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Fault Lines of Destiny: Nepal Seismic Challenges and Paths to Resilience

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Abstract: Nepal, located at the collision zone of the Indian and Eurasian tectonic plates, is a landscape defined by dynamic geological forces and profound human resilience. The metaphor "Fault Lines of Destiny" encapsulates how seismic activity not only reshapes the physical environment but also disrupts and transforms the social fabric of communities. The devastating 2015 Gorkha earthquake, with a magnitude of 7.8, exemplified this dual impact by unleashing massive ground rupture, triggering tens of thousands of landslides, and inflicting extensive infrastructural damage. Nearly 9,000 lives were lost and millions displaced, revealing systemic shortcomings in disaster preparedness and deep-seated socio-economic vulnerabilities. Advanced geophysical analyses demonstrate that the Main Himalayan Thrust and associated fault systems continuously accumulate elastic strain, indicating the potential for even more catastrophic events in the future. Integrating seismological insights—such as slip pulse behavior, basin resonance effects, and paleoseismic records—with socio-political assessments, this study advocates a comprehensive approach to disaster risk reduction. It emphasizes the importance of stringent building codes, robust early warning systems, and community-driven recovery initiatives, particularly those led by women and marginalized groups. Furthermore, targeted urban planning and public education campaigns are critical to mitigating risks and enhancing local capacity. By bridging technical research with inclusive governance and sustainable development strategies, Nepal can transform seismic challenges into a foundation for long-term resilience. Ultimately, this integrated perspective offers a pathway to reduce vulnerability, foster recovery, and secure a safer future for all communities in a region marked by both natural beauty and inherent peril. Ensuring sustainable future resilience.

Keywords: Tectonics, seismicity, resilience, earthquake, preparedness

1. Introduction

The metaphor "Fault Lines of Destiny" captures the inextricable link between Nepal's geological reality and the lived experiences of its people. Situated at the collision zone of the Indian and Eurasian tectonic plates, Nepal's landscape is etched with fault lines that mirror the vulnerabilities and resilience of its society. Here, seismic activity transcends mere geological processes—it shapes destinies, as earthquakes rupture not only the earth's crust but also the social, economic, and environmental fabric of communities. The 2015 Gorkha earthquake, a catastrophic magnitude 7.8 event, epitomized this duality, exposing the nation's fragility while highlighting its capacity for endurance (Galetzka et al., 2015). Nepal's seismic vulnerability stems from its position along one of the world's most active tectonic boundaries. The 2015 disaster claimed nearly 9,000 lives, displaced millions, and caused unprecedented infrastructural damage, laying bare systemic gaps in disaster preparedness (Galetzka et al., 2015; Suvedi, 2021). Beyond its physical toll, the earthquake revealed how socio-economic disparities—such as poverty, geographic isolation, and marginalization—amplify disaster risks, eroding household resilience (Poudel, 2019). Yet, the crisis also underscored the critical role of community-driven responses, particularly women's groups, in fostering localized risk reduction and recovery efforts (Shrestha et al., 2018). This article explores the interplay of tectonic forces and societal outcomes, using the Gorkha earthquake as a lens to dissect Nepal's seismic destiny. By integrating seismological insights—such as slip pulses and basin resonance dynamics (Galetzka et al., 2015)—with socio-political analysis, the study bridges technical knowledge and practical disaster governance. It argues that resilience-building demands policies addressing both geological realities and human vulnerabilities, prioritizing equity and inclusion (Suvedi, 2021). Ultimately, the "fault lines" framing invites a holistic understanding of disaster risk, where science and society converge to navigate the unpredictable forces shaping Nepal's future. Nepal's unique geological setting in the Himalayan region makes it a hotspot for seismic activity. Nestled between the Indian subcontinent and the Tibetan Plateau, the country lies at the convergence of the Indian and Eurasian tectonic plates. This tectonic collision has sculpted the towering Himalayas and rendered Nepal susceptible to frequent and powerful earthquakes. The region's complex fault systems, including the Main Himalayan Thrust (MHT), are the engines of this seismic unrest, releasing pent-up stress in sudden, catastrophic events that shape both the landscape and human history (Thapa, 2018). Understanding this geological backdrop is essential to appreciating the challenges Nepal faces and the strategies needed to mitigate future risks. The map emphasizes the four major thrust systems that control Nepal's tectonic framework: the Main Frontal Thrust (MFT), Main Boundary Thrust (MBT), Main Central Thrust (MCT), and South Tibetan Detachment System (STDS). These east-west trending fault systems separate the physiographic regions and represent the surface expressions of the ongoing collision between the Indian and Eurasian plates. The epicenter of the 2015 Gorkha earthquake (M 7.8) is marked in the central region near the MCT, demonstrating how these fault systems generate major seismic events (Figure 1).

