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INVESTIGATING COMMUNITY RESILIENCE IN CHAUTARA, NEPAL

B. Lizundia[(1)], H. Kaushik[(2)], J. Kupec[(3)], S. Shrestha[(4)], C. Welton-Mitchell[(5)]

[(1)] *Executive Principal, Rutherford + Chekene, Structural + Geotechnical Engineers, San Francisco, USA, blizundia@ruthchek.com*
[(2)] *Associate Professor, Department of Civil Engineering, Indian Institute of Technology Guwahati, India, hemantbk@iitg.ac.in*
[(3)] *Technical Director Ground Engineering, Aurecon, New Zealand, Jan.Kupec@aurecongroup.com*
[(4)] *Senior Engineer, Dharan Sub Metropolitan City, Nepal, surbitan@gmail.com*
[(5)] *University of Colorado, Natural Hazards Center, and University of Denver, Humanitarian Assistance Program, USA, courtneymitchell13@gmail.com*

Abstract

Following the M7.8 earthquake on April 25, 2015 in Nepal, as part of the Earthquake Engineering Reconnaissance Institute (EERI) reconnaissance trip, a research team of several academics and practitioners in earthquake engineering and risk reduction spent a few days in the town of Chautara, Nepal to document the impact of the earthquake. This paper uses our multidisciplinary reconnaissance observations about a variety of community sectors to describe the state of Chautara in early June 2015 and to identify several factors and conditions that can help understand how resilient this community was to the Nepal Gorkha Earthquake and its aftershocks. The findings and observations from our team's visit and subsequent information gathering can help inform follow-up reconnaissance investigations to the community to monitor recovery progress and to make further observations about the resilience.

The research team observed impacts to buildings, including housing, hospitals, and schools; lifelines; and social systems and psychological wellbeing. For each of these community sectors, the following questions will be addressed: What were the overall impacts, performance, and recovery of the sector to date? Which elements or components proved to be critical to the function of the sector and why? Did the sector have any cascading impacts—positive or negative—on other community systems or functions? Were transformative improvements made to the subsystem (or any policies/codes/plans influencing its operation) before the disaster that somehow changed the sector and its function in the disaster? Are transformative improvements being undertaken in the aftermath of the disaster (or have they already been undertaken) to allow the community to surpass its pre-disaster state/condition?

While making observations about community resilience and conducting traditional reconnaissance for these sectors, the team also systematically gathered detailed data for over 150 buildings along the main road in Chautara. We recorded parameters including building structural type, damage and postearthquake safety evaluation status, and characteristics of the ground slope for each building. The paper describes the survey and how the baseline data can used as a metric for future field teams investigating Chautara's recovery and resilience.

This paper also considers preliminary information for broad resilience questions for community of Chautara: How is the community organizing for recovery, i.e. what are the recovery goals (shelter, livelihoods, public services) and who are the recovery actors (government, NGO, residents, businesses)? What decisions are being made and how are resources being prioritized to maintain or alter community functions? What parts of the urban system survived, and why?

Chautara is a municipality located east of Kathmandu at the top of a large mountain ridge at approximately 1,600 m above sea level. It is the only large municipality in the Sindhupalchok district and serves as the district's headquarters. Because the ability to swiftly respond in the weeks after the event and recover over many months varies by community size, degree of direct seismic impact, and preparedness and mitigation efforts prior to the earthquake, this case study of Chautara is one of several Nepal communities studied by the EERI team.

