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A CRITICAL EVALUATION OF THE IMPACT OF NEPAL GORKHA EARTHQUAKE, THE LESSONS LEARNED AND FUTURE STRATEGIES

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Abstract

The much-feared earthquake affecting Nepal happened as a twin event of Ms 7.8 on April 25 followed by a Ms 7.1 on May 9, 2015 with epicenters migrating along an east-bound axis from Barpak of Gorkha district to Sunkhani of Dolakha district of the country. Although a devastating earthquake with a death toll of more than 9,000 and an economic loss of over 7.5 Billion US Dollar worth of loss of assets, it was not the worst-case scenario with Kathmandu valley shaken with a maximum intensity of 7.5 MMI although the northern parts of the country along the rupture shook with epicentral intensities of 9 MMI. While earthquake mitigation efforts and preparedness paid largely, the earthquake revealed many shortcomings in national approaches and serious gaps in policy, capacity and institutional development, and the lack in understanding and communicating risks. While the nation homed into earthquake response and reconstruction immediately with much confidence employing experiences gathered from recent earthquake events in other Asian countries, several factors contributed to slow pace of reconstruction.

The costly learning is being taken care of and the gaps are being addressed. The National Building Code is being updated, policies are being improved, approaches and programs are being initiated in earthquake and multi-hazard risk reduction in Nepal. These changes as well as the need for continued efforts were discussed elaborately in the Risk2Resilience (R2R) conference that was held in Kathmandu in June 2018, which developed a consensus evaluation of the efforts and charted out a road map for disaster risk reduction in Nepal considering compatibility with the stipulations of and national commitments to the global frameworks viz SFDRR, SDGs, and Paris Agreement.

This paper will make a critical analysis of the Gorkha earthquake experiences describing the lessons learned including those of earthquake reconstruction and will describe the strategies Nepal is undertaking in aspects of disaster risk management to reduce potential losses from future extensive and intensive risk disasters in Nepal.

Keywords: Nepal; Gorkha Earthquake; Disaster Risk Reduction; Resilience; National Building Code

1. Earthquake Hazards of Nepal and the Gorkha Earthquake

1.1 Understanding Seismic Hazards and Risks

Nepal faces a high level of seismic hazard risks due to its location astride the subduction boundary between Indian and Eurasian plates. The earthquake of 1934, still in memory of elderly people, destroyed 20 per cent and damaged 40 per cent of total buildings in Kathmandu Valley [1, 2, 3]. Considered largely as an act if God due to alignment of planets and as a curse to the sins committed till recent years, historical records reveal more than ten episodes of devastating earthquakes that have impacted Kathmandu Valley since the earliest recorded earthquake of 1255 in which then ruling King Abhay Malla died [4]. There were several medium-sized earthquake events in the history, but a systematic effort of seismic monitoring started in the late 1970s [5] with the establishment of the national seismology center in the Department of mines and geology which records, analyzes, and researches seismic parameters to define an earthquake model [6, 7]. Studies revealed that the whole country faces high risk levels of tremors [8, 9]. Such efforts pointed also to the need for a systematic understanding of the hazards and risks. Even smaller earthquakes in remote areas revealed that the country's mountainous parts are highly susceptible to co-seismic hazards such as earthquake-induced landslides [10], landslide dams, earthquake breeching of glacier-dammed lakes, and earthquake-induced debris flow. The southern plains of the country are susceptible to liquefaction and lateral spread [6]. High levels of seismic hazard combined with other natural hazards such as floods, debris flows, landslides, cloud bursts, and other natural hazards make Nepal, a least developed country, one of the most disaster-prone countries in the world [11]. A great stride was done later when the Department of Mines and Geology (DMG) established the first seismograph in Kathmandu Valley in 1978; the National Seismological Centre (NSC) currently uses a nation-wide network of short period seismographs, accelerometers, and more recently by GPS instruments, and seismic hazard assessment by active fault trenching, and other scientific studies [12, 6, 13, 14, 4, 15, 16].

Growing knowledge and understanding of earthquake phenomenon led to the realization of a scientific evaluation of the seismic hazards and risk, especially after the devastation of the M6.6 Udaypur earthquake of 1988. The earthquake-centric national building code was formulated based upon scientific evaluation of the hazard and the risk. Thus, a broad idea about the seismic hazard of Nepal is available (Fig 1.).