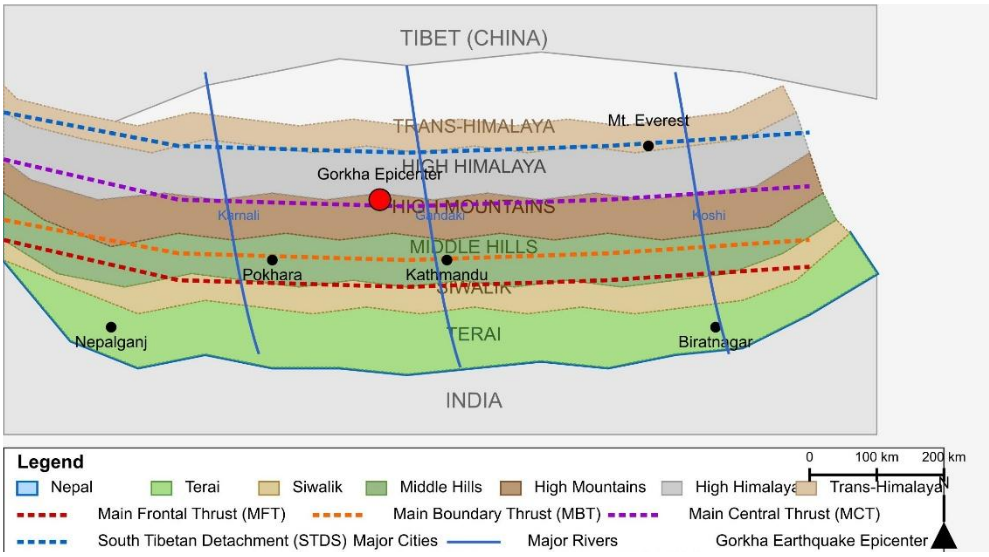

Figure 1: Map highlighting its location in the Himalayan region and major tectonic features after Avouac et al 2015, Dhital 2015

2. Geological and Tectonic Background

Nepal's seismic vulnerability is inextricably linked to its position at the convergent boundary of the Indian and Eurasian tectonic plates. The Indian plate advances northward at approximately 5 cm/year, subducting beneath the Eurasian plate and driving the uplift of the Himalayan Mountain range (Thapa, 2018). This collision generates immense geological stress, primarily accumulating along the Main Himalayan Thrust (MHT), a shallow-dipping décollement fault system that extends beneath Nepal and serves as the primary source of its earthquakes (Ader et al., 2011; Thapa, 2018). The MHT is locked at depths of 15–20 km, accumulating elastic strain at rates of 17.8–20.5 mm/year, far exceeding the seismic energy released historically (Ader et al., 2011). This strain accumulation underscores the potential for catastrophic future earthquakes, with a moment deficit of 6.6×10^{19} Nm/year on the MHT, suggesting unresolved seismic risk (Ader et al., 2011). The MHT is part of a broader network of fault systems, including the Main Boundary Thrust (MBT) and Main Central Thrust (MCT), which partition stress and influence rupture dynamics (Paudyal et al., 2010; Sitharam & Vinod, 2015). Thrust faulting dominates the region, with compressive stress-oriented north-south to northeast-southwest due to the Indian plate's northward movement (Paudyal et al., 2008). Earthquakes occur when accumulated stress exceeds the frictional strength of rocks, leading to sudden slip along these faults. The magnitude and intensity of such events depend on rupture depth, fault geometry, and slip magnitude (Grandin et al., 2015). For example, shallow ruptures amplify surface shaking, while longer fault segments release greater energy, producing higher-magnitude earthquakes (Galetzka et al., 2015). The 2015 Gorkha earthquake (Mw 7.8) exemplifies these dynamics. Originating on the MHT, the rupture propagated along a shallow-dipping, oval-shaped fault surface bounded by steeper ramps, causing a 4.8 m southwestward displacement of the Himalaya (Mitra et al., 2015; Almeida, 2016). Despite its magnitude, the event represented an incomplete release of accumulated strain, with deeper sections of the MHT remaining locked and capable of generating larger earthquakes (Hand & Pulla, 2015). Paleoseismological and geodetic studies suggest the potential for a magnitude 9 event, driven by centuries of unrelieved strain (Bhattarai et al., 2020; Catlos et al., 2016). The 2015 earthquake also triggered over 25,000 landslides, highlighting the compounded risks posed by Nepal's steep topography and monsoonal climate (Sitharam & Vinod, 2015). Nepal's seismic hazards are further exacerbated by its diverse geology, including thick sediment basins that amplify ground motion during earthquakes (Bhattarai et al., 2020). Urban areas with high-rise construction on such substrates face heightened vulnerability, necessitating site-specific seismic hazard analyses (Bhattarai et al., 2020; Kshetri, 2024). Additionally, socio-economic factors—such as poverty, inadequate infrastructure, and marginalized communities—intensify disaster impacts, eroding household resilience (Poudel, 2019). Understanding these tectonic and geological mechanisms is critical for disaster preparedness. Advances in seismology, such as modeling slip pulses and basin resonance effects, can refine hazard assessments (Galetzka et al., 2015). However, bridging technical knowledge with community-centric policies remains imperative. Integrating geological insights with equitable disaster governance, including gender-inclusive risk reduction initiatives, is essential to mitigate future catastrophes (Shrestha et al., 2018; Suvedi, 2021). Nepal's "fault lines of destiny" thus demand a dual focus: unraveling the science of its restless crust and addressing the societal fissures that amplify vulnerability. Structural configuration explains the pattern of seismicity in Nepal, with major earthquakes typically nucleating near the base of the locked zone and propagating along the MHT, as demonstrated by the 2015 Gorkha earthquake. The diagram illustrates (Figure 2) why Nepal experiences such destructive seismic events and why certain regions face greater hazards based on their position relative to the underlying fault geometry. (Based on Avouac et al., 2015; Galetzka et al., 2015; and Dhital, 2015)