Keywords: reconnaissance, resilience, Chautara Nepal, 2015 Gorkha Nepal earthquake

1. Introduction

On Saturday April 25, 2015 at 11:56 am local time, the M_w7.8 Gorkha Earthquake occurred, followed by a strong aftershock sequence [1]. The May 12, 2015 M_w7.3 aftershock located to the east of the initial epicentral area was the strongest and caused severe damage in the Dolakha and Sindhupalchok (also spelled Sindhupalchowk) districts north-northeast of Kathmandu. Per [2], there were over 8,790 casualties and 22,300 injuries. It is estimated that the lives of eight million people, almost one-third of the population of Nepal, were impacted by these earthquakes [2]. The destruction was widespread covering residential and government buildings, heritage sites, schools and health posts, rural roads, bridges, water supply systems, agricultural land, trekking routes, hydropower plants, and sports facilities. Hundreds of historical and cultural monuments were either destroyed or extensively damaged. Over half a million houses were destroyed. Rural areas in the central and western regions were particularly devastated and further isolated due to road damage, road obstructions from landslides, and destabilized slopes which also left them more susceptible to flooding and landslides during the subsequent monsoon season [2].

Sindhupalchok, a rural district with a population of 69,600 [3], was one of the most heavily impacted districts, with over 3,400 deaths, 66,000 collapsed buildings, and rescues of 4,000 people reported by local administrators. Chautara is the district headquarters and suffered severe damage. Chautara has nine wards, with the furthest at 9 km from the main area of town. There are 16,000 buildings and 5,000 homes. Per the municipal engineer, 95% of buildings were damaged, and a large number collapsed, including the only hospital. The main road through town was closed due to fallen buildings and debris, diverting traffic through 7 km of rural roads. Water service was lost. Housing losses created the largest impact, and an informal United Nations settlement camp was established at the only available level area in town. It provided tents, food, water, restrooms, and medical facilities.

Chautara was selected by the reconnaissance team as a case study to investigate resilience issues due to the level of damage and the importance of the town to the surrounding communities. In the following sections, we focus on community resilience, first discussing preparedness and performance of buildings, then geotechnical issues related to resilience, then lifeline performance, and finally turn to social and psychological effects.

2. Building Resilience

2.1 Building Stock Characteristics, Preparation, and Performance in the Earthquake

Much of the following summary on building performance is taken from [4]. The most common building typologies in Nepal are reinforced concrete (RC) frame buildings with masonry infill walls, unreinforced masonry (URM) bearing wall buildings, and wood frame buildings. The RC frames are commonly constructed in urban and semi-urban areas. Most of these buildings are three to five stories high, and most privately owned buildings are non-engineered. Burnt clay bricks are widely used as masonry infill walls. URM bearing wall buildings are an obvious choice for the population in rural areas and the outskirts of cities, primarily to limit the material expenses. Such buildings are generally two to four stories high and constructed using burnt clay brick masonry or stone masonry with cement, lime, or mud mortar or a combination of lime and brick dust. These buildings have either wooden or reinforced concrete flooring. A hybrid type of construction also prevails in semi-urban and rural areas, where wood frames are used in the ground story front façade, and rest of the house is made of unreinforced masonry bearing walls. Wood frame houses (generally two to three stories high) are also observed in rural areas where the material for such construction is easily available. In downtown Chautara, buildings were RC frame and URM bearing wall; wood frame construction was observed on the outskirts of town.

A major problem facing Nepal is the high proportion of existing owner-built properties that do not comply with many of the provisions in the code. In urban areas, over 80% of all buildings are built by owners or local masons. This number increases to over 90% in rural areas [5], and only about 5% of these have professional engineering design and supervision. In general, most of the owner-built structures are constructed following the advice of local craftsmen and masons. Therefore, the three common types of construction in Nepal suffered a variety of damage during the 2015 Gorkha Earthquake and aftershocks. The RC frame buildings with masonry infills and URM wall buildings suffered extensive damage, whereas as expected, wood frame construction typically performed very well, except for those cases where slope failure took place or where the heavy brick veneer on the exterior collapsed.

