

25 April 2015 Gorkha Earthquake Disaster Risk Reduction Situation Report
DRR sitrep 2015-002 – June 2, 2015

This disaster risk reduction situation report explains the drivers of disaster risks in Nepal and draws attention to the efforts that have been undertaken to reduce these risks. A key overview of the background of historical disasters, the calculated risks and the on-going work on disaster risk reduction in Nepal are summarized in a previous Preventionweb DRR situation report for Nepal: <http://preventionweb.net/go/44170>

1. Drivers of Disaster Risks in Nepal

A magnitude 7.8 earthquake struck Nepal on April 25 and caused massive destruction. The main quake was followed by numerous aftershocks of magnitude 5 or higher causing further damage and losses. At the moment, there is little information about the factors that contributed to the growth of disaster risks in Nepal. Disaster risk, which is the likelihood of the loss of life, injury or destruction and damage from a disaster in a given period of time, is influenced by the hazard itself, the exposure of people, property and livelihoods to these hazards, and their susceptibility to the damaging effects of hazards. Changes in any of these components will either increase or decrease the risks, and when a disaster strikes they will determine the size of its impacts. This DRR situation report covers the hazard, exposure and vulnerability that combined to make the earthquake in Nepal so deadly.

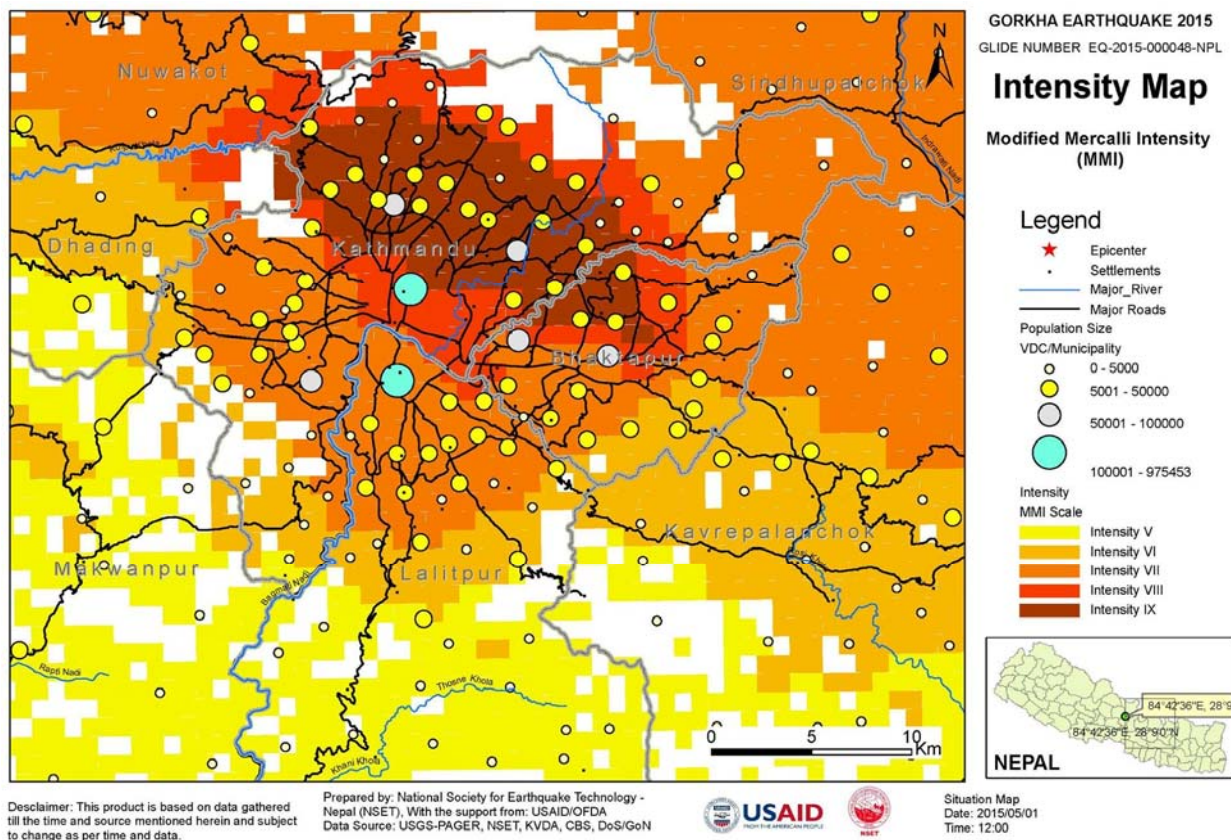


Figure 1. 25 April 2015 Gorkha earthquake shake map. Source: NSET - <http://www.nset.org.np/eq2015/>