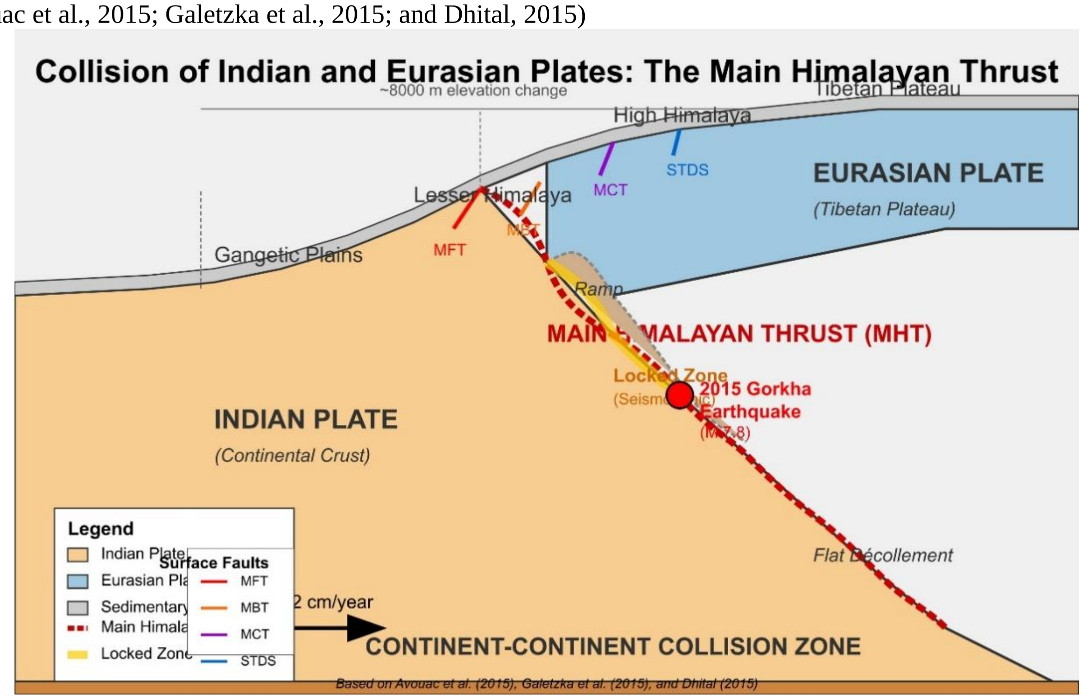

Figure 2: Diagram illustrating the collision of the Indian and Eurasian plates and the Main Himalayan Thrust fault.

3. Historical Seismic Activity in Nepal

Nepal's seismic history is a chronicle of recurring devastation, shaped by its position along the collision zone of the Indian and Eurasian tectonic plates. The earliest recorded earthquake, in 1255, reportedly killed a third of Kathmandu's population, while the 1408 event further underscored the region's volatility (Joshi & Kaushik, 2017; Wikipedia contributors, 2022). Paleoseismic evidence reveals even earlier catastrophes, such as a major earthquake around 1100 A.D. that caused ~17 meters of surface displacement, potentially exceeding Mw 8.8 in magnitude (Lavé et al., 2005). These historical events, preserved in oral traditions and written chronicles, illustrate Nepal's enduring vulnerability to seismic hazards (Joshi & Kaushik, 2017). The 20th century witnessed two pivotal disasters. The 1934 Nepal-Bihar earthquake (Mw 8.0) (Table 1) remains one of the deadliest, claiming over 10,000 lives and flattening infrastructure across eastern Nepal and northern India (Chamlagain et al., 2011; Whelpton, 2021). Its destruction exposed the fragility of traditional unreinforced masonry, prompting early calls for improved construction standards (Joshi & Kaushik, 2017). Decades later, the 1988 Udayapur earthquake (Mw 6.8) caused significant damage in the Kathmandu Valley, disrupting economies and agriculture, and highlighting urban vulnerabilities (Chamlagain et al., 2011; Whelpton, 2021). The 2015 Gorkha earthquake (Mw 7.8) marked a turning point in Nepal's seismic narrative. Despite its magnitude, Kathmandu's damage was mitigated by improved building practices, though rural areas suffered catastrophic losses due to landslides and vulnerable stone masonry (Hough, 2015; Hazarika et al., 2016). The disaster claimed nearly 9,000 lives, damaged over 600,000 structures, and destroyed cultural heritage sites, triggering a global humanitarian response (Gautam, 2017; Wikipedia contributors, 2022). However, it also exposed systemic gaps in disaster preparedness, particularly in rural risk communication and infrastructure resilience (Gautam, 2017).

