Journal of Advanced College of Engineering and Management, Vol. 10, 2025, Advanced College of Engineering and Management

REVIEW OF STATUS OF POST-EARTHQUAKE RECONSTRUCTION IN NEPAL (2015-2024): CHALLENGES, PROGRESS, AND FUTURE DIRECTIONS

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ABSTRACT

In 2015, a powerful earthquake struck Nepal's Gorkha District, causing extensive loss of life and property, and deeply affecting the nation's infrastructure, housing, and cultural heritage. This disaster severely damaged Nepal's rich cultural sites, with numerous temples and monuments either fully or partially destroyed. The loss of these heritage landmarks represented not only cultural devastation but also a profound impact on national identity and historical continuity. This article employs a qualitative approach, including critical literature review, field visits, interviews, document analysis, and case studies, to thoroughly examine the status of post-earthquake reconstruction efforts. The study focuses on key areas of reconstruction, such as housing, public infrastructure, and heritage restoration, offering an in-depth look at both progress and ongoing challenges. Although considerable advances have been made in rebuilding efforts, the earthquake highlighted Nepal's need to strengthen building practices and disaster preparedness to better withstand future seismic events. Major obstacles in the reconstruction process include funding limitations, bureaucratic inefficiencies, corruption, logistical difficulties, governance issues, lack of coordination, limited accessibility, shortages of skilled labor, knowledge gaps, and the socio-cultural factors impacting rebuilding. This earthquake has underscored the urgency of revising building codes and adopting improved structural reinforcement methods to reduce future risks. Effective governance, inter-agency collaboration, and strategic incorporation of social and cultural dimensions are essential for continuing and sustaining the current reconstruction efforts in Nepal. Finally, the paper offers recommendations for strengthening Nepal's post-earthquake recovery and resilience, focusing on institutional capacity building, coordination, and community based rebuilding strategies.

Keywords: Reconstruction, Rebuilding, Recovery, Gorkha Earthquake 2015

1. Introduction

On April 25, 2015, a devastating earthquake with a moment magnitude of 7.8 struck the Gorkha District of Nepal, causing widespread destruction and loss of life. This earthquake, known as the Gorkha earthquake, was the most catastrophic seismic event in Nepal since the 1934 Bihar-Nepal earthquake. The earthquake and its aftershocks resulted in over 8,790 deaths and 22,300 injuries, and it severely impacted the country's infrastructure, heritage, and housing (Gautam & Chaulagain, 2016; Acharya, Sharma, Pokharel, & Adhikari, 2022; Sharma, Kc, Subedi, & Pokharel, 2018). The earthquake caused extensive damage to Nepal's infrastructure, including roads, hydropower plants, irrigation canals, schools, and hospitals. Approximately half a million buildings were completely destroyed, and another 256,697 were partially damaged (Acharya, Sharma, Pokharel, & Adhikari, 2022). The destruction of critical infrastructure, such as roads and bridges, hindered rescue and relief operations, exacerbating the humanitarian crisis (Lizundia, Davidson, Hashash, & Olshansky, 2017)

Nepal's rich cultural heritage suffered immensely due to the earthquake. Historic monuments and cultural heritage buildings, particularly in the Kathmandu Valley, were either damaged or destroyed, where both masonry-timber and masonry structures experienced significant damage, with many collapsing entirely (Pan, Wang, Guo, & Yuan, 2018; Bhagat et al., 2018; Davis et al., 2019). The loss of these cultural heritage sites was not only a cultural catastrophe but also a blow to the nation's identity and history. The

earthquake had a profound impact on housing, with nearly a million private houses affected. The National Reconstruction Authority (NRA) was established to oversee the reconstruction efforts. By 2020, significant progress had been made, with 67% of private houses, 74% of educational institutions, and 58% of health facilities reconstructed (Acharya, Sharma, Pokharel, & Adhikari, 2022). However, challenges such as bureaucratic hurdles, lack of coordination, and political instability slowed the reconstruction process. (Sharma, Kc, Subedi, & Pokharel, 2018)

The recovery process has been slow but steady. The earthquake highlighted the urgent need for revising building codes and developing proper strengthening techniques for structures to withstand future seismic events. (Gautam & Chaulagain, 2016; Sharma, Deng, & Noguez, 2016). The lessons learned from the Gorkha earthquake emphasize the importance of adequate structural design and the incorporation of traditional seismic adaptations in modern reconstruction efforts (Khanal, 2023; Goda et al., 2015). The 2015 Gorkha earthquake had a devastating impact on Nepal's infrastructure, cultural heritage, and housing. While significant progress has been made in reconstruction, the event underscored the need for improved building practices and disaster preparedness to mitigate the effects of future earthquakes.

2. Research Questions

The main objective of this research is to review the status of post-earthquake reconstruction efforts in Nepal from 2015 to 2024 regarding housing, public infrastructure, and heritage sites. This research intends to examine the extent of progress in housing and public infrastructure reconstruction; to explore the challenges faced in maintaining architectural heritage during reconstruction and to identify gaps in the reconstruction process and suggest policy recommendations for future resilience building. Hence, the following research questions are formulated for the commencement of this research.

(i) What is the overall status of post-earthquake reconstruction efforts in Nepal from 2015 to 2024?

(ii) What are the primary challenges faced during the reconstruction process after earthquake in Nepal?

(iii) What are the actual progress of reconstruction after 2015 Earthquake on housing, public infrastructure and cultural heritage?

3. Literature Review

The 2015 Gorkha earthquake in Nepal caused extensive damage, affecting millions of people and destroying significant infrastructure. The Gorkha earthquake in Nepal in 2015 resulted in 67% private house reconstruction, 74% educational institution reconstruction, and 58% health facility reconstruction in five years. (Acharya, Sharma, Pokharel, & Adhikari, 2022). Restoration and preservation efforts in Nepal are based on notions of "authenticity" and "originality," with the government focusing on using traditional construction materials and norms for heritage buildings. (Bajracharya & Michaels, 2017). However, Nepali government institutions' post-earthquake reconstruction framework has not fully implemented pre-earthquake plans, and local stakeholders' involvement in reconstruction is often weakening due to under-resourced governance structures (Daly, Ninglekhu, Hollenbach, Barenstein, & Nguyen, 2017).