1.1) Hazards

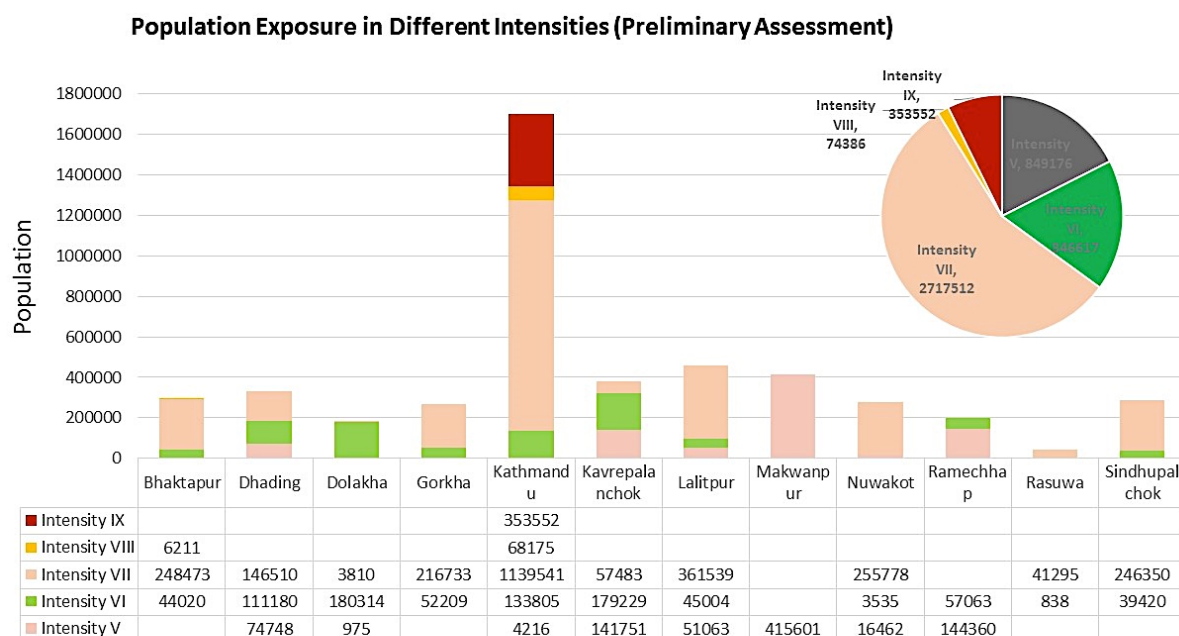
Nepal’s landscape, which is predominantly composed of hills and steep mountains combined with fragile geological formations and heavy monsoon rainfall, leads to wide range of geological and hydro-meteorological hazards affecting the country. In addition, Nepal’s geological characteristics together with torrential rain during rainy season often result in landslides, debris flows, and floods.

Statistics from the EM-DAT show that floods are most frequent hazard, with 50 events reported from 1900 to 2014. Landslides follow this, with 23 events reported in the same period, then epidemics, with 17 events. There have been 6 earthquake events registered in the EM-DAT database. A study published in April 2015 reported¹ that despite the availability of new data and methodological improvements, the available earthquake hazard map showing the probability of tremors happening across Nepal is about 20 years old. The study goes on to recommend that an update to the seismic hazard map is “imperative” as this will be important for policies on building regulations, insurance, and emergency preparedness.

1.2) Exposure

Besides the high incidence of hazards in Nepal, there is also a high degree of exposure to these hazards. The earthquake was focused in the Janakpur Zone of Nepal, which has a population of 2,222,000. There were approximately 5.6 million people within a radius of 100 km, 4.1 million within 75 km and 1.4 million within 50km radius of the epicenter. This means that a large number of people were exposed to a high degree of ground shaking.

Out of the country's 23 million population², 86 percent lives in rural areas, and 82 percent of the economically active population works in agriculture, fishing, or forestry. Nepal’s population marked



Gorkha Earthquake 2015



Figure 2. Population exposure to the 25 April Nepal earthquake shaking. Source: NSET - <http://www.nset.org.np/eq2015/>

¹ <http://www.preventionweb.net/english/professional/news/v.php?id=43897>

² Based on Nepal's 10th population census, conducted in June 2001

an increase of 5 million between the 1991 and the 2001 census with an average annual growth rate of 2.3 percent.

According to the World Bank³, the Kathmandu Valley has a population of 2.5 million people and a population density of about 13,000 people per square kilometers. It is also growing at 4 percent per year, making it one of the fastest-growing metropolitan areas in South Asia, and the first region in Nepal to face rapid urbanization at a metropolitan scale. *Figure 1* shows the shake map of the Gorkha earthquake and the population density. *Figure 2* shows the exposed population compared with the shaking intensity as generated by the Gorkha earthquake.