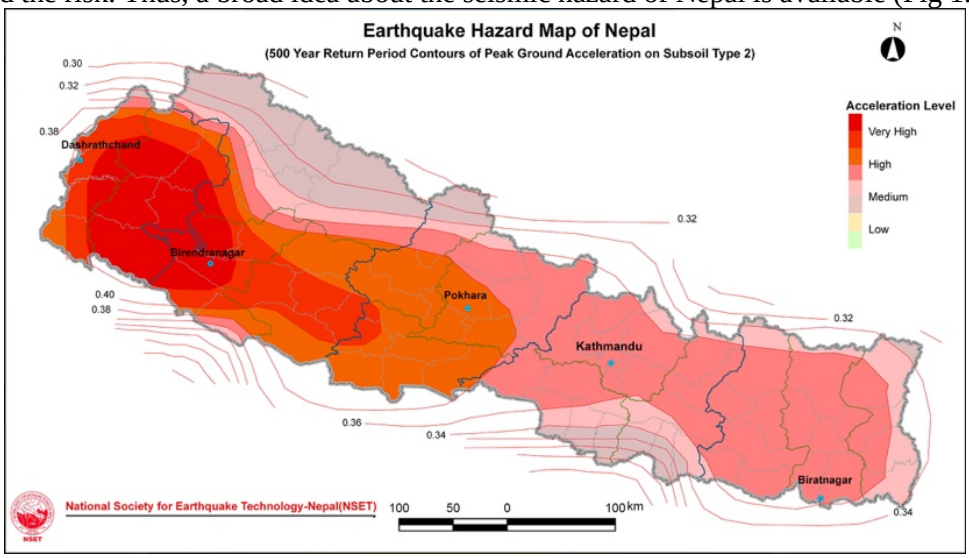

Fig. 1 - Probabilistic Seismic Hazard Map of Nepal showing PGA values with 10% probability of exceedance in 50 years [17, recoloured and redrawn by NSET]

1.2 Understanding Seismic Risks

Formulation of the national building code was complete in 1994, however its implementation posed a great challenge due to the lack of capacity in terms of human resources and institutional mechanism. A study in 2001 revealed that the major source of earthquake risk in terms of human casualty in urban areas of Nepal came from possible collapse of buildings [18]. Figure 2 illustrates this conclusion. Prevalence of poorly constructed non-engineered buildings constructed with traditional low-strength building materials such as stone and brick masonry in mud mortar offered little earthquake-resistance. This demanded a careful and calculated approach to start a quest for improving seismic performance of the new as well as existing building stock of the country that amounted to more than 6 million. Reaching to such a vast volume of buildings was naturally a huge problem.

Fig. 2 - Sources of Earthquake Risk in Kathmandu Valley [18]

1.3 Implementing National Building Code was Much More Difficult than Creating it

Formulation of the national building code was complete in 1994, however its implementation posed a great challenge due to the lack of supporting institutional mechanism and capable human resources. Furthermore, building construction largely relied on owner-build process, and building permit system, existing in the urban municipal areas was geared towards generating revenue rather than towards enhancing seismic safety. Under such situation, a few of the municipalities started formal implementation of the national building code in early 2000. It became evident in the earlier years that seismic risk reduction should be implemented as a campaign consisting of awareness raising activities, capacity building for all stakeholders involved in building construction processes including the masons, the house-owners, the traders in construction materials, the local political and administrative authorities, and other change agents of the society including the school teachers, parents. It became also evident that primary and secondary schools could be the locus of earthquake risk reduction programs as examples of successful vulnerability reduction. The following section provides a brief on the comprehensiveness of such initiatives.

2. Efforts of Earthquake Risk Reduction Prior to The Gorkha Earthquake

2.1 Code Implementation in the Initial Years

The efforts towards implementing the building code gradually metamorphosed into a comprehensive effort towards enhancing seismic resilience by acquiring multiple dimensions. Slowly and gradually, Nepal implemented several organized approaches towards earthquake risk assessment and reduction through the process of learning and doing and addressing the felt needs. This helped much and paid ultimately as it made Nepal much better prepared to face the Gorkha earthquake of 2015.