The reconstruction efforts have faced numerous challenges, which have been extensively discussed in the literature. Challenges in reconstruction after the 2015 Nepal earthquake include funding, corruption, logistical issues, institutional gaps, lack of coordination, bureaucratic hurdles, weak governance, accessibility, manpower shortage, knowledge gap, and socio-cultural aspects (Sharma, Kc, Subedi, & Pokharel, 2018). Accessibility and transportation were identified as the greatest challenge in school reconstruction after the 2015 Nepal earthquake (Westoby, Wilkinson, & Dunn, 2021). Public heritage sites, buildings, educational and health institutions, and government structures lag behind in reconstruction efforts after the 2015 Nepal earthquake (Kadel & Kadel, 2023). Delays in heritage reconstruction in Nepal were primarily due to lack of a well-defined policy, conflict on construction materials, procurement modality, limited governance capacity, and lack of workforce for traditional artwork (Sharma, Kc, & Pokharel, 2022). The delay in reconstruction after the 2015 Nepal earthquake was caused by the inability of the government and international community to encourage local participation and strengthen the capability of local communities (Regmi, 2016). Lack of funding, construction materials, labors, and experienced human resources hinder the smooth progress of reconstruction after the 2015 Nepal earthquake. (Dhungana, Dahal, Shrestha, Thapa, & Neupane, 2020)

The reconstruction efforts in Nepal after the 2015 earthquake have faced significant challenges, including financial constraints, governance issues, logistical difficulties, manpower shortages, and the need for cultural preservation. Addressing these challenges requires improved governance, better coordination among stakeholders, and active involvement of local communities to ensure sustainable and effective reconstruction. Some of the major challenges highlighted in the literature includes

(i) Funding and Financial Constraints

Despite significant international financial pledges, the reconstruction efforts have been hampered by insufficient funding and increased national debt, which has not effectively reached the affected communities. (Regmi, 2016; Dhungana, Dahal, Shrestha, Thapa, & Neupane, 2020).

(ii) Corruption and Governance Issues

Weak governance, bureaucratic hurdles, and political instability have significantly delayed reconstruction efforts. The absence of local government and poor coordination among stakeholders have exacerbated these issues (Sharma, Kc, Subedi, & Pokharel, 2018; Uprety, 2018; Sharma, Kc, Subedi, & Pokharel, 2018).

(iii) Logistical Challenges

Difficult geographical terrain and inaccessibility of affected areas have posed major logistical challenges. Transportation of materials and accessibility to remote areas have been particularly problematic, especially during the monsoon season (Westoby, Wilkinson, & Dunn, 2021; Uprety, 2018; Sharma, Kc, Subedi, & Pokharel, 2018)

(iv) Manpower and Resource Shortages

There has been a significant shortage of skilled labor and construction materials, which has slowed down the reconstruction process. The lack of experienced human resources and traditional artisans has also been a critical issue (Sharma, Kc, Subedi, & Pokharel, 2018; Sharma, Kc, & Pokharel, 2022; Dhungana, Dahal, Shrestha, Thapa, & Neupane, 2020)

(v) Cultural Preservation

The reconstruction of heritage structures has faced delays due to conflicts over the use of traditional versus modern materials and techniques. There is a lack of a well-defined policy for heritage reconstruction, and the focus on authenticity has sometimes led to further delays (Sharma, Kc, & Pokharel, 2022; Bajracharya & Michaels, 2017)

(vi) Community Involvement and Local Participation

The top-down approach adopted by the government and international donors has often ignored local participation, which is crucial for sustainable reconstruction. Effective reconstruction requires the involvement of local communities in the planning and implementation phases (Regmi, 2016; Dhungana, Dahal, Shrestha, Thapa, & Neupane, 2020)

4. Research design and Methodology

In order to understand the challenges, progress, and future directions in the aftermath of this disaster, a comprehensive qualitative research methodology is employed. Hence the research design will include a critical review of literature, interviews and field visits to gather in-depth data and insights from various sources and stakeholders involved in the recovery process. By employing a qualitative research methodology that combines document analysis, case studies, interviews, and field observations, this research aims to provide a comprehensive assessment of the challenges, progress, and future directions in the recovery process following the 2015 earthquake in Nepal. The detailed methodology used in this research will include the following steps

(i) Data Collection

Document Analysis: Existing research and reports on post-disaster damage assessments and recovery efforts in these areas will be reviewed. This will include reviewing documents such as reports from government and non-government agencies, such as UN and NGO reports. Other documents shall include reports from National Reconstruction Authority (NRA) and other reconstruction policies to understand the official stance and progress.

Review of Case Studies: Select case studies of successful and delayed reconstruction projects, focusing on housing, schools, heritage sites, and public infrastructure.

Semi-Structured Interviews: Conduct semi-structured interviews with a diverse group of stakeholders, including resettled households, community leaders, local government officials, and representatives from humanitarian organizations

Key Informant Interviews: Engage with key informants such as disaster response coordinators, health professionals, and mental health experts to understand the broader impact of the earthquake on health systems and psychosocial well-being

Field Observations: Conduct field visits to affected areas to observe the current state of infrastructure, housing, and community facilities. This will help validate the information gathered through interviews and case studies

(ii) Data Analysis

Thematic Analysis: The research will use thematic analysis to identify and analyze patterns and themes across the collected data. This will involve coding the interview transcripts, field notes, and case study documents to extract key insights related to challenges, progress, and future directions in the recovery process.