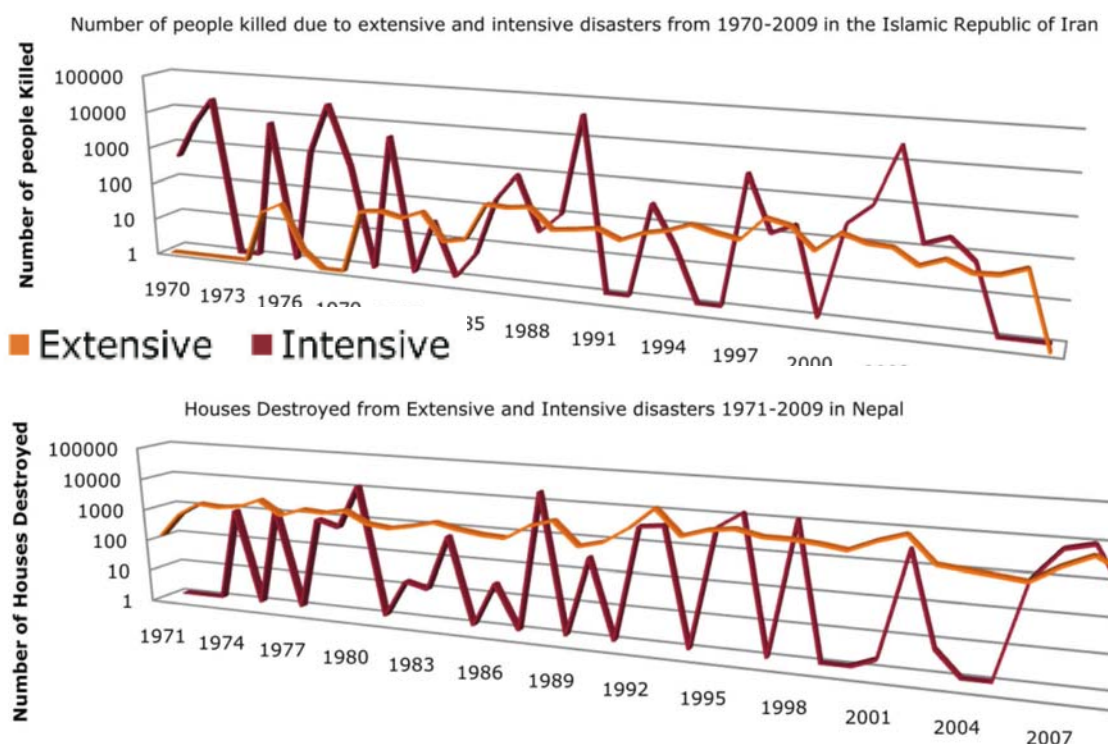


Figure 3. Mortality (above) and housing damage (below) in Nepal from 1971-2009 for both extensive (frequently occurring but small disasters) and intensive (infrequent but large disasters) risks. Source: UNISDR and ESCAP, Asia Pacific Disaster Report 2012 - www.preventionweb.net/go/29288

Kathmandu, followed by Dhanusa, Siraha has the highest percentage of people categorized as being in the productive age group (15-59 years old) who are exposed to hazards. There are also a high proportion of children exposed to the same hazards. In addition to the exposure of people, the earthquake also affected assets⁴. For a 100-year return period, on average 35 percent of permanent houses in Nepalese districts were exposed to a very high hazard earthquake zone. Baitadi, Darchula, Kathmandu, Baglung, Doti were the five districts with the highest percentage of permanent houses exposed to a very high hazard zone. Other critical infrastructure such as education, health and transportation were also highly exposed to hazards. For example, 84.8 percent of schools in the districts of Nepal were in located in hazard prone areas⁵. The most exposed schools were found in Bara, Parsa, Kanchanpur, Illam and Rautahat; these schools were located in the most earthquake prone areas. For hospitals, 20 districts have 100 percent health post exposure to high hazard zone areas and another 19 districts have health post exposure to moderate hazard zone areas. Similarly it has been shown that in more than 20 districts roads were located in hazard prone areas and in 15

³ <https://www.worldbank.org/en/news/feature/2013/04/01/managing-nepals-urban-transition>

⁴ GFDRR, Nepal Hazard Risk Assessment, <http://bit.ly/1GDTMfK>

⁵ GFDRR, Nepal Hazard Risk Assessment, <http://bit.ly/1GDTMfK>

districts 100 percent of the roads were located in earthquake prone areas. This increased the overall exposure of Nepal to the disaster.

1.3) Vulnerability

Another factor that contributes to disaster risks is vulnerability, which is the susceptibility of people, properties and livelihoods to the damaging effects of the hazard. Historical damage and loss data provides insights on the vulnerability of people and assets in Nepal. For example, *Figure 3* shows that a large proportion of destructive disasters in Nepal are small-scale disasters, averaging more than 90% of all disasters, which cause more death; affects more people; destroy more houses; and cause more economic damages, as compared to large but infrequent disasters. This shows that there is very high vulnerability of both people and assets in Nepal. The Pacific Disasters Center ranks Nepal as 37 out of 172 countries in its disaster vulnerability index as shown in *Figure 4*.

Some experts⁶ noted that Kathmandu was vulnerable to earthquakes due to its high population density, unplanned development practices, unsafe construction, lack of urban planning, high incidence of poverty, and high inequality in terms of access to public services. In addition, others⁷ view the vulnerability of people to hazards such as drought and other adverse weather conditions as depending on their socio-economic status. Poor and socially excluded groups will be less able to absorb shocks than well-positioned and better-off households.

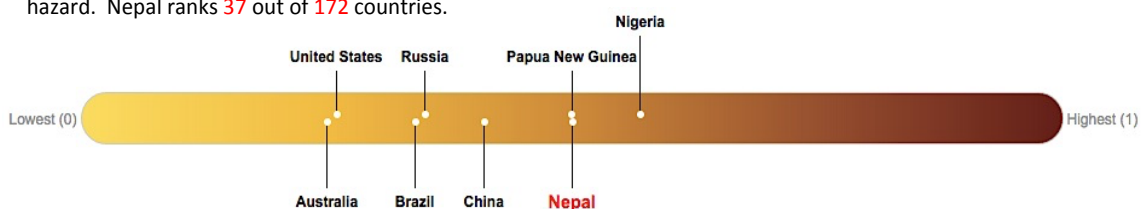
Risk and Vulnerability Profile: Nepal (Vulnerability)

RVA NPL-002

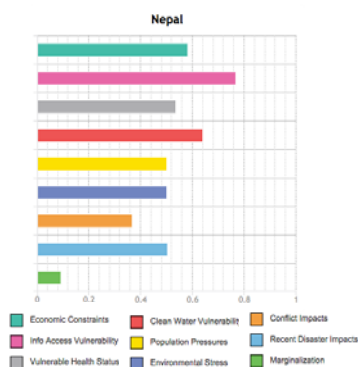


Vulnerability:

Vulnerability represents pre-event conditions that make a country more susceptible to the damaging effects of a hazard. Nepal ranks 37 out of 172 countries.