Nepal government made implementation of the national building code mandatory in all then 56 urban municipalities and the few urbanizing rural centres by a national legislation in 1998. However, actual implementation was slow; only few municipalities could start code compliance process. Dharan municipality was the first to incorporate the code into its building permit process officially, and building upon the experience, other few municipalities followed suit. This effort was accompanied with a host of other initiatives including a) orientation and explanation of the building code provisions, b) earthquake awareness among the population on a massive scale, c) capacity building on earthquake resistant construction process and quality control together with demonstration of good practice by running risk reduction program in public schools, and gradual improvement in the supporting policy and legislative landscape pertaining to local economic and social development.

Nepal building code prescribes different standards to the different building categories from professionally engineered to the non-engineered buildings produced using owner-driven approaches and the rural houses using stone masonry and adobe. Consequently, the risk reduction initiatives were tailored to the different target groups as per the building categories. Wide consultations led to exploration and scientifically analysis of the traditional wisdom in building constructions, especially in heritage and historical buildings and learn from the past experiences, and training of local masons due to the heavy concentration of non-engineered buildings. The following sections provide brief introduction of these approaches.

2.2 Synchronizing national efforts with Global Campaigns and Events

Nepal actively took parts in such global initiatives as the International Decade for Natural Disaster Reduction (IDNDR, 1990-1999; World Seismic Safety Initiative, WSSI; and environmental protection and preservation; etc.) since the early 1990s. Although fatalism still prevailed, such initiatives gradually made people to demand mitigation against natural hazards. The government of Nepal started several initiatives including organization of the 1st National Conference on Disaster Management in 1993, establishment of a National IDNDR Committee for disaster management, development and enaction of National Action Plan on Disaster Management (NAP) etc. The Nepal Geological Society (NGS) started officially observing the International Day for Natural Disaster Reduction (IDNDR Day). The National Society of Earthquake Technology - Nepal (NSET) was established as a felt need to help people and public sector to reduce the impact of earthquake.

Nepal started participating consistently in all global initiatives and frameworks such as the world conferences on Disaster Reduction in Yokohama, Kobe, and Sendai, in the biennial Global Platforms on Disaster reduction and the Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR). Nepal is an active participant of the SAARC Disaster Management Centre (SDMC). This helped Nepal largely - disaster awareness and risk perception of the Nepalese grew continuously over the years. With rising disaster awareness and with the growing demand for safety against natural hazards in Nepal, most major development partners improved their Assistance Strategy and incorporated disaster reduction and management as an integral part of development assistance process.

At the same time, Nepalese professionals learned much from the earthquake experience of response and reconstruction in the aftermath of earthquake events in India , Iran, and Indonesia, where NSET was invited to work together with local humanitarian agencies, and NSET organized programs of technical assistance to the affected areas in Chamoli, Gujarat, AJK/Pakistan, Bam, and Banda Aceh. NSET was invited to share their experiences in several other countries, and such interaction and exchanges provided huge opportunities of learning experience gather in the earthquake theatres. NSET shared such experiences in the form of draft manuals for vulnerability and damage assessment and several other methodologies that were handy and useful in the immediate aftermath of the Gorkha earthquake in Nepal. This also instilled a sense of confidence in Nepalese professional to face and address the emergent needs in training, institutional and human resources capacity development and the policy and strategy needs.

2.3 School Earthquake Safety Program (SESP) as the Starting Point for Risk Reduction

Vulnerability assessment of school buildings and implementation of simple structural intervention towards improving seismic performance together with disaster education and preparedness, with participation of all direct stakeholders including the students, teachers, parents and community leaders, very early on proved to be the right approach to proliferate message of seismic safety in the community. The message progressed from the teachers to the students, from the students to the parents, and ultimately from the parents to the entire community.

Simple seismic retrofitting and or earthquake-resistant reconstruction of the main structures and non-structural elements of the school buildings involved training to local masons, carpenters, contractors, supervisors, engineering technicians, and building engineers/architects on earthquake-resistant design and code-compliance construction technology and seismic retrofitting. It also included earthquake awareness programs targeting students and community members and teacher's trainings. School disaster emergency preparedness and response planning and exercises of safe evacuation drill and first aid also evolved as parts of SESP.

Two decades later, today, SESP is one of the disaster risk reduction programs that has conclusively demonstrated its technical, economic, social and political feasibilities and has become the most attractive programs for funding by the government and by small or large funding agencies and international development partners [19]. It has become a national program and the retrofitted school buildings have demonstrated the wisdom of retrofitting as none of the retrofitted school buildings got damaged by Gorkha Earthquake 2015.