(iii) Expected Outcomes

Identification of Key Challenges: The research will identify the primary challenges faced by affected communities, such as inadequate housing, limited access to healthcare, and psychosocial issues

Assessment of Progress: Evaluate the progress made in recovery efforts, including the effectiveness of government and NGO interventions, and the resilience of local communities

Recommendations for Future Directions: Provide actionable recommendations for improving disaster response and recovery strategies, with a focus on enhancing community resilience, ensuring equitable aid distribution, and addressing the specific needs of marginalized groups

5. Results and Discussion

Progress in Housing Reconstruction

The reconstruction efforts following the 2015 Nepal earthquake have shown significant progress, although the pace and extent of recovery vary between urban and rural areas. In one of the hardest-hit mountain villages, more than 90% of households had reconstructed earthquake-resistant houses by March 2020, with substantial financial and technical support from the government (Sapkota, Kurita, & Neupane, 2021). The Gorkha earthquake in Nepal in 2015 resulted in 67% private house reconstruction, 74% educational institution reconstruction, and 58% health facility reconstruction in five years. (Acharya, Sharma, Pokharel, & Adhikari, 2022). The majority of newly constructed mud masonry houses in Nepal are better than old ones, but regional variation in reconstruction rates and overall delay in retrofitting pose risks, highlighting the need for improved housing design and seismic consideration. (Khadka, 2020). However, in some rural areas, more than 80% of newly constructed mud masonry houses were better than the old ones, but around 30% of houses remained unreconstructed even after five years (Khadka, 2020).

The recovery process has been notably different between urban and rural areas. In the Kathmandu Valley, the National Reconstruction Authority (NRA) achieved only 43% progress in housing reconstruction by April 2020, compared to 75% in rural municipalities (Shrestha, Parajuli, & Malani, 2021). This disparity is attributed to several constraints in urban areas, including land issues and access to finance, which are less problematic in rural settings (Shrestha, Parajuli, & Malani, 2021) In rural areas, the recovery has been more robust, with significant improvements in housing quality and infrastructure. For instance, rural communities have seen better housing, increased income, improved disaster risk awareness, and enhanced infrastructure facilities such as roads, clean water supply, and functioning school buildings and hospitals (Sapkota, Kurita, & Neupane, 2021). Additionally, 90% of people in rural areas were back in their homes within four years, and the quality of housing and earthquake safety had improved. (Platt, Gautam, & Rupakhety, 2020)

In contrast, urban areas like Kathmandu Valley have faced slower progress due to structural and non-structural issues. Post-earthquake reconstruction in Kathmandu Valley has primarily focused on private housing, with public infrastructure and heritage sites lagging behind, highlighting the need for

accelerated efforts (Kadel & Kadel, 2023). The reconstruction of public heritage sites, educational and health institutions, and government structures has lagged behind, although private housing has seen satisfactory progress. (Kadel & Kadel, 2023) The preference for traditional building materials and techniques, such as Stone Mud Mortar (SMM) and Brick Mud Mortar (BMM), persists in some urban regions, which has also affected the pace of reconstruction (Kadel & Kadel, 2023). Overall, while significant progress has been made in housing reconstruction after the 2015 Nepal earthquake, the recovery has been faster and more comprehensive in rural areas compared to urban areas. The differences in recovery rates highlight the need for targeted policies and support mechanisms to address the unique challenges faced by urban and rural communities in post-disaster scenarios.

Overall, the 2015 Nepal earthquake led to improved community resilience and sustainable development, with most households recovering well and gaining better housing, income, and disaster risk awareness (Sapkota, Kurita, & Neupane, 2021). However, the government of Nepal needs to integrate reconstruction activities with a long-term urban renewal strategy to overcome land and finance constraints in urban housing reconstruction.

Progress in Public Infrastructure Reconstruction

The 2015 earthquake severely impacted educational infrastructure, with approximately 9,000 schools damaged or destroyed (Paudyal & Bhandary, 2022). Initial assessments revealed that improper construction materials, lack of supervision, and non-compliance with building codes were significant factors contributing to the damage. Reconstruction efforts have faced numerous challenges, including accessibility and transportation issues, which were reported as the greatest obstacles (Westoby, Wilkinson, & Dunn, 2021). Despite these challenges, there have been notable improvements. By 2020, many schools had been reconstructed with better materials and techniques, although the progress varied significantly across different regions (Acharya, Sharma, Pokharel, & Adhikari, 2022; Westoby, Wilkinson, & Dunn, 2021). Good practices such as providing training and transporting materials outside the monsoon season have been identified as effective strategies to expedite reconstruction (Westoby, Wilkinson, & Dunn, 2021)

Hospitals and health facilities were also heavily damaged, particularly in high-intensity areas due to improper design and adverse site configurations (Chen et al., 2018). The reconstruction of health facilities has been slower compared to other sectors, with only 58% of health facilities rebuilt within the first five years (Acharya, Sharma, Pokharel, & Adhikari, 2022). The need for enhanced aseismic capacity of structural and non-structural components has been emphasized to improve the resilience of health infrastructure (Chen et al., 2018) By 2020, there were improvements in the quality and functionality of hospitals, with better disaster preparedness and increased coverage of health services in some areas. (Sapkota, Kurita, & Neupane, 2021)

Government offices, essential for coordinating emergency response and reconstruction activities, were initially functional within 40 days after the earthquake (Chen et al., 2018). However, the overall progress in rebuilding government structures has lagged behind other sectors (Kadel & Kadel, 2023). Factors such as weak governance, bureaucratic hurdles, and political instability have significantly hindered the reconstruction process (Sharma, K., Kc, Subedi, & Pokharel, 2018; Sharma, K., Kc, Subedi, & Pokharel, 2018). Despite these challenges, there have been efforts to improve governance and streamline

reconstruction processes, although the impact of these measures has been limited (Sharma, K., Kc, Subedi, & Pokharel, 2018; Sharma, K., Kc, Subedi, & Pokharel, 2018)

Overall, the reconstruction of public infrastructure in Nepal following the 2015 earthquake has seen mixed progress. While there have been significant advancements in rebuilding schools and hospitals, the reconstruction of government offices has been slower. Challenges such as accessibility, weak governance, and political instability have impeded the reconstruction efforts. However, the adoption of better construction practices and strategic planning has the potential to expedite the rebuilding process and enhance the resilience of public infrastructure in Nepal.