Table 1: Summary of notable historical earthquakes in Nepal

Date	Magnitude	Death	Location	Remarks	Refrences
1255 CE	~7.8	~30% of Kathmandu's population	Kathmandu Valley	King Abhaya Malla died. Severe damage to temples and palaces.	(Nepal Seismological Center)
1408 CE	~8.0	Unknown	Kathmandu Valley	Severe destruction reported in historical texts.	(Nepal Seismological Center)
1833 CE	~7.6	~500	Kathmandu Valley, Eastern Nepal	Significant damage in Kathmandu and Bhaktapur.	(Bilham, 2019)
1934 CE (Bihar-Nepal Earthquake)	8	~10,700 (8,500 in Nepal)	Eastern Nepal & Northern Bihar (India)	Widespread destruction, including collapse of Dharahara Tower.	(Bilham, 2019)
1988 CE	6.9	~1,500	Udayapur, Eastern Nepal	Major damage in Nepal and Bihar, India.	(Nepal Seismological Center, n.d.)
2015 CE (Gorkha Earthquake)	7.8	~9,000	Gorkha, Central Nepal	Massive destruction, including Kathmandu Valley and historical monuments. Followed by major aftershocks.	(USGS, 2015)

3.1 Lessons Learned and Evolving Preparedness

Historical earthquakes have yielded critical insights. The 1934 disaster spurred initial seismic hazard assessments, including Probabilistic Seismic Hazard Analysis (PSHA), which informed early building code revisions (Chamlagain et al., 2011). The 2015 earthquake reinforced the need for retrofitting historic structures—some of which demonstrated resilience due to traditional engineering—and integrating seismic hazard mapping into urban planning (Joshi & Kaushik, 2017; Hazarika et al., 2016). Post-2015 reforms emphasized community-based early warning systems and stricter construction codes, though implementation remains uneven (Gautam, 2017; Suvedi, 2021). Nevertheless, challenges persist. Socioeconomic disparities, geographic isolation, and reliance on informal construction continue to amplify risks (Suvedi, 2021). The 2015 event also revealed the MHT’s capacity for larger ruptures, with paleoseismic studies warning of potential Mw 9 earthquakes due to unresolved strain (Bhattarai et al., 2020; Catlos et al., 2016). Nepal’s history thus serves as both a caution and a catalyst, urging holistic strategies that blend technical advances—such as basin resonance modeling—with equitable policies to safeguard vulnerable communities (Galetzka et al., 2015; Suvedi, 2021).

4. Unraveling the Forces Behind the Tremor: Scientific Analysis of the 2015 Gorkha Earthquake

The 2015 Gorkha earthquake, a magnitude 7.8 (Mw) event, struck Nepal on April 25, with its epicenter located in the Gorkha district, approximately 85 km northwest of Kathmandu (Grandin et al., 2015). The hypocenter occurred at a shallow depth of 8.2 km along the Main Himalayan Thrust (MHT), where a 120–150 km-long fault segment ruptured unilaterally eastward, releasing energy equivalent to hundreds of atomic bombs (Grandin et al., 2015; Wang & Fialko, 2015). Teleseismic waveform analysis revealed a multistage rupture lasting ~55 seconds, propagating 160 km east-southeast from the hypocenter (Fan & Shearer, 2015). The maximum slip reached 5.1–5.8 m at depths of 8–10 km, though the rupture did not breach the surface, complicating immediate hazard assessments (Wang & Fialko, 2015; Almeida, 2016). Advanced geodetic and remote sensing technologies provided unprecedented insights into the earthquake’s mechanics. GPS and Interferometric Synthetic Aperture Radar (InSAR) data mapped a slip pulse ~20 km wide, propagating at 3.3 km/s over 140 km toward the Kathmandu basin, with maximum surface displacements of 6.5 m near the epicenter (Galetzka et al., 2015; Wang & Fialko, 2015). Satellite radar imagery documented ~2 m of uplift in the Kathmandu basin and subsidence in northern regions, corroborating the MHT’s locked geometry (Diao et al., 2015; Almeida, 2016). Rapid seismological methods, including W-phase analysis, delivered critical source parameters within 20–30 minutes of the event, enhancing ground-shaking predictions (He et al., 2015). These tools also tracked postseismic deformation up to 150 km northward, attributed to afterslip (0.2–0.47 m downdip) and viscoelastic relaxation (Sreejith et al., 2016; Liu-Zeng et al., 2020). The earthquake’s impact was shaped by Nepal’s unique geological setting. The MHT’s gently dipping, oval-shaped fault geometry bounded by steeper ramps constrained rupture propagation, limiting surface damage but leaving deeper segments locked for future events (Almeida, 2016). Crustal deformation from centuries of Indian-Eurasian plate convergence (20.5 mm/yr) primed the MHT for failure, with accumulated strain exceeding historical seismic release (Ader et al., 2011;

Basu et al., 2021). The Kathmandu Valley's soft sedimentary basin amplified seismic waves through whole-basin resonance, collapsing taller structures while sparing many traditional dwellings (Galetzka et al., 2015). Over 30,000 aftershocks, including a Mw 7.2 event on May 12, 2015, redistributed stress along adjacent fault segments, prolonging risks (Kuang et al., 2019; Kumar et al., 2016). Additionally, steep topography and monsoonal soils triggered ~25,000 landslides, compounding devastation (Sitharam & Vinod, 2015). The 2015 earthquake underscored the need for integrating geological insights with practical resilience strategies. While modern tools improved hazard mapping, the event revealed gaps in rural risk communication and infrastructure retrofitting (Gautam, 2017). Future preparedness must address basin amplification effects, high-rise construction on unstable substrates, and the MHT's potential for larger (Mw ≥9) ruptures (Bhattarai et al., 2020; Catlos et al., 2016). By coupling scientific advances with community-centric policies, Nepal can navigate its seismic destiny with greater resilience.