2.4 Enhancement of Emergency Response Capacity (PEER)

Informal training on drop, cover and hold on in school and some light search and rescue skill training to the common people was started in Nepal in late 1990s. Later, Nepal implemented a Program for Enhancement of Emergency Response (PEER) with core funding support by the United States Agency for International Development / Office of U.S. Foreign Disaster Assistance (USAID/ OFDA). It consists in imparting a system of training programs on Medical First Responder (MFR), Collapsed Structure Search and Rescue (CSSR), Community Action for Disaster Response (CADRE), Hospital Preparedness for Emergencies (HOPE) and Swift Water Rescue. All these training programs are aimed at developing instructors for the respective courses [20]. There are two parallel streams of action: i) training strategy and training curricula for developing the end-user responders, and ii) training strategy and training curricula for developing national, regional and international instructors in all the above-mentioned courses. PEER is implemented in collaboration with the Ministry of Home Affairs, Government of Nepal [21] in Nepal. It has so far trained more than 1,100 MFR-CSSR trained professional responders in Asia [22]. Of these, 245 are from Nepalese Army, Nepal Police, Nepal Armed Police Force and the Nepal Red Cross Society; all mandated with emergency first response tasks.

The direct impact of PEER is the enhanced capacity of the country and communities to prepare for emergency response through skills imparted to their members responsible for emergency response. Indirectly, it also serves helping the government to develop emergency response framework such as the National Disaster Response Framework (NDRF) enacted in 2013. Most of the PEER graduates/instructors belong to emergency response agencies, became catalysts in promoting PEER, designed similar training curricula for their organizations and have delivered similar emergency response trainings for their response personnel.

Utilising the inertia generated by PEER, NSET has developed training programs for at neighbourhood family household levels for enhancing a combination of skills in the form of Basic Emergency Response (BEMR), Community Search and Rescue (CSAR), Damage Assessment Training (DAT), Vulnerability and Capacity Assessment (VCA), Community Fire Response Trainings (CFRT), development and testing emergency response plans and prepositioning emergency supplies at different levels [23]. The target trainees are individuals, communities, government/nongovernmental organizations, academic and health institutions, and other international agencies.

These programs have contributed much to enhancing earthquake risk perception, preparedness, and internalization of risk reduction by ever increasing number of citizens in Nepal.

2.5 Proliferation of Building Code Implementation

Following the experience of Dharan, Vyas and a few other municipalities, several other urban settlements started incorporating the NBC provisions into their building permit process which hitherto dealt only with planning bylaws and which was geared towards generating revenues for the municipality. The Department of Urban Development and Building Construction (DUDBC) and the Ministry of Federal Affairs and General Administration (MOFAGA) started encouraging municipalities by promulgating conducive policies and encouraging other private institutions to arrange technical assistance (TA) to the municipalities.
In 2011, the government of Nepal acknowledged the efforts of the civil society organization that is focused in earthquake risk management, namely the National Society for Earthquake Technology – Nepal (NSET) in providing technical assistance to some municipalities and allowed NSET to start a separate dedicated program called Building Code Implementation Program in Nepal (BCIPN), which supported 24 municipal governments in public awareness, capacity building and institutional system for code enforcement [24]. The program strategy was developed based upon a detailed needs assessment and risk perception of the people. Based on decade long experience and survey of cities in the areas of urbanization, human resource, intuitional system and public perception of risk, BCIPN adopted a three-pronged approach to assist target cities; namely, (i) enhancing earthquake awareness and risk communication, (ii) helping technical and institutional capacity building, and (iii) institutionalizing the building code implementation process by introducing policy changes.

BCIPN became an instant success in institutionalizing building code compliance in new construction in Dharan and about 30 municipalities of Nepal even prior to the 2015 Gorkha earthquake. An evaluation of the code compliance in drawing and on site during construction appears in Figure 4 that shows a dramatic increase in code compliance in new buildings averaged for about 50 urban and urbanising municipalities of Nepal since 2012 indicating that city governments in Nepal can actually enhance the seismic performance of new buildings if they are provided with technical assistance for capacity enhancement, improved institutional structure and proper policy and legal environments.