Progress in Heritage Site Restoration

The 2015 Gorkha earthquake in Nepal caused extensive damage to numerous UNESCO-listed heritage sites, including those in Kathmandu, Patan, Bhaktapur, and Swayambhu. The restoration of these sites has been a complex and multifaceted process, involving various stakeholders and facing numerous challenges. Significant progress has been made in the conservation and reconstruction of damaged heritage structures in Kathmandu Valley, particularly in Patan Durbar Square and the Royal Palace. Collaborative efforts between local craftsmen and international organizations, such as the Institute of Conservation and the Kathmandu Valley Preservation Trust, have been instrumental in achieving these results (Haselberger & Krist, 2020)

The restoration of Gaddi Baithak, a neoclassical palace in Kathmandu, has been a notable success. This project, funded by the U.S. Ambassadors Fund for Cultural Preservation, employed performance-based engineering to seismically strengthen the structure while preserving its historical integrity (Davis et al., 2019). In Patan, the reconstruction efforts have not only focused on prominent heritage sites but also on smaller, community-centric structures such as arcaded platforms, small monasteries, and shrines. This inclusive approach has helped in preserving the intangible heritage and cultural practices of the local communities (Brosius & Michaels, 2020). The Char Narayan Temple in Patan Darbar Square has been a focal point of restoration efforts, with debates on using traditional materials versus modern reinforcements to ensure seismic resilience (Bajracharya & Michaels, 2017). Bhaktapur has seen a mix of reconstruction methodologies, with a preference for traditional Stone Mud Mortar (SMM) and Brick Mud Mortar (BMM) structures. Retrofitting techniques have been employed to enhance the seismic resilience of these structures, proving to be more cost-effective than complete rebuilding (Kadel & Kadel, 2023)

The restoration of UNESCO-listed heritage sites in Nepal post-2015 earthquake has seen commendable progress, particularly in areas like Patan and Kathmandu. However, the process has been fraught with challenges, including policy gaps, governance issues, and technical difficulties. Moving forward, a balanced approach that integrates traditional methods with modern seismic reinforcements, supported by robust community participation and clear policies, will be essential for the sustainable restoration of these invaluable heritage sites. The slow reconstruction of heritage structures in Nepal after the 2015 Gorkha earthquake is primarily due to a lack of well-defined policies, conflicting construction materials, limited governance capacity, and lack of workforce for traditional artwork. (Sharma, K., Kc, & Pokharel, 2022). Post-earthquake conservation in Patan, Nepal, has achieved remarkable results through a balance of traditional and modern materials and methods, with Austrian experts playing a key role. (Haselberger & Krist, 2020)

Post-earthquake reconstruction in Kathmandu Valley has primarily focused on private housing, with public infrastructure and heritage sites lagging behind, highlighting the need for accelerated efforts. (Kadel & Kadel, 2023). Post-earthquake heritage restoration can be improved by re-interpreting traditional practices and incorporating community participation for inclusive and sustainable conservation. (Lekakis, Shakya, & Kostakis, 2018). Post-disaster investigations reveal potential weaknesses in historic structures, aiding in reconstruction and heritage protection in the face of future earthquakes. (Davis et al., 2019).

The lack of a well-defined policy for heritage reconstruction has been a significant barrier. Conflicts over the materials and methods to be used, coupled with limited governance capacity, have slowed down the reconstruction process (Sharma, K., Kc, & Pokharel, 2022). The decision by the Government of Nepal to mandate the use of traditional construction materials and techniques has led to delays and controversies, particularly when modern reinforcements are proposed for better seismic resilience (Bajracharya & Michaels, 2017). While community-driven initiatives have been crucial in some areas, the lack of a structured framework to support these efforts has hindered broader participation. In some cases, local communities have taken the lead in restoring smaller, less monumental structures without official support, highlighting the need for more inclusive and sustainable heritage management practices (Lekakis, Shakya, & Kostakis, 2018; Brosius & Michaels, 2020). The shortage of skilled workforce for traditional artwork and construction has been a persistent challenge. Additionally, the procurement modalities for reconstruction materials have often been inefficient, further delaying the restoration efforts (Sharma, K., Kc, & Pokharel, 2022).

6. Conclusion

The reconstruction progress in Nepal following the 2015 earthquake has been marked by a mix of achievements and ongoing challenges. The devastating earthquake, which registered a magnitude of 7.8, resulted in significant loss of life and widespread destruction of infrastructure, homes, and cultural heritage sites. In the immediate aftermath, the Nepalese government, supported by international aid and organizations, launched a comprehensive reconstruction plan aimed at rebuilding affected areas. Initial efforts focused on emergency relief and temporary housing, with a strong emphasis on community engagement and participation in the rebuilding process. However, progress has been hampered by various factors, including bureaucratic delays, inefficiencies in fund disbursement, and corruption concerns. While some urban areas have seen faster reconstruction due to better access to resources, rural communities have faced significant hurdles in rebuilding efforts, often lacking essential services and infrastructure. As of 2023, many affected regions are still grappling with unfinished reconstruction projects, inadequate housing, and persistent gaps in disaster preparedness and resilience.

One of the most significant challenges in the reconstruction process after the 2015 earthquake in Nepal has been the lack of effective government coordination and clear policy implementation. Bureaucratic delays have plagued the recovery efforts, often resulting in slow responses to immediate needs. Various government agencies, each with their own mandates and objectives, have struggled to work cohesively, leading to fragmented efforts and overlapping responsibilities. This lack of coordination has often resulted in confusion and inefficiencies, where communities find themselves navigating a complex web of regulations and approvals to initiate reconstruction. Additionally, the policies set forth for rebuilding have sometimes been inconsistent or inadequately communicated, hindering the effective application of reconstruction strategies. The complexity of navigating bureaucratic processes has discouraged local

participation and slowed down the overall recovery timeline. To address these challenges, it is essential to streamline processes, enhance inter-agency communication, and establish clear guidelines that empower local authorities and communities to take an active role in the reconstruction process.

