparency.

8. Conclusion and Recommendations

Conclusions

Nepal, like many other disaster-prone countries, is working to become more resilient; however, the country's other issues, such as unstable political issues, difficult geographical boundaries, and limited economic resources, make it vulnerable organizationally, economically, physically, and socially. As a result, Nepal has provided numerous positive examples, such as initiating the growth of rescuers and volunteers. The acts, policies, and coordinating mechanisms are allin place. It has also been participating in international programs aimed at achieving sustainable development. However, there are numerous gaps and problems that make implementing thesepolicies even more challenging. Nonetheless, if Nepal continues to improve, it will be prepared for the next major calamity and will be able to respond successfully.

Recommendations

- The Disaster Risk Reduction and Management Act of Nepal (DRRMA 2017) shouldthrive to solve fundamental flaws in the country's DRRM. These flaws include the absence of a complete DRRM strategy at the local level, a lack of awareness of currentplans, and a lack of collaboration among stakeholders.
- Public awareness and preparedness regarding earthquake risk mitigation measures and emergency response capacity at different levels should be strengthened.
- Technological progress, particularly in hazard, risk, and damage assessment, SAR operation, and information collection and dissemination is required.
- Coordination (vertical and horizontal) among disaster-related agencies should be effective.
- A dedicated organization should be established to handle the entire cycle of disasterpreparation, mitigation, response, and recovery.
- Risk-sensitive land use planning should be implemented in urban areas.
- In Nepal, there are provisions of acts and policies that are useful in DRRM, however,there is a significant gap in implementation, thus the government should be very serious, about disaster preparedness and should be well prepared for responding to the nextdisasters in Nepal.

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