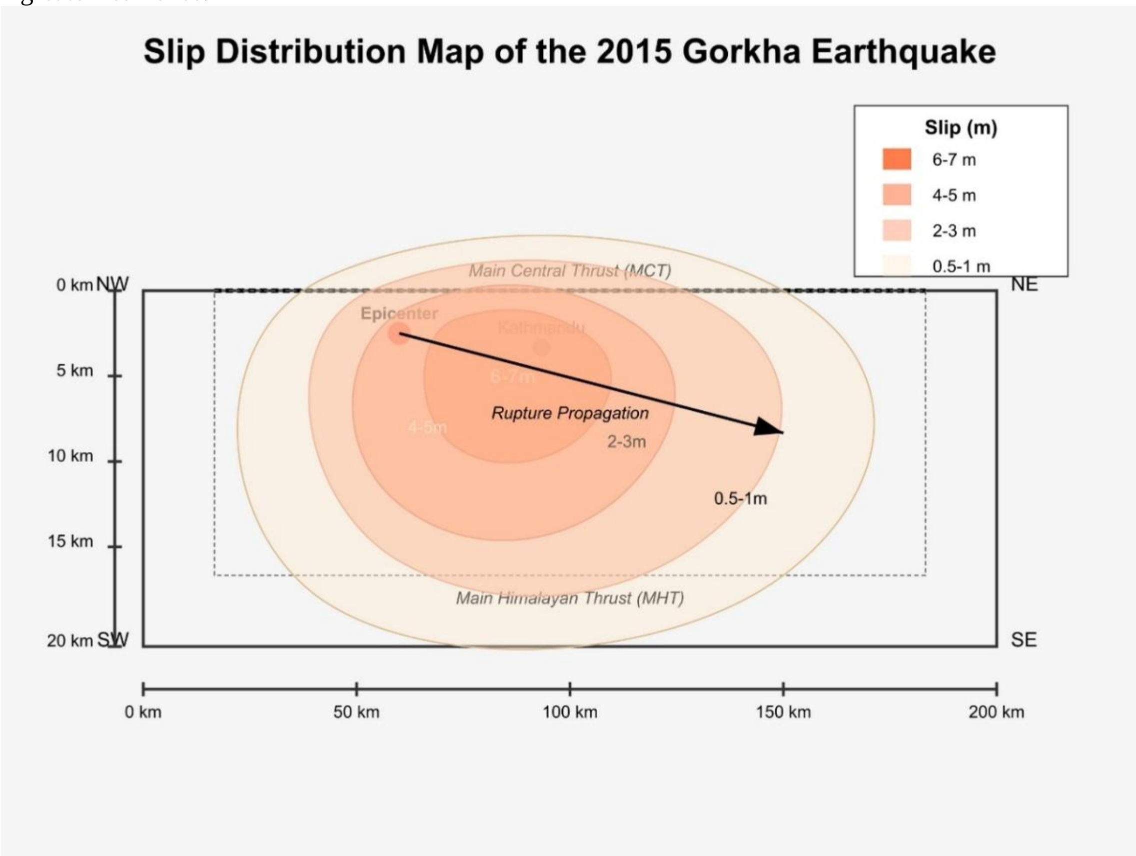

Figure 3: Slip distribution map of the April 25, 2015 Gorkha earthquake. The map shows the spatioal distribution of slip amplitude along the Main Himalayan Thrust fault plane. The maximum slip of 6-7 meters occurred northest of Kathmandu (orange region), with rupture propagation eastward

5. Resilience, Recovery and Future Preparedness

The 7.8 magnitude earthquake that struck Nepal on April 25, 2015, tested the nation's resilience and exposed both its strengths and vulnerabilities. In the immediate aftermath, local communities demonstrated remarkable initiative, stepping in where formal systems faltered. Women's groups, in particular, emerged as unsung heroes, organizing the distribution of food, water, and temporary shelters while supporting vulnerable populations such as children and the elderly. These grassroots efforts were complemented by the Nepalese government's response, which mobilized military and civilian resources for search-and-rescue operations. International aid poured in, totaling over $4 billion from donors like the United Nations, India, and the United States, funding everything from emergency medical care to long-term reconstruction. However, the response was not without challenges. Coordination between local authorities, national agencies, and international partners often broke down, with overlapping efforts leading to inefficiencies. Bureaucratic delays further compounded the problem, as funds and supplies languished in administrative limbo while survivors awaited relief. A study by Shrestha et al. (2018) highlights how poor communication and inadequate pre-disaster planning exacerbated these issues, leaving rural areas particularly underserved. Despite the outpouring of global support, the government's disaster management framework struggled to translate resources into timely action, underscoring the need for systemic reform (Shrestha et al., 2018). This duality of resilience and struggle painted a complex picture of Nepal's recovery, where human spirit shone through even as institutional weaknesses dimmed progress.