The reconstruction efforts following the 2015 Nepal earthquake have faced significant challenges related to the availability of funds, donor fatigue, and the efficient use of allocated resources. Initially, the international community responded generously, pledging substantial financial assistance to aid Nepal's recovery. However, as time progressed, many donors shifted their focus away from Nepal, leading to a phenomenon known as donor fatigue. This reduction in funding sources created a gap in financial resources necessary for long-term reconstruction, making it difficult for the government and NGOs to sustain ongoing recovery efforts. Moreover, the efficient use of allocated resources has been another critical challenge. Reports of mismanagement, corruption, and lack of transparency in how funds were utilized have raised concerns among stakeholders and the affected communities. Many reconstruction projects were hampered by bureaucratic hurdles and ineffective distribution of resources, which slowed progress and diminished the overall impact of the assistance provided. This inefficiency has been further exacerbated by a lack of capacity at the local government level to manage large-scale reconstruction projects, leading to a situation where funds were either underutilized or misappropriated. Additionally, the disparity between the promised financial support and the actual disbursement of funds has created uncertainty in planning and executing reconstruction projects. The delay in funding releases can stall crucial initiatives, causing additional suffering for communities still grappling with the aftermath of the disaster. To address these funding challenges, there is a pressing need for improved financial management, greater accountability, and a renewed commitment from the international community to support Nepal's recovery efforts over the long term. This would ensure that the resources available are effectively utilized to meet the needs of the affected population and contribute to a more resilient recovery process.

The reconstruction of heritage sites in Nepal after the 2015 earthquake has been marked by a significant tension between the desire to preserve cultural identity through traditional methods and the practicalities of employing modern construction techniques. This dichotomy reflects broader debates within heritage conservation and disaster recovery. Following the earthquake, which devastated numerous historic structures, including UNESCO World Heritage Sites in the Kathmandu Valley, there was a widespread acknowledgment of the need to restore these cultural landmarks. Many of these sites, constructed using traditional materials and techniques, held immense historical, cultural, and religious significance for local communities. Rebuilding them using traditional methods was seen as essential to maintaining their authenticity and cultural value. Traditional construction techniques, such as the use of mud, stone, and timber, have been passed down through generations and are intimately linked to the identity of the communities they represent.

However, the challenges presented by the earthquake prompted some stakeholders to advocate for modern construction techniques. Proponents of this approach argued that modern materials, such as reinforced concrete, could provide enhanced structural integrity and resilience against future seismic events. Given that many heritage structures had been severely damaged, the use of modern techniques was seen as a way to ensure that these buildings could withstand potential future disasters. This perspective was often rooted in a desire to prioritize safety and longevity over preserving the traditional aesthetic. The tension between these two approaches has led to conflicts among various stakeholders, including government agencies, architects, conservationists, and local communities. Some conservationists argue that the use of

modern materials could fundamentally alter the character of historic sites, undermining their cultural significance and authenticity. Conversely, advocates for modern techniques often emphasize the need for practicality and disaster resilience, suggesting that strict adherence to traditional methods could result in more vulnerable structures.

In practice, this tension has resulted in mixed outcomes. Some reconstruction projects have successfully integrated traditional techniques with modern engineering practices to create hybrid solutions that respect the original design while enhancing structural safety. For instance, the incorporation of seismic retrofitting techniques alongside traditional construction has emerged as a viable compromise, allowing for the preservation of heritage values while addressing safety concerns. Additionally, community engagement has played a crucial role in navigating this tension. Local stakeholders have often voiced their preferences for how their heritage is restored, emphasizing the importance of cultural identity and traditional craftsmanship. In some cases, successful collaborations between local artisans and modern architects have yielded solutions that honor both heritage and resilience. Overall, the ongoing reconstruction efforts in Nepal highlight the complexity of balancing cultural preservation with the need for safety and resilience. The dialogue between traditional methods and modern techniques will continue to shape the future of heritage restoration in Nepal, requiring careful consideration of the values, needs, and aspirations of the communities involved.

The 2015 earthquake in Nepal created significant logistical and geographic challenges as well, particularly in remote and rural areas where access to resources and skilled labor was severely restricted. The earthquake caused extensive damage to infrastructure, including roads, bridges, and transportation networks, complicating efforts to transport construction materials to affected regions. Many rural communities were isolated due to landslides, damaged pathways, and the overall destruction of access routes, which hindered the timely delivery of essential supplies for reconstruction. In addition to transportation challenges, there was a scarcity of skilled labor in these remote areas. The earthquake displaced many residents, resulting in a loss of workforce and expertise needed for reconstruction. Skilled workers often migrated to urban centers in search of better opportunities, leaving behind a gap in local labor resources. This migration was further exacerbated by the trauma and loss experienced during the earthquake, as many individuals were reluctant to return to their previous occupations in damaged environments. Consequently, local reconstruction efforts faced difficulties in finding qualified personnel to carry out the necessary repairs and rebuilding. Moreover, the reliance on traditional building methods in rural areas presented additional hurdles. While these techniques are well-suited to the local context, they require skilled artisans who were often unavailable due to the aforementioned reasons. As a result, many reconstruction projects were delayed or not executed to the required standards, leading to concerns about the durability and safety of rebuilt structures. Efforts to address these challenges necessitated innovative solutions, such as training programs to build local capacity and the establishment of partnerships with organizations that could mobilize skilled labor from other regions. However, overcoming the logistical and labor-related difficulties in remote areas remains a critical factor in ensuring effective and sustainable reconstruction following the 2015 earthquake. The long-term recovery of these communities depends on addressing these challenges and facilitating access to both materials and skilled labor.