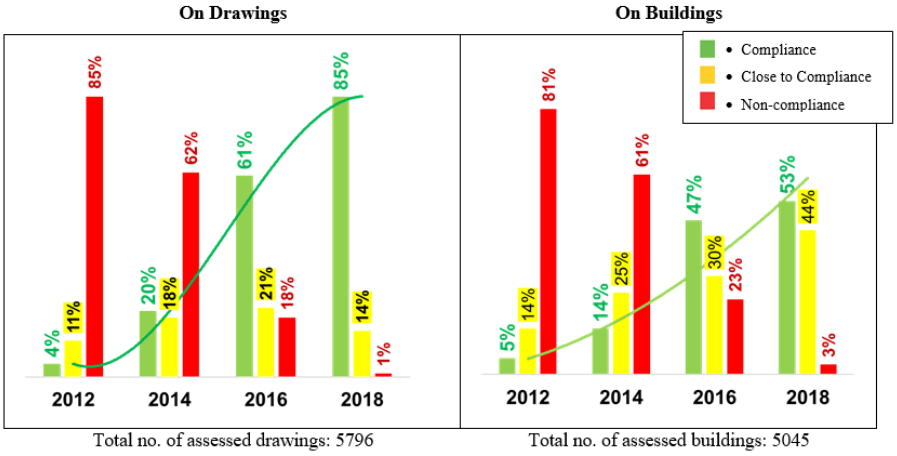

Fig. 3 - Building code compliance on drawing and buildings of program municipalities under TSBCIN Project area (Source: NSET, 2020)

3. THE GORKHA EARTHQUAKE: IMPACT AND RESPONSE

3.1 The Impact

The M7.8 Gorkha earthquake of 2015 killed over 9,000 people and damaged nearly a million buildings, leaving several million homeless [25, 26, 27, 28, 29, 30]. Gorkha Earthquake was not unexpected. People of Kathmandu and Nepal were geared and prepared towards expecting a bigger event largely due to the implementation of comprehensive programs of earthquake risk management that Nepal started as early as 1994 as described in the previous sections. The devastation was great in rural areas and some urbanizing

settlements along the east-west axis from the epicenter of the main shock on April 25, 2015 to that of the largest aftershock on May 12, 2015 along the northern parts of the country. Kathmandu valley was spared with minimal damage and casualty largely due to the timing of the earthquake in the late morning hours of a Saturday, a weekend in Nepal, and due to "directivity" of wave propagation towards north of the earthquake rupture progression. Figure 4 presents an earlier version of the shaking intensity map of the affected areas in Nepal.

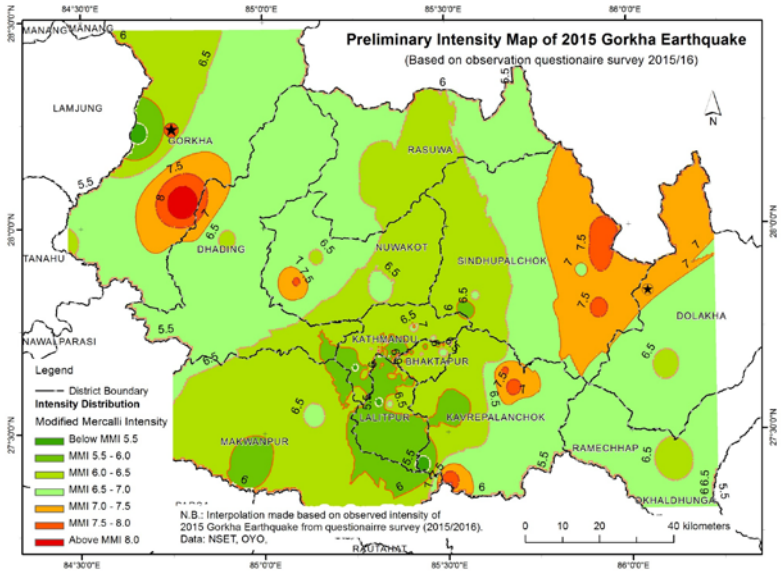

Fig. 4 - Intensity Map of Gorkha Earthquake 2015 presenting earlier version of Shaking (Source: NSET).