RC frame buildings of all heights suffered damage ranging from minor to severe, and even to collapse, depending on their location and configuration. Primary reasons for the poor performance exhibited by these buildings are non-engineered construction, lack of seismic features, non-ductile detailing, poor configuration and connections between different members, poor material quality and workmanship. Damage was more prominent in buildings constructed on ridge tops perhaps due to ridge-top amplification of ground motion. Interestingly, masonry infill walls were found to be more or less intact in large number of buildings that had permanent displacement, implying a foundation failure. Generally, a geotechnical investigation for the project site is not carried out in Nepal, except for some important projects, which often results in inappropriate foundations on slopes. A large number of buildings constructed on slopes collapsed or suffered permanent displacement/tilt due to foundation or slope failure. URM buildings performed worse than RC frame with masonry infill. Moreover, buildings with poor quality construction and mud mortar performed noticeably worse. Typical damage to these buildings includes wythe delamination, out-of-plane/in-plane/corner wall damage, roof/attic damage, and partial/total collapse. Due to the lightweight construction and inherent ductility in the framing system, timber frame houses performed reasonably well during the earthquake and aftershocks when compared with the URM bearing wall and RC frame dwellings.

Sindhupalchok had dramatic loss of housing, with 84% of homes categorized as totally destroyed, 13% as heavily damaged, 1% with moderate damage, 1% with minor damage, and none with zero damage [3]. Over 90% of homes were vacated [3]. Statistics were not available for Chautara, but housing losses were significant.

Most of the critical healthcare facilities and school buildings in Nepal also belong to one of the three common typologies as already discussed. The RC frame with infill hospital in Chautara was significantly damaged and vacated. As noted in [4], the World Health Organization performed a rapid health assessment of hospitals and healthcare facilities in 12 affected districts in Nepal at the time of the EERI reconnaissance trip, and found that approximately 90% of health care facilities outside main towns were not functioning. The assessment included 21 hospitals in 10 districts (nine private hospitals, eight district hospitals, and four larger central hospitals). Of these, four district hospitals (Chautara Hospital, Ramechhap District Hospital, Rasuwa District Hospital, and Trisuli District Hospital) were not functional, with damaged infrastructure (no water supply or power, and perhaps only limited out-patient activities). These four district hospitals were replaced by field hospitals that were managed by foreign medical teams. One was located at the informal settlement camp at Chautara.

Similarly, a large number of school buildings constructed as RC frame with infills and URM bearing walls suffered severe damage and were already evacuated at the time of the visit. The classes were held in tents erected in open grounds near the school buildings.

2.2 Postearthquake Safety Evaluation

Postearthquake safety evaluations in Nepal are discussed in [4], with a summary provided here. By the time of the reconnaissance team's visit to Nepal, 60,000 postearthquake safety evaluations had been done. Many government agencies and organizations were involved, with the Nepal Engineers' Association (NEA) taking a prominent role. Other nongovernmental organizations participated, and some utilized volunteer foreign engineers. In most cases, only government buildings received an official posted placard or tag. In other cases, although a placard was not posted, evaluators discussed their findings with owners, residents, and tenants.

Nepal had developed guidelines regarding postearthquake safety evaluation prior to the Gorkha Earthquake [6]. The guidelines draw from [7], [8] and [9], but also have information specific to Nepal. The three categories used by the Nepal guidelines are summarized in Table 1.

In Chautara, prior to the EERI team's visit, postearthquake safety evaluations had been done along the main town street, also known as the Dolaghat-Chautara Highway, reportedly by DUDBC inspectors. Several damaged government buildings had received a posted red UNSAFE placard. Other buildings that had been evaluated were not posted, but they were documented with a red, yellow, or green spray-painted dot on the building to represent their UNSAFE, RESTRICTED USE, and INSPECTED status. We observed many buildings with red and yellow dots that were continuing to be occupied and shops that remained open to the public. Residents and shop owners indicated that evaluators had explained the meaning of the dots, but they chose to keep the stores open due to the need for income. They did not sleep in the residential portions upstairs at night, but rather in a nearby tent. We understood this approach was not uncommon throughout the town while large aftershocks continued.