7. Recommendations for Future Direction

Despite these challenges, the emphasis on restoring housing, infrastructures and cultural heritage has helped foster community-driven approaches and local engagement, which is vital for long-term recovery. Overall, while strides have been made in certain areas, the reconstruction process in Nepal requires to address lingering issues and ensure sustainable development in the aftermath of the earthquake. Good governance and strategic incorporation of social and cultural aspects can help accelerate reconstruction after the 2015 Gorkha earthquake in Nepal. Post-earthquake housing reconstruction in Nepal has helped landless households gain homestead land, but inclusive policies and socio-technical facilitation are needed to achieve better outcomes for vulnerable households. (Rawal, Bothara, Pradhan, Narasimhan, & Singh, 2021). Hence, a successful post-disaster housing reconstruction in Nepal's earthquake-affected communities should rely on a multi-dimensional holistic approach, addressing social, economic, and political dimensions.

Strategies for capacity building of Local Governments and Communities in Earthquake Disaster Management in Nepal

The 2015 earthquake in Nepal highlighted the critical need for enhanced local capacity in disaster management. A cornerstone of effective disaster management is the capacity of local governments to plan, coordinate, and implement appropriate measures. This requires a comprehensive disaster management plan that outlines roles, responsibilities, and emergency procedures, as well as regular training and capacity building for local government officials and community members. Additionally, fostering effective coordination among different departments and agencies at the local level is essential for a unified response. Community-Based Disaster Risk Reduction (CBDRR) Community-based disaster risk reduction (CBDRR) is also a critical approach to enhancing local resilience. By involving communities in identifying and assessing local risks, developing mitigation measures, and participating in emergency response, CBDRR can empower individuals and strengthen social cohesion. Early warning systems, community-based search and rescue teams, and disaster preparedness kits are essential components of CBDRR.

Building codes and standards that ensure new construction is earthquake-resistant, as well as programs to retrofit existing structures, are crucial for improving infrastructure resilience. Additionally, urban planning practices that consider disaster risk, such as avoiding construction in high-risk areas and ensuring adequate open spaces for evacuation, are essential. A well-prepared emergency response is also essential for minimizing the impacts of disasters. This requires the establishment of well-trained and equipped emergency response teams at the local level, as well as comprehensive disaster recovery plans that address housing, infrastructure, and livelihood restoration. Effective disaster management requires a culture of knowledge sharing and collaboration. This includes disseminating information about earthquake safety and preparedness through various channels, collaborating with neighboring countries and international organizations, and seeking assistance from donor agencies. Sustainable development is essential for building resilience to disasters. Addressing poverty and inequality, promoting environmental conservation, and incorporating climate change adaptation measures into disaster management planning are key strategies for achieving this goal.

Strategies to enhance coordination between government agencies, international donors, and local stakeholders

The 2015 earthquake in Nepal highlighted the critical importance of effective coordination among government agencies, international donors, and local stakeholders in disaster response and recovery. A strong and centralized coordination mechanism is essential for effective disaster management. The National Disaster Management Authority (NDMA) should be empowered to serve as the central coordinating body, ensuring clear lines of communication and accountability. Inter-agency coordination committees at national, provincial, and local levels should also be established to facilitate information sharing, decision-making, and resource allocation.

Effective communication and information sharing are crucial for a coordinated response. Common Operating Procedures (COPs) should be developed and implemented to guide the actions of all stakeholders during emergencies. Robust information management systems should be invested in to ensure timely and accurate data collection, analysis, and dissemination. Joint Information Centers (JICs) should also be established to provide a central platform for coordinating information dissemination and public communication. Transparency and accountability are essential for building trust and confidence among stakeholders. Open data policies should be adopted to make relevant information accessible to all stakeholders. Independent oversight mechanisms should be established to monitor the use of resources and ensure accountability. Public engagement should also be fostered through transparent and inclusive mechanisms to ensure that the voices of all stakeholders are heard.

Building trust and collaboration among government agencies, international donors, and local stakeholders is essential for a coordinated response. Regular dialogue and collaboration should be promoted to foster mutual understanding and respect. Capacity building opportunities should also be provided to enhance the understanding of disaster management principles and practices among all stakeholders. A shared vision for disaster management that reflects the needs and priorities of all stakeholders should be developed. Technology can play a significant role in enhancing coordination and efficiency in disaster response. Geographic Information Systems (GIS) can be used to visualize data, identify vulnerable areas, and support decision-making. Remote sensing technologies can be employed to monitor the impact of disasters and assess damage. Modern communication technologies, such as social media and mobile applications, can also be leveraged to facilitate information sharing and coordination. Learning from past experiences is essential for improving future responses. Comprehensive post-disaster reviews should be conducted to identify lessons learned and inform future planning. Best practices and lessons learned should also be shared with other countries facing similar challenges.

Strategies for Resilience Building and Sustainable Reconstruction in Nepal

The 2015 earthquake in Nepal presented a unique opportunity for the country to rebuild in a way that is more resilient, sustainable, and equitable. Resilient Urban Planning requires detailed seismic zoning maps to guide land use planning and building regulations. Strict building codes and standards that incorporate seismic design principles and energy efficiency requirements should be enforced. Urban renewal initiatives that prioritize the reconstruction of damaged infrastructure in a sustainable and resilient manner should be promoted. Sustainable reconstruction should prioritize green building practices, renewable energy, and sustainable infrastructure. Green building materials and technologies should be encouraged to reduce environmental impact and improve energy efficiency. Investment in renewable energy sources can reduce dependence on fossil fuels and enhance energy security. Sustainable infrastructure, such as transportation systems and water supply networks, that are resilient to future disasters should be prioritized.

Community-Based Disaster Risk Reduction (CBDRR) is also essential for building resilience. Communities should be involved in disaster risk assessment, planning, and implementation of mitigation measures. Early warning systems should be developed and implemented to provide timely alerts and facilitate evacuation. Disaster preparedness training and education for communities, including first aid, search and rescue, and evacuation procedures, should be promoted. Environmental Protection is crucial for sustainable reconstruction. Damaged ecosystems, such as forests and wetlands, should be restored to reduce vulnerability to natural hazards. Biodiversity conservation and sustainable land use practices, including reforestation, afforestation, and soil conservation, should be implemented.