Vulnerability Index



Index	Nepal		Total Countries
	Score	Rank	
Vulnerability	0.50	37	172
Sub-Components			
Economic Constraints	0.58	30	179
Info Access Vulnerability	0.77	25	197
Vulnerable Health Status	0.54	58	185
Clean Water Vulnerability	0.64	44	192
Population Pressures	0.50	84	208
Environmental Stress	0.50	50	178
Conflict Impacts	0.37	29	211
Recent Disaster Impacts	0.50	40	206
Marginalization	0.09	174	193

Source: PDC's Global Risk and Vulnerability Assessment

Figure 4. Nepal vulnerability profile. Source: Pacific Disaster Center - <http://bit.ly/1J6ScDp>

⁶ http://www.preventionweb.net/files/33962_33962interviewjanakee1.pdf

⁷ <https://weadapt.org/knowledge-base/vulnerability/nepal-disasters-background>

A 2007 World Food Programme household survey⁸ found that the Far- and Mid-West regions in Nepal are generally considered as the poorest parts of the country, which would indicate high vulnerability to hazards. The survey showed that in almost 94 percent of the households, drought, hailstorms, unemployment, illness, landslides and death of a family member created food shortage. In addition, it revealed that in drought-affected areas, average household food grain stocks would deplete six times faster than in non-drought-affected areas. This means that hazards directly affected the well-being of populations, which made the same populations more vulnerable to future disasters and increased the change of a hazard becoming a disaster.

The existing stock of Nepal’s infrastructure is also vulnerable to hazards. For example, a survey of close to 1,000 building structures in the year 2000 by JICA under the Study on Earthquake Disaster Mitigation of Kathmandu Valley (SEDM) project found that in Kathmandu valley, owners construct most of the buildings themselves both in the rural and urban areas. Although there are significant increases in the suburban area of the number of buildings constructed by contractors, majority of the existing housing are owner-built. This is shown in Figure 5.

In 2008, Amod Dixit of the National Society for Earthquake Technology (NSET) reported⁹ that:

“combining building construction process as well as the mode of transmission of the construction, it can be found out that less than 10 percent of the buildings are engineered which is constructed by engineers, and over 90 percent are non-engineered, by craftsmen or local masons. In terms of pre-construction investment on the other hand, [little] investment has been done to majority craftsmen whereas there are a lot of training and fostering process for engineers and even for sub engineers. That is, practically, there is no investment for production of qualified construction workers in Nepal. Therefore, thinking about key stakeholders in housing construction in Nepal, whereas there are clients (owners), consultant which in charge of design as well as construction supervision, contractor of builders, masons, owner builders, and material suppliers, craftsman or craftsmen play(s) crucial roles in non-engineered construction.”

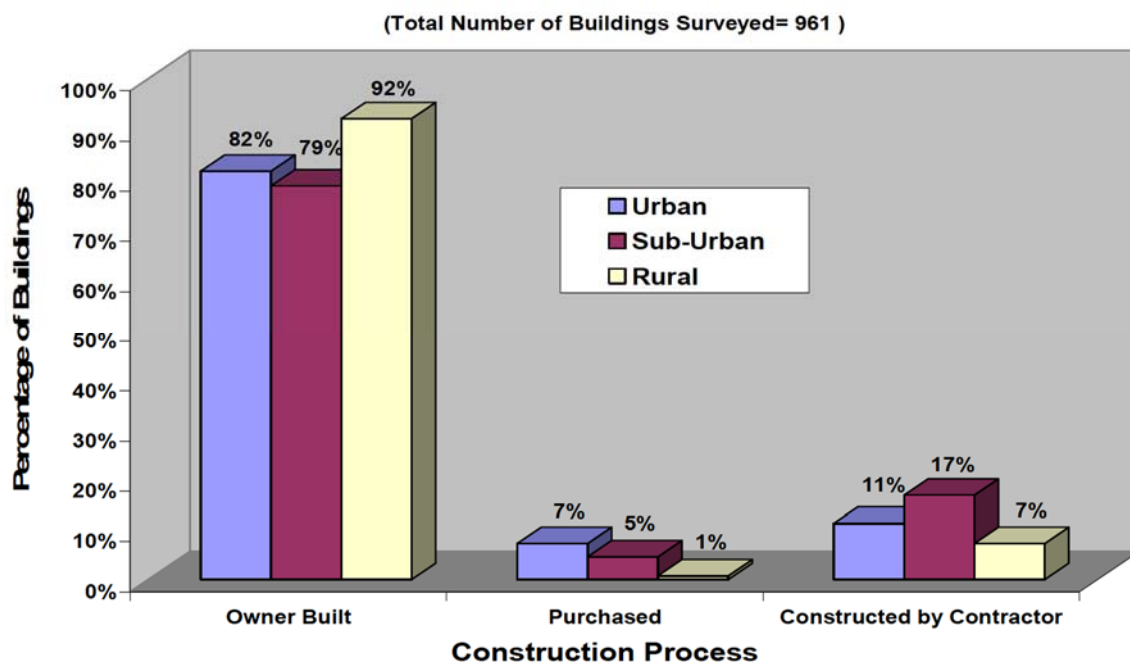


Figure 5. Building Construction Process for Residential Buildings in Kathmandu Valley. Source: Building Inventory Survey under the SEDM (2000) as noted by Amod Mani Dixit in the paper “Challenges of Building Code Implementation in Nepal”

⁸ <http://home.wfp.org/stellent/groups/public/documents/ena/wfp130002.pdf>

⁹ Challenges of Building Code Implementation in Nepal, in From Code to Practice - Challenges for Building Code Implementation, International Symposium 2008 on Earthquake Safe Housing

2) Efforts to Reduce Disaster Impacts

Although the real impact of the 2015 earthquake in Nepal will not be fully known before the post-disaster needs assessment (PDNA), estimates are already being made about the potential impact. The speculation on the impact of the disaster is mostly based on the country's vulnerability to the earthquake.