The total economic value of the damage and losses amounted to 7 billion US$ of which the damage and losses in Housing and Human Settlements sector constituted almost half of the total with education, infrastructure, tourism, cultural and productive sectors sustaining brunt of the total losses [31].

3.2 The Emergency Response

Nepal was in a political turmoil and a stagnant economy when the Gorkha earthquake happened. Despite such unfavorable condition, Nepal faced the earthquake bravely and with dignity homing into situation assessment and mobilizing search and rescue by a combination of 76 fully equipped and self-sufficient international SAR teams and emergency response capabilities of the three national security organizations, namely the Nepal Army, the Armed Police Force and the Nepal Police, and the community members in the affected areas ([32, 33, 34].

Remoteness and rugged terrain of the impacted area, and adverse monsoon weather hindered effective SAR in the absence of adequate equipment. Nonetheless, search and rescue were conducted with all efforts; EERI (2016) reported the performance of the national responders, notwithstanding the problems of logistics, was superb. Had the same level of earthquake happened a decade earlier, the performance of SAR could have been much less effective. With more than 25 hospitals and 1,000 other health facilities destroyed in the worst affected districts, the medical response quickly picked up. A review one year later stated that the health sector's response to the earthquake was rapid, well-coordinated and tailored to the needs of the affected population. Seismic retrofitting of Kathmandu hospital and training of staff in mass casualty management and existence emergency response plans helped much.

3.3 Relief, Early Recovery and Needs Assessment

Nepal's Ministry of Home Affairs (MOHA) homed into the relief and early recovery by mobilizing national as well as international resources in providing, among others, a) financial support to the families with casualty and damaged or lost houses including conceptualization of Special Loans for Earthquake Victims, b) facilitating temporary shelters and relief camps for individuals and the community, c) Conceptualization

of relief packages including National Reconstruction and Rehabilitation Fund (NRRF), d) development of an early plan for Rehabilitation and Reconstruction Plan backed by the NRRF, e) coordination of relief efforts by several national and international organizations and benevolent charities, conceptualization of the National Reconstruction Consultation Committee (NRRC), f) information management including collection of data and its dissemination g) maintenance of law and order, h) management of the Prime Minister's relief Fund, i) Formulation of Post Disaster Need Assessment (PDNA), in short period of time, and j) coordination of response by other line ministries including development of indicative list of priority relief items, issuance of Earthquake Victim Identity Card, concept for deployment of volunteers etc. Thus, the government approached the response in a comprehensive way leading to the organization of the International Donors' Conference on earthquake reconstruction and rehabilitation in Kathmandu on 25 June 2015.

PDNA early on set principles for reconstruction that employed approaches a long-term goal of enhancing national resilience to disasters, promulgated disaster risk reduction and Build Back Better as the cardinal principles, emphasized awareness raising, and improvements in national DRR systems in the short, medium and long terms [31]. The Ministry of Federal affairs led the Earthquake Early Recovery Programme focussing on (i) Debris management, (ii) Reconstruction of community infrastructures, and (iii) Restoration of public service delivery. Guidelines for early recovery followed the principles of a) Appropriateness to local context including cultural context, b) Long-term sustainability, and c) Strengthening existing local institutions and mechanisms. For the first time in Nepal, the government could organize post-earthquake building triaging in Kathmandu Valley and some other urban settlements by mobilizing professionals after a brief training.

Detailed damage assessment of more than 200,000 earthquake-damaged buildings yielded information on seismic performance of Nepalese building typologies, leading to formulation of fragility curves [35] and strategies for reconstruction. Arranging for temporary housing was another area that the country managed without much controversies. Proven international practices such as cash for work, emergency livelihoods and economic recovery, equal opportunities of training for women, on-farm and off-farm activities, and establishment of institutional mechanism and training cash for work, and equal pay for equal work for women.

Unfortunately, concept of transitional shelter was not very actively articulated in the society. This led to unrealistic expectation among the population as well as at the political leadership on the possibility of provision of shelter before "the next monsoon" or "before the next winter" or within "a year or two".