Social Equity and Inclusion should be considered in reconstruction efforts. The needs of vulnerable groups, such as women, children, the elderly, and people with disabilities, should be prioritized. Affordable housing options for all affected communities should be ensured. Job creation and livelihood opportunities should be supported to promote economic recovery. Governance and Accountability are essential for effective reconstruction. Transparent and participatory decision-making processes should be implemented to ensure accountability and public trust. Anti-corruption measures should be strengthened to prevent misuse of resources and ensure fair distribution of aid. Institutional capacity building should be invested in to enable government agencies and local organizations to effectively implement reconstruction and resilience-building programs.

References

1. Khanal, P. (2023). Impact of 2015 Earthquake on the Shifts in Internal and International Relations of Nepal. Kalika Journal of Multidisciplinary Studies. https://doi.org/10.3126/kjms.v5i1.60918.
2. Kadel, R., & Kadel, R. (2023). Post-Earthquake Reconstruction in Kathmandu Valley: Progress and Challenges. Journey for Sustainable Development and Peace Journal. https://doi.org/10.3126/jsdpj.v1i02.58274.
3. Fehr, T. (2022). Nepal's Post-Earthquake Development Surge. Sociology of Development. https://doi.org/10.1525/sod.2021.0021.
4. Aryal, K. (2022). Inequality in Post Earthquake Reconstruction: An Ethnographic Account of a Peri-urban Locality in the Northern Part of Kathmandu. Dhaulagiri Journal of Sociology and Anthropology. https://doi.org/10.3126/dsaj.v16i01.50920.
5. Sharma, K., Kc, A., & Pokharel, B. (2022). Status and Challenges of Reconstruction of Heritage Structures in Nepal After 2015 Gorkha, Nepal Earthquake. Heritage & Society, 15, 89 - 112. https://doi.org/10.1080/2159032X.2022.2126229.
6. Acharya, P., Sharma, K., Pokharel, G., & Adhikari, R. (2022). Reviewing the progress of reconstruction five years after the 2015 Gorkha earthquake, Nepal. Building Research & Information, 50, 595 - 609. https://doi.org/10.1080/09613218.2022.2043139.
7. Paudyal, Y., & Bhandary, N. (2022). Damage to School Buildings During the 2015 Nepal Earthquake and Reconstruction Strategy. . https://doi.org/10.21203/rs.3.rs-1212791/v1.
8. Rawal, V., Bothara, J., Pradhan, P., Narasimhan, R., & Singh, V. (2021). Inclusion of the poor and vulnerable: Learning from post-earthquake housing reconstruction in Nepal. , 10, 100162. https://doi.org/10.1016/J.PDISAS.2021.100162.
9. Liu, C., Fang, D., & Zhao, L. (2021). Reflection on earthquake damage of buildings in 2015 Nepal earthquake and seismic measures for post-earthquake reconstruction. Structures, 30, 647-658. https://doi.org/10.1016/J.ISTRUC.2020.12.089.
10. Westoby, L., Wilkinson, S., & Dunn, S. (2021). The road to recovery: Understanding the challenges affecting school reconstruction in rural Nepal following the 2015 Gorkha earthquake.

11. Sapkota, J., Kurita, K., & Neupane, P. (2021). Progress after the 2015 Nepal Earthquake: Evidence from Two Household Surveys in One of the Hardest-Hit Mountain Villages. Sustainability. https://doi.org/10.3390/su132111677.

12. Shrestha, C., Parajuli, B., & Malani, S. (2021). Unravelling constraints of urban housing reconstruction. , 11, 100178. https://doi.org/10.1016/J.PDISAS.2021.100178.

13. Panday, S., Rushton, S., Karki, J., Balen, J., & Barnes, A. (2021). The role of social capital in disaster resilience in remote communities after the 2015 Nepal earthquake. International journal of disaster risk reduction, 55, 102112. https://doi.org/10.1016/J.IJDRR.2021.102112.

14. Rushton, S., Balen, J., Crane, O., Devkota, B., & Ghimire, S. (2021). Re-examining critiques of resilience policy: Evidence from Barpak after the 2015 earthquakes in Nepal.. Disasters. https://doi.org/10.1111/disa.12487.

15. Suvedi, M. (2020). Significant accomplishment of the post-disaster housing reconstruction: A community perspective from 2015 earthquake affected communities in Nepal. , 4, 110-128. https://doi.org/10.3126/craiaj.v4i1.32754.

16. Khadka, B. (2020). Mud masonry houses in Nepal: A detailed study based on entire reconstruction scenario in 31 earthquake-affected districts. Structures, 25, 816-838. https://doi.org/10.1016/j.istruc.2020.03.042.

17. Platt, S., Gautam, D., & Rupakhety, R. (2020). Speed and quality of recovery after the Gorkha Earthquake 2015 Nepal. International journal of disaster risk reduction, 50, 101689. https://doi.org/10.1016/j.ijdrr.2020.101689.

18. Paudyal, Y., Bhandary, N., & Yatabe, R. (2020). Preliminary damage survey of school buildings and proposed plan for reconstruction of school buildings after 2015 Gorkha earthquake in Nepal. . https://doi.org/10.21203/rs.3.rs-21671/v1.

19. Haselberger, M., & Krist, G. (2020). Tracking Trends: A Study of Post-Earthquake Approaches to Conservation in Patan, Nepal. Studies in Conservation, 65, P124 - P131. https://doi.org/10.1080/00393630.2020.1758872.

20. Brosius, C., & Michaels, A. (2020). Vernacular Heritage as Urban Place-Making. Activities and Positions in the Reconstruction of Monuments after the Gorkha Earthquake in Nepal, 2015–2020: The Case of Patan. Sustainability, 12, 8720. https://doi.org/10.3390/su12208720.