2.1) Effects on the People

As of 18 May 2015, the reported death toll was¹⁰ 8,604 and the total number of injured, 16,808. A 2002 study by JICA outlines a possible disaster scenario for an earthquake striking in central Nepal. JICA estimated a possible death toll of 18,000 mostly from house collapses, with the estimated number of people injured around 147,000 due to building collapse and falling objects.

One reason for this difference is that this earthquake is not the worst case for the capital, Kathmandu. If for example there was a repeat of the 1934 great Bihar-Nepal earthquake today, the predictions above may actually exceed the impact of the earthquake, as noted in an analysis by Geohazards International (GHI) in 1999¹¹.



Photo 1. Female Masons Trained in Earthquake Safe Construction.
Source: Kathmandu Metropolitan City and supported by the UNDP Comprehensive Disaster Risk Management programme.
<http://bit.ly/1FEDLUL>

Since 2009, the Nepal Risk Reduction Consortium (NRRC) have been training close to 2,000 masons and have provided technical training in seismic resilience for Engineers and specialists. In addition, the NRRC has assisted the government building code compliance strategy, including supporting the digitization of the permit approval process and GIS mapping of all buildings in Kathmandu Valley. These together with other measures to improve disaster preparedness and response capacity of various stakeholders most likely also contributed to the reduced mortality in this disaster. *Photo 1* shows female masons training conducted by Kathmandu Metropolitan City.

2.2) Effects on the Economy

The Finance Ministry of Nepal has reported that country suffered a loss of up to US\$10 billion due to the earthquake and the subsequent aftershocks. This represents up to half of the country's US\$ 20 billion GDP. Chairing a meeting of donor agencies, Finance Minister Ram Sharan Mahat said that the preliminary estimated cost for the reconstruction of the quake-ravaged country is US\$5 billion and works have been started by setting up a fund of US\$2 billion for the time being.

¹⁰ <http://bit.ly/1LIsap4>

¹¹ <http://geohaz.org/projects/kathmandu.html>

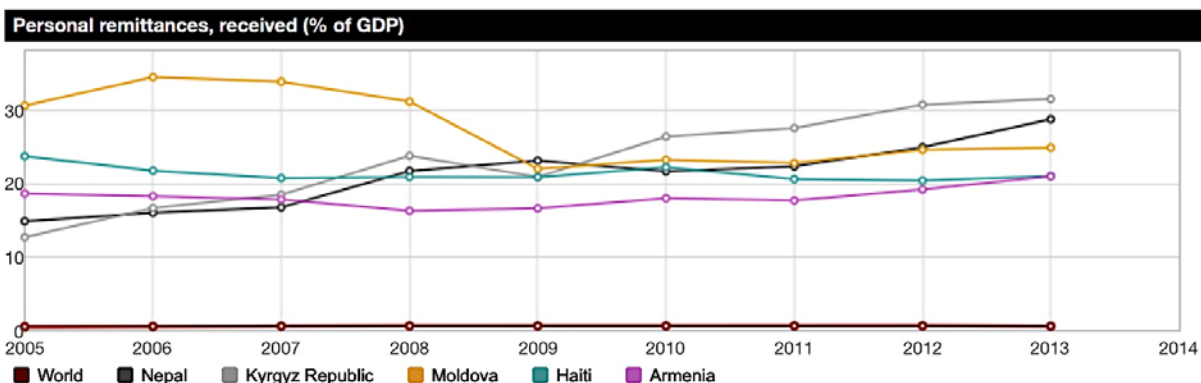


Figure 6. Personal remittances received as a per cent of national GDP. Source: Chart from <http://bit.ly/1JWIFk4>. Data from the World Bank.

This article¹² reports that based on historical earthquakes in and around Nepal and then using the change in values of buildings and intensities seen in the 2015 earthquake the loss is expected to be around US\$3 billion to US\$3.5 billion and around a US\$5 billion to US\$5.5 billion replacement cost. These costs do not yet include the cost of building back better structures.

Additional indirect losses to the tourism industry and the value of cultural structures are yet to be calculated. Tourism accounts for about 8 percent of the total economy, and there are calculations that the Gorkha earthquake may cost around US\$1.5 billion per year in indirect losses to Nepal due to loss in tourism.

Also, insurers will only cover a fraction of losses, despite the massive direct economic losses. According to the Insurance Information Institute, less than US\$3.50 is spent per capita annually in Nepal on property and casualty insurance, versus the nearly US\$2,300 spent each year in the U.S. Nepal's insurers collected premiums of about US\$277 million in 2013, with most of those funds for life coverage. Insurance is one means to reduce the economic vulnerability to a disaster. Opinions¹³ have been written on why this option may be considered in the future to reduce the vulnerability of Nepal's economy to future risks. Considering the country's current social and economic structure, micro-credit can catalyze the local economy and make needed produce more readily available locally.