Building a more resilient Nepal requires a multi-faceted approach that addresses both structural and societal vulnerabilities. One critical step is the adoption of stringent building codes tailored to withstand seismic activity. Traditional construction methods, such as unreinforced mud-brick homes common in rural areas, proved deadly during the 2015 quake, collapsing under the strain and claiming thousands of lives. Modern seismic-resistant designs—incorporating reinforced concrete, flexible foundations, and lightweight materials—must become the standard, enforced through rigorous inspections and incentives for compliance. Research by Gautam and Chaulagain (2016) emphasizes that retrofitting existing structures, though costly, could significantly reduce future casualties and economic losses, offering a practical bridge between tradition and safety (Gautam & Chaulagain, 2016). Beyond infrastructure, technology offers a lifeline. Early warning systems, powered by real-time seismic monitoring and satellite data, could provide precious seconds or even minutes for evacuation, potentially saving thousands of lives. Japan's success with such systems serves as a model, where sensors detect initial tremors and trigger automated alerts via mobile networks and public broadcasts. Nepal could adapt this technology to its rugged terrain, linking it with community-based drills to ensure readiness. Urban planning also demands attention: haphazard development in Kathmandu Valley and other high-risk zones amplifies exposure to earthquakes. Relocating critical infrastructure like hospitals and schools away from fault lines, coupled with zoning laws to limit residential sprawl, would mitigate preventable losses. Public education is equally vital. Empowering communities with knowledge about earthquake preparedness—such as creating emergency kits, identifying safe zones, and practicing drop-cover-hold drills—can foster a culture of resilience. Suvedi (2021) argues that sustained awareness campaigns, particularly in remote regions, could bridge the gap between policy and practice, turning passive victims into active survivors (Suvedi, 2021). If Nepal commits to these measures with consistent funding and political will, it could transform its seismic vulnerability into a source of strength, setting a precedent for disaster-prone regions worldwide.

Looking ahead, Nepal's path to resilience hinges on advancing seismological research and embedding preparedness into its national fabric. Enhanced seismic networks, equipped with dense arrays of sensors, can improve the precision of hazard mapping, identifying micro-zones of risk that current models overlook. This data-driven approach would enable targeted interventions, from reinforcing specific villages to rerouting planned highways. Global collaboration amplifies this potential: partnerships with earthquake-prone nations like Chile or New Zealand could facilitate the exchange of cutting-edge technologies, such as AI-driven predictive models, and best practices in community-led recovery. The 2015 disaster already spurred some progress—international teams helped install additional seismometers—but sustained investment remains critical. Integrating disaster preparedness into Nepal's sustainable development goals (SDGs) offers a holistic framework for the future. Reconstruction efforts should prioritize green building techniques, such as solar-powered community centers that double as emergency hubs, aligning resilience with climate goals. Education systems could weave disaster risk reduction into curricula, ensuring that the next generation inherits both knowledge and agency. Lama and Anderson (2019) advocate for this synergy, noting that linking disaster management with development not only reduces vulnerability but also attracts long-term donor support by showcasing measurable outcomes (Lama & Anderson, 2019). For instance, reforestation projects in landslide-prone areas could stabilize soil while creating jobs, addressing ecological and economic needs simultaneously. Nepal's journey offers lessons for the world. Its recovery, though imperfect, showcases the power of collective action—communities rallying amidst chaos, governments pivoting under pressure, and nations uniting in solidarity. By marrying local ingenuity with global expertise, Nepal can evolve from a cautionary tale into a blueprint for resilience. Other tectonically active regions, from the Himalayas to the Pacific Ring of Fire, face similar threats; Nepal's successes and setbacks could guide their strategies, proving that preparedness is not just a reaction but a legacy. With bold reforms and unwavering commitment, Nepal can not only recover but thrive, turning the scars of 2015 into a foundation for a safer tomorrow.

Table 2: Summary of policy recommendations for improving disaster resilience in Nepal

Policy Recommendation	Description	Refrences
Strengthening Building Codes	Enforce seismic-resistant building standards, retrofit old structures, and ensure compliance through strict monitoring.	(ADB, 2020; UNDP, 2019)
Early Warning Systems	Improve earthquake monitoring and warning systems using advanced technology and better communication networks.	(USGS, 2021; GoN, 2022)
Community-Based Disaster	Conduct public awareness campaigns, earthquake	(IFRC, 2018; UNDRR,

Preparedness	drills, and training programs at local levels.	2020)
Infrastructure Resilience	Invest in disaster-resistant roads, bridges, hospitals, and emergency shelters.	(World Bank, 2021; NPC Nepal, 2019)
Institutional Coordination & Governance	Strengthen disaster management agencies and improve coordination between national and local governments.	(GoN, 2022; UNDP, 2019)
Emergency Response & Recovery Plans	Develop and update emergency response strategies, ensuring rapid relief and reconstruction efforts.	(IFRC, 2018; ADB, 2020)
Financial & Insurance Mechanisms	Promote disaster risk insurance and establish dedicated funds for disaster mitigation and recovery.	(World Bank, 2021; NPC Nepal, 2019)
Environmental & Land Use Planning	Implement zoning regulations to prevent settlements in high-risk areas and promote eco-friendly infrastructure.	(UNDRR, 2020; GoN, 2022)

6. Conclusion

The 2015 Gorkha earthquake exemplifies the intricate interplay between Nepal's geological fault lines and human vulnerability, revealing a seismic narrative where natural forces shape both the earth and the lives atop it. From ancient tremors to modern catastrophes, Nepal's history has shown that while the earth's movements are inevitable, human resilience and proactive measures can dramatically reduce their impact. The "Fault Lines of Destiny" metaphor encapsulates this dynamic, underscoring the need for continuous research, improved construction practices, early warning systems, and community empowerment to transform vulnerability into strength. Recognizing that the lessons from past earthquakes provide invaluable insights for future preparedness, it is imperative that global collaboration unites nations, scientists, and local communities in a concerted effort toward disaster risk reduction and sustainable development. Through such unified action, the narrative of Nepal's seismic challenges can evolve into one of hope, resilience, and a determined commitment to safeguarding lives and heritage.