Table 1. NSET/DUDBC guideline postearthquake safety placard criteria [6]

Posting Classification	Color	Description
INSPECTED	Green	No apparent hazard found, although repairs may be required. Original lateral load capacity not significantly decreased. No restriction on use or occupancy
LIMITED ENTRY/Restricted Use	Yellow	Dangerous condition believed to be present. Entry by owner permitted only for emergency purposes and only at own risk. No usage on continuous basis. Entry by public not permitted. Possible major aftershock hazard
UNSAFE	Red	Extreme hazard may collapse. Imminent danger of collapse from an aftershock. Unsafe for occupancy or entry, except by authorities.

2.3 Survey of Damaged Buildings in Chautara

Earthquake reconnaissance efforts generally do not have sufficient time or resources to collect statistical damage data, and instead observations and findings are typically based on an anecdotal approach. In Chautara, however, the EERI team had sufficient time to conduct a detailed statistical survey of the damage to all of the buildings along each side of a long, representative length of the main town street. This was a unique opportunity, given the significant in Chautara and along the street. The street was near or at the crest of the hill, and some of the buildings were on the up slope side of the hill, while others were on the down slope side of the hill. Information on the survey is taken from [4].

Information was recorded for 152 buildings by a group of four EERI team members who reached consensus on each building. The evaluation began at Press Chowk Square at 27.7734ºN, 85.71699ºE and proceeded north to 27.77733ºN, 85.71201ºE to the informal UN settlement camp. Buildings on the up slope side of the street where typically on a relatively flat site. Those on the down slope side had a relatively steep drop off to the rear of the building. Fig. 1a shows the rear of a building on a steep down slope. Fig. 1b shows the postearthquake safety evaluation marks for a pair of buildings.

At the time of the EERI visit, not all of the buildings had the spray painted mark visible. Some were so badly damaged that they had been demolished or were in the process of being demolished. Others had collapsed, but were not yet demolished. For those with lesser levels of damage, the ATC-13 [10] damage scale was used, with qualitative damage state categories of major, heavy, moderate, slight, light, and none. All of the buildings along the street were either URM bearing wall buildings or reinforced concrete frame with masonry infill. There were 56 URM buildings and 96 RC frame buildings. Of the URM buildings, 46 were stone, four were brick, and six were a combination of stone and brick.

Table 2 provides a summary of all 152 cases showing the damage status, building type, and slope condition. Table 2 combines the more severe damage status categories of demolished, collapsed, major, red and heavy into one group and the less severe categories of yellow, moderate, green, slight, light, and none into a second group, and then provides the percentages for each group. The following observations can be made from Table 3.

- RC frame buildings performed better than URM buildings. For the RC frame buildings, 47% were in the more severe damage category; for URM buildings, 89% were in the more severe category.
- Buildings on flat lots on the up slope side of the street performed better than those on the down slope side of the street. For flat lots, 54% were in the more severe damage category; for down slope lots, 66% were in the more severe category.
- URM buildings on the down slope side of the street performed particularly poorly, with 97% in the more severe damage category.

(a) (b)

Fig. 1—(a) Rear view of RC frame with masonry infill building in Chautara showing the down slope side; note stone infill at lowest story (photo: Bret Lizundia), and (b) damaged buildings in Chautara showing spray-painted marks indicating postearthquake safety evaluation status (photo: Hemant Kaushik).

Table 2 – Chautara street survey showing number of buildings by damage status, building type, and slope condition

	Number of Buildings by Structural Type and Slope Condition								
	All Buildings			URM			RC Infill		
Damage Status	Flat or Down	Flat	Down	Flat or Down	Flat	Down	Flat or Down	Flat	Down
Demolished	20	2	18	20	2	18	0	0	0
Collapsed	10	5	5	9	5	4	1	0	1
Major	2	0	2	0	0	0	2	0	2
Red	58	17	41	18	7	11	40	10	30
Heavy	5	2	3	3	2	1	2	0	2
Yellow	33	8	25	1	1	0	32	7	25
Moderate	4	2	2	1	1	0	3	1	2
Green	9	3	6	1	0	1	8	3	5
Light	4	4	0	1	1	0	3	3	0
Slight	6	4	2	2	2	0	4	2	2
None	1	1	0	0	0	0	1	1	0
Total	152	48	104	56	21	35	96	27	69