In addition, 2.2 million Nepalese who work overseas sent remittances that are equivalent to more than 25% of Nepal's GDP in 2014, and these represent close to double the value of export of goods and services of Nepal. The World Bank in a 2009 study¹⁴ found a link between remittances and disasters, where it noted that "migrant remittance flows increase in the aftermath of natural disasters, macroeconomic or financial crises, and act as a safety net for households that have migrants abroad." There is scope for remittances to help economic recovery if it is also invested in education or in business development and used not just as a household safety net for daily family expenses, which at present is reported to take up close to 80% of remittances.¹⁵ Figure 6 shows that the personal remittances received as a percent of national GDP in Nepal is second largest in the world just behind those for Kyrgyz Republic.

¹² <http://www.scientificamerican.com/article/experts-calculate-new-loss-predictions-for-nepal-quake/>

¹³ <http://www.preventionweb.net/english/professional/news/v.php?id=44168>

¹⁴ <http://bit.ly/1J7CDeN>

¹⁵ <http://bit.ly/1FpnbG9>

2.3) Effects on Infrastructure and cultural heritage

According to the Department of Education, 14,500 classrooms were destroyed in the earthquake. Since the catastrophe took place on a Saturday instead of a school day, this avoided thousands of deaths among schoolchildren. National Society for Earthquake Technology (NSET) reports that out of 35,000 public and private schools, only 350 to 400 have been retrofitted. ADB also reports¹⁶ that 160 public school buildings survived the earthquake in Kathmandu Valley because they were part of a school safety program, which includes retrofitting.

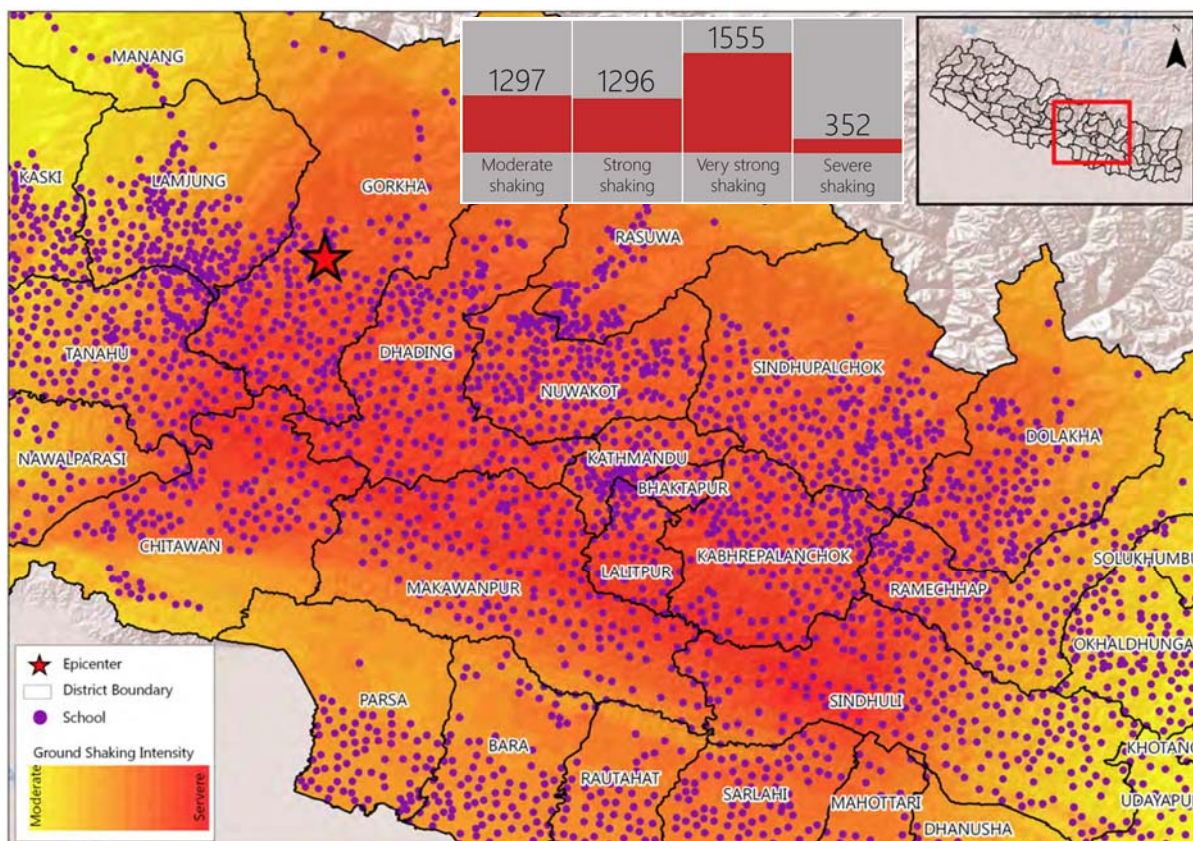


Figure 7. The number and location of potentially affected schools in Nepal from the 2015 Gorkha earthquake. In total there could be 4,500 schools affected by the quake. Source: ADPC - <http://bit.ly/1Avwl7q>

The Nepal Risk Reduction Consortium in its progress review in 2013¹⁷ notes that an action plan is in place for the assessment of 1,800 school buildings in the Kathmandu Valley. In addition the Consortium reports that 65 school buildings retrofitted to date and a plan in place for the retrofitting an additional 260 school buildings. The re-construction of 280 school buildings is also ongoing. Also, 156 masons have been reported trained so far out of 1,050 targeted under the programme. Out of the 162 schools damaged from the Sikkim earthquake in September 2011, 70 school blocks reconstructed, 31 retrofitted, and work have been initiated in 48 of the remaining 53 blocks to be completed soon. *Figure 7* shows the 4,500 schools and their location which are potentially affected by the Gorkha earthquake.