3.4 Earthquake Reconstruction

Nepal homed into earthquake reconstruction by establishing the National Reconstruction Authority (NRA) which was tasked to build back better in the earthquake affected areas in five years' time. NRA successfully gather the earthquake risk management knowledge in the country as well as the learnings earthquake reconstruction in other developing countries, and managed the required financial resources, establishing the needful administrative structure to involve all agencies, national and international, in providing technical assistance, financial and governance support to each and every household impacted by the earthquake. Figure 5 portrays a satisfying picture of the progress of earthquake damaged housing reconstruction in Nepal as of mid-February 2020 (Fig. 5). Similar achievement has been reported for the reconstruction of public and school buildings [36] and the overall reconstruction is considered satisfactory. However, one must note that the pace of reconstruction of heritage and health institutions is not as much as for the private housing.

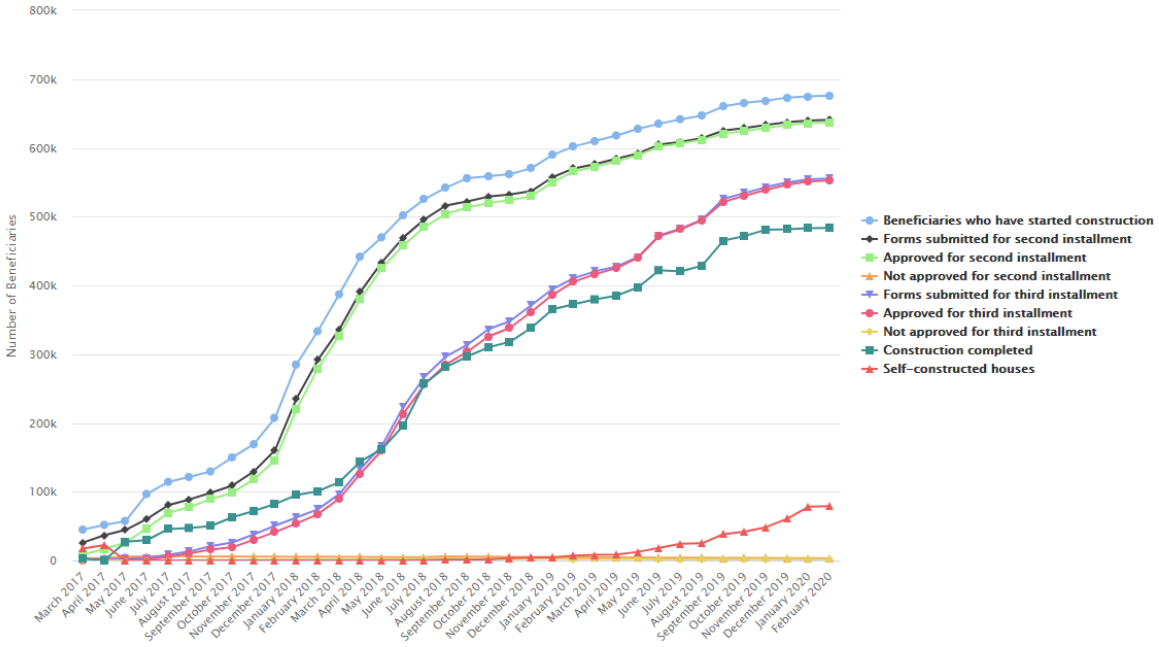

Fig. 5 - Earthquake Housing Reconstruction Progress Chart as of Feb 15, 2020
(Source: EHRP https://ehrpinspection.nra.gov.np/moud/combined-chart, accessed Feb 15, 2020.

3.5 Gorkha Earthquake as the Test for Earthquake Risk Management Efforts in Nepal

Starting from the aftermath of the 1988 M6.6 Udaypur Earthquake, Nepal initiated a variety of efforts and programs in aspects of earthquake risk management starting from formulation of the national building code and its implementation to a program of massive earthquake awareness including the annual nation-wide observance of the Earthquake Safety Day (ESD), institutionalization of school earthquake safety program consisting of simple retrofitting of school building and earthquake preparedness drill etc. The country witnessed a successful use of the network of FM radio stations to cover more than 80% of the country's territory with earthquake preparedness PSA several times a day for the past several years. Other print and electronic media have also been mobilized successfully.

Nepal government took a lead in organizing an international conference – Risk to Resilience (R2R) in June 2018 with the aim of assessing the efficacy of Nepal's preparedness as tested by the Gorkha earthquake to chart out a path for future for continued reduction of earthquake risks. R2R drew a wide participation of the major actors and contributors of disaster risk reduction programs and initiatives in Nepal including related representatives of the government, academia, private sector and civil society organizations as well as representatives of the international development partners, donors and the banks. The conference thus articulated a credible voice.