Table 3 – Chautara street survey showing percentage of buildings by damage status, building type and slope condition

	Percentage of Buildings by Structural Type and Slope Condition								
	All Buildings			URM			RC Infill		
Damage Status	Flat or Down	Flat	Down	Flat or Down	Flat	Down	Flat or Down	Flat	Down
Demolished/Collapsed/Major Red/Heavy	63	54	66	89	76	97	47	37	51
Yellow/Moderate/Green Light/Slight/None	38	46	34	11	24	3	53	63	49
Total	100	100	100	100	100	100	100	100	100

The survey provides an excellent metric to monitor recovery both for government administrators and researchers. Possible items could include the following:

- What is the status of each building at discrete points in time, such as damage status has worsened with time and aftershocks, collapsed buildings have transitioned to demolished, repairs are in progress or completed, rebuilding is in progress or completed, or damage remains unaddressed.
- Are buildings with RESTRICTED USE and UNSAFE status being occupied? Does the pattern continue of keeping ground floor shops open, but not sleeping in upper residential stories?
- Are buildings being rebuilt with the same standards, techniques, and materials, or are improvements being made?
- Who is performing the repairs and reconstruction? Is it the owner or a contractor?
- Has the city reviewed the plans? Did they review include checking for conformance with the structural provisions of the Nepal Building Code?
- Was there inspection by the government during repairs or rebuilding?

2.4 Barricades and Shoring

At the time of the team's visit to Chautara, there were no barricades or shoring in place. Debris that had fallen into the main street had been partially cleared to create a narrow route for pedestrians and local traffic. Much of the debris was being moved by hand, though heavy equipment was beginning to arrive to assist in removing more significant damaged elements. Heavily damaged buildings lined the street. In some cases, the buildings were leaning towards the street, indicating the likely direction they could fall in an aftershock. Pedestrians were walking right next to these buildings.

In California, the California Building Officials (CALBO) developed a document to provide guidance for barricades, cordons, and shoring based on observations following the 2011 and 2012 earthquakes in Christchurch, New Zealand. The *Interim Guidance for Barricading, Cordoning, Emergency Evaluation, and Stabilization of Buildings with Substantial Damage in Disasters* [11] guide recommends setting a preliminary soft barrier for fencing at a horizontal offset distance of at least 1.5 times the height of a damaged structure in typical situations. These guidelines are recent, not mandatory, and not well publicized, and typically each jurisdiction approaches barricading differently following an earthquake. In most locations in Nepal, the streets are narrower than the height of the buildings adjacent to the street, so a 1.5 horizontal to 1.0 vertical criterion would lead to preventing access to the street entirely, and buildings on one side could still pose a risk to the adjacent or opposing buildings. This was the case in Chautara. The decision to barricade or cordon weighs public safety on one hand vs. access on the other. Cordoning off the main street in Chautara would have limited life safety risks in aftershocks, but it would have had a dramatic impact on the community functionality, recovery, and resilience.

3. Geotechnical Issues Related to Resilience

Large scale slope stability modelling available prior to the reconnaissance trip indicated that many slopes in the epicentral area are likely to have failed due to the severe seismic shaking [12, 13, 14]. Given the geology and topography, the team expected to be confronted with land instability issues, and a geotechnical professional was included as part of the team to determine the impact of geohazards on remote communities and key infrastructure.