References

[1]. ADB (Asian Development Bank). (2020). Disaster Resilience in South Asia: Policies and Practices. Manila, Philippines.

[2]. Ader, T.J., Avouac, J., Jing, L., Lyon-Caen, H., Bollinger, L., Galetzka, J., Genrich, J.F., Thomas, M.Y., Chanard, K., Sapkota, S.N., Rajaure, S., Shrestha, P., Ding, L., & Flouzat, M. (2011). Convergence rate across the Nepal Himalaya and interseismic coupling on the Main Himalayan Thrust: Implications for seismic hazard. Journal of Geophysical Research, 117. https://doi.org/10.1029/2011JB009071

[3]. Adhikari, P., Nepal, S., & Dawadi, S. (2024). Impacts of Gorkha Earthquakes: A Comprehensive Study. Spektra: Jurnal Fisika dan Aplikasinya. https://doi.org/10.21009/spektra.091.05

[4]. Avouac, J.-P., Meng, L., Wei, S., Wang, T., & Ampuero, J.-P. (2015). Lower edge of locked Main Himalayan Thrust unzipped by the 2015 Gorkha earthquake. Nature Geoscience, 8(9), 708-711. https://doi.org/10.1038/ngeo2518

[5]. Bhattarai, T.N., Nagao, T., & Lohani, T.N. (2020). State of Seismic Hazard Analysis: Reviewing the Needs after Mw 7.8 Gorkha, Nepal Earthquake.

[6]. Bilham, R. (2019). The seismic history of Nepal: A review of historic and modern earthquakes in the Himalayan region. Geological Society, London, Special Publications, 483(1), 423-482. https://doi.org/10.1144/SP483.16

[7]. Catlos, E.J., Friedrich, A.M., Lay, T., Elliott, Carena, S., Upreti, B.N., DeCelles, P.G., Tucker, B.E., & Bendick, B. (2016). Nepal at Risk: Interdisciplinary Lessons Learned from the April 2015 Nepal (Gorkha) Earthquake and Future Concerns,. Gsa Today, 26, 42-43. https://doi.org/10.1130/GSATG278GW.1

[8]. Chamlagain, D., Bhattarai, G. K., & Rajaure, S. (2011). Seismic hazard assessment of eastern Nepal using 1934 and 1988 earthquakes. Journal of Nepal Geological Society, 42, 85–93. https://doi.org/10.3126/jngs.v42i0.31453

[9]. Dhital, M. R. (2015). Geology of the Nepal Himalaya: Regional perspective of the classic collided orogen. Springer International Publishing. https://doi.org/10.1007/978-3-319-02496-7

[10]. Diao, F., Walter, T. R., Motagh, M., Prats-Iraola, P., Wang, R., & Samsonov, S. V. (2015). The 2015 Gorkha earthquake investigated from radar satellites: slip and stress modeling along the MHT. Frontiers in Earth Science, 3. doi:10.3389/feart.2015.00065

[11]. Fan, W., & Shearer, P.M. (2015). Detailed rupture imaging of the 25 April 2015 Nepal earthquake using teleseismic P waves. Geophysical Research Letters, 42, 5744 - 5752. https://doi.org/10.1002/2015GL064587

[12]. Gautam, D. (2017). Impacts and Insights of the Gorkha Earthquake.