R2R resolution recognizes the improved policy and legal environment for disaster risk reduction including mandatory compliance to the national building code even for the non-engineered and rural houses, the innovative methods and massive awareness efforts for disaster risk assessment and reduction, calls for a shift from disaster management to disaster risk management, from damage assessment to vulnerability assessment and reduction, and from relief to risk reduction. Classifying according to the four Sendai priorities of actions, R2R adopted a 30-point strategic actions in order to support achievement of the seven SFDRR global targets in the context of Nepal by 2030 [37].

4. Discussion and Conclusions

Nepal made a great stride in disaster risk reduction since it was impacted by the M6.6 Udaypur earthquake in 1988 by undertaking a seismic hazard and risk assessment for use in formulating the acceptable level of risk while formulating the strategy and approaches for the national building code (NBC). Efforts towards implementation of NBC pointed to the need for raising awareness, enhancing institutional and stakeholders' capacity and creation of conducive and encouraging policies. This requires a long term sustained effort. The history of DRR in Nepal confirms this fact.

Disastrous events in other developing countries usually sent panic in Nepal – many talked about a “doomsday” should a large earthquake strike Nepal which the characterized as "Japan-type of hazard level and Haiti-type of vulnerability". But the aftermath of the Gorkha earthquake revealed the inherent resilience of the Nepalese society that could withstand the huge impact of the earthquake and faced it bravely with dignity.

Fig. 5 shows that the reconstruction of even damaged private houses was extremely slow even until December 2017 and the pace picked up five times in the next 12 months. This is explained by the need to spend the precious post-earthquake time in formulating and promulgating policies, procedures, regulation, formats and formulae for implementing reconstruction. Further, it is seen that reconstruction of private and public houses and that of the school buildings is in much comfortable situation than that of heritage buildings and monuments and health structures. This is simply because there was some learning and some experience developed in Nepal by implementing seismic retrofitting and seismic resistant construction of such buildings in the past two decades. Therefore, the national capacity could home into reconstruction once the policies and procedures got cleared, and seen in the steep rise in the reconstruction curve during 2018-2019 in Fig., 5. This was because the Nepalese professionals could understand the nature and seismic performance of vernacular non-engineered buildings, realized the need for training the masons and the municipal engineers and worked with the municipalities to best incorporate the stipulations of the national building code in the municipal building permit application. Unfortunately, similar efforts were not done for religious monuments and there are few who could confidently suggest the optimal strategies and methodology for the reconstruction of such important structures.

Had there been not a wide discussion in the past two decades on the need to improve and update the national legislation, Nepal would still have faced the Gorkha earthquake with a fire fighting approach of addressing the emergency response adequately and the reconstruction not with the concept of building back better or using the local resources and skills with an owner-driven approach. Similarly, had Nepal not been engaged in the implementation of the building code by working closely with sample municipalities, the country could not have been able to approach earthquake reconstruction with so much of confidence offered by the existence of a group of mason-instructors and trained masons, the corresponding curricula and training strategy.

From the above briefs and discussion, one can make the following obvious conclusions among many others, which have not been reported here due to page limitations.

1. Disaster risk reduction (DRR) is a long-term process and can be achieved only as a mission. This requires a long-term vision with all program adding bricks to the edifice through coordination, collaboration and synergistic actions.
2. The quality of preparedness determines the quality of response. This is true not only for emergency response but also for recovery, rehabilitation and reconstruction.
3. A large disaster event offers huge opportunities for introducing changes in risk perception and approaches in DRR. This is the time when the benefit cost ratio of Disaster preparedness and risk reduction is felt and seen the most.
4. Disaster reconstruction offers the best opportunities for risk reduction. A disaster usually arrests larger attention for national as well as international partners which can be utilized for achieving building back better and inculcate a culture of safety.

5. National experience counts – learning from Kashmir earthquake during Pakistan reconstruction and Chamoli / Gujarat reconstruction very valuable – need to be involved in a disaster theater for all including government officials.
6. Manuals, guidelines, training curricula, policies and legislation should better be formulated before the disastrous event. Even reconstruction strategy including institutional development and allocation of authority should be accomplished beforehand. Possible impact scenario could be handy.

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