¹⁶ <http://bit.ly/1PPuLnz>

¹⁷ <http://un.org.np/reports/review-report>

It has been reported that 400 health posts, or community health centres were destroyed in the 2015 Gorkha earthquake, with an additional 300 damaged and three district hospitals which collapsed. However, the World Health Organization reported¹⁸ that the 2015 Gorkha earthquake and its aftershocks failed to disrupt the services at Kathmandu’s largest public hospitals, including Tribhuvan University Teaching Hospital (TUTH), Patan Hospital, Civil Service Hospital, Birendra Army Hospital and the trauma centre at Bir Hospital.

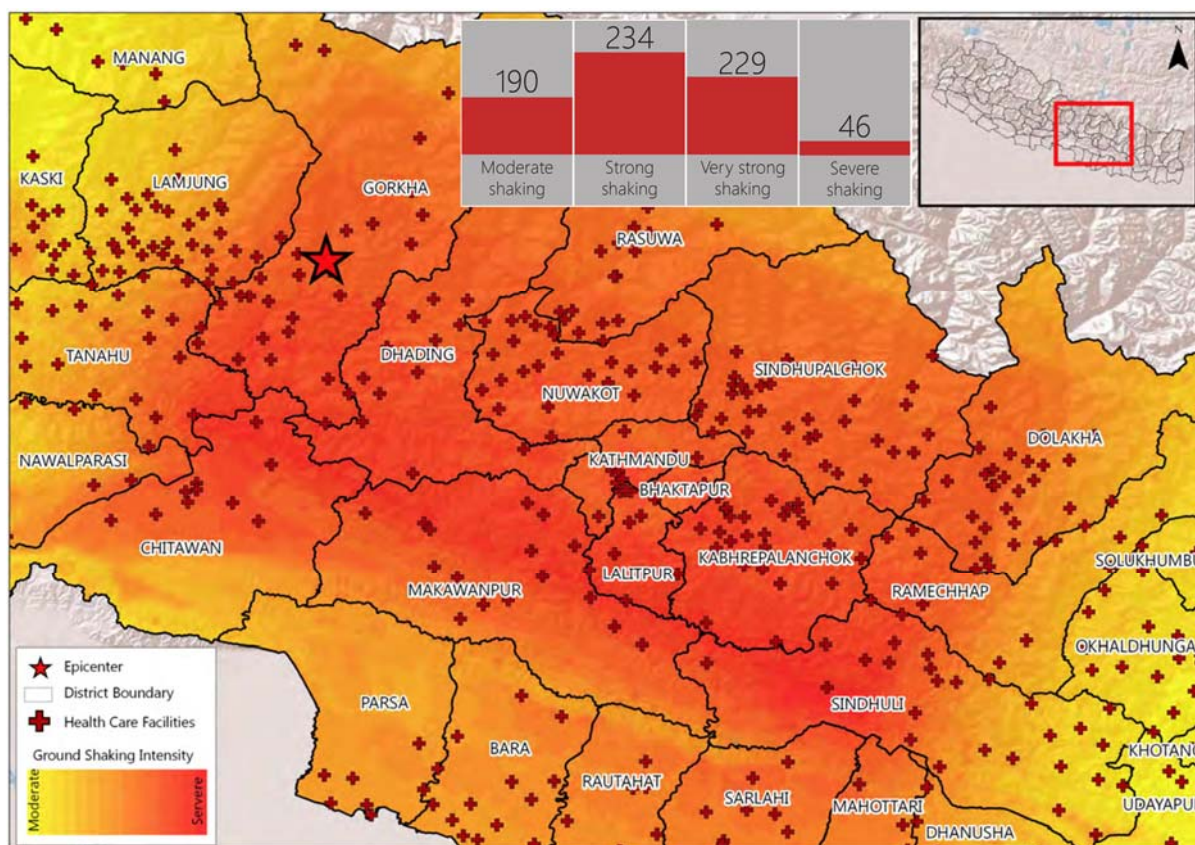


Figure 8. The number and location of potentially affected health facilities in Nepal from the 2015 Gorkha earthquake. In total there could be 699 schools affected by the quake. Source: ADPC - <http://bit.ly/1ckKbhq>

These hospitals have been retrofitted for safety, which involves everything from repairing cracks in walls to installing seismic belts and roof bracing, and has been a core part of preparedness plans. The WHO further reported that these retrofitted hospitals went through a process of prioritization, where emergency rooms, maternity wards, and operating theatres were some of the first areas where retrofitting was applied. In addition it was also noted that the response to the earthquake by health care providers was resilient because of pre-planning and training initiatives under the WHO-supported Hospital Preparedness for Emergency Programme.

Similar experiences have also been reported elsewhere. For example, it has been reported that the Chhatrapati Free Clinic (CFC) in Kathmandu didn’t suffer damage in the recent earthquake, despite the building being built back in 1962 and three floors were added in 1985. This was because three years ago, the owner decided to retrofit the building costing him 40 per cent of constructing a new building. As a result, the clinic was able to treat hundreds of people injured in the earthquake and provided shelter to many who lost their homes. *Figure 8* shows the 699 health clinics and their location, which are potentially affected by the Gorkha earthquake.

¹⁸ <http://www.who.int/mediacentre/news/releases/2015/nepal-second-quake/en/>

It is important to take note that economic losses will be much less when a robust safe schools and hospitals program is in place. Last but not least, much of the social life in communities takes place around these vital structures, and when these remain intact, will help communities to quickly regain pace in recovering and organizing themselves.