[13]. Gautam, D., & Chaulagain, H. (2016). Structural performance and vulnerability of buildings during the 2015 Gorkha earthquake. Journal of Earthquake Engineering, 20(5), 779-796.
[14]. GoN (Government of Nepal). (2022). National Disaster Risk Reduction and Management Policy. Kathmandu, Nepal.
[15]. Hazarika, H., Bhandary, N.P., Kajita, Y., Kasama, K., Tsukahara, K., & Pokharel, R.K. (2016). The 2015 Nepal Gorkha Earthquake: An overview of the damage, lessons learned and challenges.
[16]. He, X., Ni, S., Ye, L., Lay, T., Liu, Q., & Koper, K.D. (2015). Rapid Seismological Quantification of Source Parameters of the 25 April 2015 Nepal Earthquake. Seismological Research Letters, 86, 1568-1577. https://doi.org/10.1785/0220150131
[17]. IFRC (International Federation of Red Cross and Red Crescent Societies). (2018). Community-Based Disaster Risk Reduction in Nepal.
[18]. J. Galetzka et al.Slip pulse and resonance of the Kathmandu basin during the 2015 Gorkha earthquake, Nepal.Science349,1091-1095(2015).DOI:10.1126/science.aac6383
[19]. Jing, L., Zhang, Z., Rollins, C., Gualandi, A., Avouac, J., Shi, H., Wang, P., Chen, W., Zhang, R.Y., Zhang, P., Wang, W., Li, Y., Wang, T., & Li, Z. (2020). Postseismic Deformation Following the 2015 Mw7.8 Gorkha (Nepal) Earthquake: New GPS Data, Kinematic and Dynamic Models, and the Roles of Afterslip and Viscoelastic Relaxation. Journal of Geophysical Research: Solid Earth, 125. https://doi.org/10.1029/2020JB019852
[20]. Joshi, V.M., & Kaushik, H.B. (2017). Historic Earthquake-Resilient Structures in Nepal and Other Himalayan Regions and Their Seismic Restoration. Earthquake Spectra, 33, 299 - 319. https://doi.org/10.1193/121616eqs240m
[21]. Kshetri, R. (2024). Major natural hazards in Nepal Himalaya. International Journal of Multidisciplinary Research and Growth Evaluation. https://doi.org/10.54660/.ijmrge.2024.5.2.675-681
[22]. Kuang, J., Ge, L., & Ng, A.H. (2019). Co-Seismic Deformation and Source Model of the 25 April 2015 MW 7.8 Nepal Earthquake and the 12 May 2015 MW 7.2 Aftershock. IGARSS 2019 - 2019 IEEE International Geoscience and Remote Sensing Symposium, 6768-6771. https://doi.org/10.1109/IGARSS.2019.8900573
[23]. Kumar, A., Singh, S., Mitra, S., Priestley, K., & Dayal, S. (2016). The 2015 April 25 Gorkha (Nepal) earthquake and its aftershocks: implications for lateral heterogeneity on the Main Himalayan Thrust. Geophysical Journal International, 208, 992-1008. https://doi.org/10.1093/GJI/GGW438
[24]. Lama, P., & Anderson, R. (2019). Integrating disaster risk reduction with sustainable development in Nepal. Disaster Prevention and Management, 28(3), 345-359.
[25]. Lavé, J., Yule, D., Sapkota, S.N., Basant, K.N., Madden, C., Attal, M., & Pandey, R. (2005). Evidence for a Great Medieval Earthquake (~1100 A.D.) in the Central Himalayas, Nepal. Science, 307, 1302 - 1305. https://doi.org/10.1126/SCIENCE.1104804
[26]. Nepal Seismological Center. Historical Earthquakes in Nepal. Department of Mines and Geology, Government of Nepal. Retrieved from http://seismonepal.gov.np/
[27]. NPC Nepal (National Planning Commission). (2019). Post-Disaster Recovery Framework.
[28]. Paudyal, H., Shanker, D., Singh, H.N., Panthi, A., Kumar, A.S., & Singh, V.P. (2010). Current understanding of the seismotectonics of Western Nepal Himalaya and vicinity. Acta Geodaetica et Geophysica Hungarica, 45, 195-209. https://doi.org/10.1556/AGEOD.45.2010.2.5
[29]. Poudel, N. (2019). Vulnerability and Disaster Resilience at Household Level. Molung Educational Frontier, 9, 109–120. https://doi.org/10.3126/mef.v9i0.33592
[30]. Shrestha, N., Shrestha, S.N., Parajuli, B., Dixit, A.M., Upadhyay, B.K., Khanal, O.K. and Sen Oli, K. (2019), "Enhancing earthquake resilience of communities: an action by women’s groups in Nepal", Disaster Prevention and Management, Vol. 28 No. 1, pp. 84-92. https://doi.org/10.1108/DPM-07-2018-0217
[31]. Shrestha, S., Bajracharya, R., & Kargel, J. S. (2018). Disaster response and recovery: Lessons from the 2015 Nepal earthquake. Natural Hazards Review, 19(4), 04018014.
[32]. Sitharam, T.G., & Vinod, J.S. (2015). Nepal Earthquake of April 25, 2015. International Journal of Geotechnical Earthquake Engineering, 6, 81-90. https://doi.org/10.4018/IJGEE.2015010105
[33]. Sreejith, K.M., Sunil, P.S., Agrawal, R., Saji, A.P., Ramesh, D.S., & Rajawat, A.S. (2016). Coseismic and early postseismic deformation due to the 25 April 2015, Mw 7.8 Gorkha, Nepal, earthquake from InSAR and GPS measurements. Geophysical Research Letters, 43, 3160 - 3168. https://doi.org/10.1002/2016GL067907
[34]. Suvedi, M. (2021). Earthquake Impact, Coping Mechanism, and the Community Discourses: Experiences from the Central Hills of Nepal. Journal of Disaster and Emergency Research, 4(1), 29-37. doi: 10.18502/jder.5811

[35]. UNDP (United Nations Development Programme). (2019). Building Resilience to Disasters in Nepal.
[36]. UNDRR (United Nations Office for Disaster Risk Reduction). (2020). Disaster Risk Reduction Strategies for Nepal.
[37]. USGS (United States Geological Survey). (2021). Advancing Earthquake Early Warning Systems.
[38]. USGS. (2015). M7.8 - 36km E of Khudi, Nepal. United States Geological Survey. Retrieved from https://earthquake.usgs.gov/earthquakes/eventpage/us20002926/executive
[39]. Wang, K., & Fialko, Y. (2015). Slip model of the 2015 Mw 7.8 Gorkha (Nepal) earthquake from inversions of ALOS-2 and GPS data. Geophysical Research Letters, 42, 7452 - 7458. https://doi.org/10.1002/2015GL065201
[40]. Whelpton, J. (2021). Earthquakes in Nepali History. Epicentre to Aftermath. https://doi.org/10.1017/9781108991636.002
[41]. World Bank. (2021). Financing Resilient Infrastructure in Nepal.