21. Aksha, S., & Emrich, C. (2020). Benchmarking Community Disaster Resilience in Nepal. International Journal of Environmental Research and Public Health, 17. https://doi.org/10.3390/ijerph17061985.

22. Rayamajhee, V., Storr, V., & Bohara, A. (2020). Social entrepreneurship, co-production, and post-disaster recovery.. Disasters. https://doi.org/10.1111/disa.12454.

23. Davis, C., Coningham, R., Acharya, K., Kunwar, R., Forlin, P., Weise, K., Maskey, P., Joshi, A., Simpson, I., Toll, D., Wilkinson, S., Hughes, P., Sarhosis, V., Kumar, A., & Schmidt, A. (2019). Identifying archaeological evidence of past earthquakes in a contemporary disaster scenario: case studies of damage, resilience and risk reduction from the 2015 Gorkha Earthquake and past seismic events within the Kathmandu Valley UNESCO World Heritage Property (Nepal). Journal of Seismology, 24, 729 - 751. https://doi.org/10.1007/s10950-019-09890-7.

24. Sanjeeb, G. (2019). Community engagement in disaster recovery: Lessons from the aftermath of Nepal earthquake 2015. Journal of Advances in Humanities and Social Sciences. https://doi.org/10.20474/jahss-5.1.1.

25. He, L. (2019). Identifying local needs for post-disaster recovery in Nepal. World Development. https://doi.org/10.1016/J.WORLDDEV.2019.02.005.

26. Lam, L., & Kuipers, R. (2019). Resilience and disaster governance: Some insights from the 2015 Nepal earthquake. International Journal of Disaster Risk Reduction. https://doi.org/10.1016/J.IJDRR.2018.10.017.

27. Kc, A., Gan, C., & Dwirahmadi, F. (2019). Breaking Through Barriers and Building Disaster Mental Resilience: A Case Study in the Aftermath of the 2015 Nepal Earthquakes. International Journal of Environmental Research and Public Health, 16. https://doi.org/10.3390/ijerph16162964.

28. Pan, Y., Wang, X., Guo, R., & Yuan, S. (2018). Seismic damage assessment of Nepalese cultural heritage building and seismic retrofit strategies: 25 April 2015 Gorkha (Nepal) earthquake. Engineering Failure Analysis, 87, 80-95. https://doi.org/10.1016/J.ENGFAILANAL.2018.02.007.

29. Bhagat, S., Buddika, H., Adhikari, R., Shrestha, A., Bajracharya, S., Joshi, R., Singh, J., Maharjan, R., & Wijeyewickrema, A. (2018). Damage to Cultural Heritage Structures and Buildings Due to the 2015 Nepal Gorkha Earthquake. Journal of Earthquake Engineering, 22, 1861 - 1880. https://doi.org/10.1080/13632469.2017.1309608.

30. Sharma, K., Kc, A., Subedi, M., & Pokharel, B. (2018). Challenges for reconstruction after Mw7.8 Gorkha earthquake: a study on a devastated area of Nepal. Geomatics, Natural Hazards and Risk, 9, 760 - 790. https://doi.org/10.1080/19475705.2018.1480535.

31. Uprety, R. (2018). Gorkha Earthquake 2015 and Post Disaster Reconstruction in Nepal: Challenges and Prospects. Journal of APF Command and Staff College. https://doi.org/10.3126/japfcsc.v1i1.26707.

32. Chen, H., Xie, Q., Feng, B., Liu, J., Huang, Y., & Chen, H. (2018). Seismic Performance to Emergency Centers, Communication and Hospital Facilities Subjected to Nepal Earthquakes, 2015. Journal of Earthquake Engineering, 22, 1537 - 1568. https://doi.org/10.1080/13632469.2017.1286623.

33. Lekakis, S., Shakya, S., & Kostakis, V. (2018). Bringing the Community Back: A Case Study of the Post-Earthquake Heritage Restoration in Kathmandu Valley. Sustainability. https://doi.org/10.3390/SU10082798.

34. Sonda, D., Miyamoto, K., Kast, S., & Khanal, A. (2018). The restoration and seismic strengthening of the earthquake-damaged UNESCO heritage palace in Kathmandu. International Journal of Architectural Heritage, 13, 153 - 171. https://doi.org/10.1080/15583058.2018.1497229.

35. Lizundia, B., Davidson, R., Hashash, Y., & Olshansky, R. (2017). Overview of the 2015 Gorkha, Nepal, Earthquake and the Earthquake Spectra Special Issue. Earthquake Spectra, 33, 1 - 20. https://doi.org/10.1193/120817eqs252m.

36. Daly, P., Ninglekhu, S., Hollenbach, P., Barenstein, J., & Nguyen, D. (2017). Situating local stakeholders within national disaster governance structures: rebuilding urban neighbourhoods following the 2015 Nepal earthquake. Environment & Urbanization, 29, 403 - 424. https://doi.org/10.1177/0956247817721403.

37. Bajracharya, M., & Michaels, A. (2017). “Religious” Approaches to Heritage Restoration in Post-Earthquake Kathmandu. Material Religion, 13, 379 - 381. https://doi.org/10.1080/17432200.2017.1335085.

38. Gautam, D., & Chaulagain, H. (2016). Structural performance and associated lessons to be learned from world earthquakes in Nepal after 25 April 2015 (MW 7.8) Gorkha earthquake. Engineering Failure Analysis, 68, 222-243. https://doi.org/10.1016/J.ENGFAILANAL.2016.06.002.

39. Sharma, K., Deng, L., & Noguez, C. (2016). Field investigation on the performance of building structures during the April 25, 2015, Gorkha earthquake in Nepal. Engineering Structures, 121, 61-74. https://doi.org/10.1016/J.ENGSTRUCT.2016.04.043.

40. Regmi, K. (2016). The political economy of 2015 Nepal earthquake: some critical reflections. Asian Geographer, 33, 77 - 96. https://doi.org/10.1080/10225706.2016.1235053.