The earthquake damaged a large number of cultural and heritage sites in Nepal. Outside of Kathmandu, a number of such sites and structures survived the earthquake and its aftershocks, including the Boudhanath and Swayambunath.

A crowd map¹⁹ as shown in Figure 9 was developed by ICCROM and shows reported damages to cultural heritage sites in Nepal after the earthquake. A report²⁰ analysing the 141 entries in this crowd map notes that 68 entries mention sites that have collapsed completely. An additional 56 entries mention major structural damage, which means that these sites are at particular risk as their situation could worsen with another aftershock. The rest of the entries mention medium or minor damage to heritage, or they refer to salvage, cleaning or protection efforts.

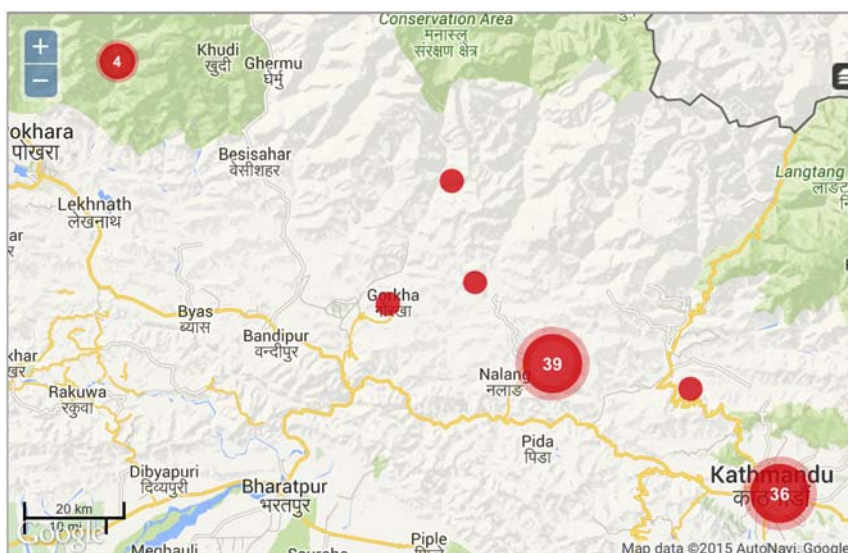


Figure 9. Crowd map of damage caused to cultural heritage in Nepal as a result of the Gorkha earthquake on 25 April 2015. Source: ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property) - <https://kathmanduculturalemergency.crowdmap.com>

Within Kathmandu in Durbar Square, a large number of iconic sites and structures were destroyed, though a few survived, including Taleju and Jannath temples, the Kumari House, and the Pashupatinath Temple. The list of destroyed cultural and historic structures been reported to have been completely destroyed include Kasthamandap, Maju Dega and Narayan Vishnu Temples, Trailokya Mohan, Krishna (Chasin Dega), Dharahara (Bhimsen Tower), Hari Shankar, Jagan Narayan, Fasidega Temple, and Vatsala Durga Temple.

Many temples and monuments that were restored in the recent past performed much better in this earthquake, and also there were many historic structures that were resilient because of their design, the type materials of used and the engineering of their construction. They performed well on past earthquakes and again in this one. The Pashupatinath Temple, which withstood this earthquake, has been renovated a number of times recently and by design is not very tall, and is made of brick as opposed to mortar, with walls that are held together by a roof made of metal sheets.

The above impacts provide an insight to some lessons learned in reducing risks to infrastructures - retrofitting, good design and engineering, and use of good building materials all support resilient infrastructures. Supporting with proper capacities of users and service providers ensure that these infrastructures are operational after disasters.

¹⁹ <https://kathmanduculturalemergency.crowdmap.com>

²⁰ <http://bit.ly/1d0XF2d>

3) Conclusions

To understand Nepal's risk to disasters in the future, it is necessary to better understand the underlying drivers of these risks. Given the fact that Nepal has a high level of frequent hazards, exposure and vulnerability the country is still very much at risk for future disasters.

Looking at the impact of the earthquake the report explains that the earthquake largely affected the Nepalese economy, in terms of its infrastructure, tourism, cultural heritage, schools and hospitals. These will also be key areas in building back better after the disaster. There is a lot of scope to build back better than before and to ensure that the risks are not rebuilt for future generations to suffer from again.

4) Resources

Important resources related to disaster risk reduction in Nepal:

- Nepal DRR Country Profile in Preventionweb: <http://bit.ly/1PPtz3L>
- Nepal Risk Reduction Consortium: <http://un.org.np/coordinationmechanism/nrrc>
- A variety of Nepal disaster risk maps: <http://bit.ly/1PPt3m8>
- Damage to cultural heritage crowd map: <http://bit.ly/1PPtiOe>
- NSET resources on the Gorkha earthquake: <http://www.nset.org.np/eq2015/>
- Preventionweb disaster risk mapping platform: <http://bit.ly/1PPtNI6>

Preventionweb "Ask an Expert" sessions:

- On Building Resilience by Reducing Disaster Risks to Cultural Heritage: <http://bit.ly/1PPtaOL>

Preventionweb related resources:

- Hazards in Nepal: <http://bit.ly/1PPue5b>
- Disaster vulnerability in Nepal: <http://bit.ly/1PPusJs>
- Disaster risks in Nepal: <http://bit.ly/1PPuqBo>
- Nepal and DRR: <http://bit.ly/1d0ZqwB>