Modelling based on remote sensing indicated that many slopes would have failed. This was confirmed by news footage and discussions with the Geotechnical Extreme Event Reconnaissance (GEER) team [15]. Many roads were buried or impacted by landslide debris. This cut off many remote townships and villages such as Sengati at the Tama Koshi River, where relief goods and help for the first few weeks were only able to be delivered by helicopter. The only road from Sengati towards the Chinese border along the river was at the time of our reconnaissance trip still fully blocked by landslide debris over much of its length and only the first 5 km were partially cleared before efforts were abandoned due to ongoing rockfalls. Discussions with local residents indicated that the army camp upstream may wait till the end of the 2015 monsoon season to clear the road.

Discussions with the municipal engineer in Chautara indicated that numerous large landslides affected the Sindhupalchok district. This was confirmed by US Air Force aerial reconnaissance missions and GEER team aerial surveys. One such landslide was visited to determine is location, size, and impact on the community. The particular issue with the Herlang Berlang landslide, as it was locally referred to, was that it impacted a local village and buried houses and caused fatalities. The municipal civil engineer requested that a geotechnical engineering 'check' to see if the relocated village was in a location with a lower risk profile. The details of the landslide are provided in [4]. The team noted extensive land damage at the cliff or escarpment edge and significant downslope landslide debris volumes. The relocated village appeared to be sited some several hundred meters away from the landslide on a prominent ridgeline thus reducing any future impact. The municipal engineer indicated that at least 32 villages in Sindhupalchok were relocated away from imminent hazards, but those relocations were undertaken without any specific engineering advice. Relocation guidelines are needed.

The Herlang Berlang landslide is likely to further retreat over time due to extensively cracked land, and this will affect the only access road along the escarpment to the relocated village and several others. Although the current pedestrian access route could be easily re-routed, it appeared that the municipality was building a road extension just at the head of the landslide. Landslides affected numerous roads, and in many instances the landslides were still very active with ongoing debris and rockfall onto the carriageway.

In Chautara and nearby Irkhu, the team noted that buildings on slopes did not perform as well as buildings on level ground. This could be mainly associated with foundations on steeper terrain creating the need for unfavorable short and long column combinations, but many buildings along the Dolaghat-Chautara Highway were leaning in a southeast to northwest direction indicating the main direction of seismic shaking. Thus, shaking directivity and proximity to ridgelines causing ridge amplification effects increased the building damage which in turn impacted main access roads by either building debris being deposited on the roadway or severely damaged buildings leaning over the road.

4. Lifeline Resilience

Lifeline performance was discussed with both the Sindhupalchok district engineer and the Chautara municipal engineer. They reported the following.

- Initial response and mobilization: The army came first and performed a general evaluation of conditions including lifelines, provided search and rescue, and began some road repairs. Additional government administrative staff arrived from other parts of the country two days after the earthquake. NGOs followed.
- Food and water: On the day of the earthquake, the municipality provided food and water, by making local purchases. There was still no water service at the time of reconnaissance trip, due to damaged pipelines. The water was being brought by three tanker trucks from a spring four km away. Tanker truck service started on the second day after the earthquake. Initially, the municipality operated the tanker service. After 15 days, NGOs took over this task. There were seven distribution points for Chautara and its surrounding wards. The army was working on repairs to the pipelines which were anticipated in two weeks after our visit. During the visit, bottled water was available in stores. As of May 2016, some repairs have been made to the water pipeline system, but pre-earthquake capacity has not been fully restored. Additional repairs and upgrades are planned.
- Sanitation: They had no reticulated sanitation system before the earthquake. The vast majority of homes in Chautara used septic tanks.
- Roads: 14% of roads were blocked at the time of our visit. The Sindhupalchok district was performing the repairs with their own resources, as issuing a contract to outside sources was estimated to take up to one month. They plan to widen the main road to 15m. The main road through town was blocked by building debris and impassable at the time of our visit. A local road was widened and improved using imported river gravel and crushed demolition debris to provide the 7 km detour noted above.
- Power: Electricity is provided by hydropower. It took 12-13 days to restore power after the April 25 mainshock and a similar period following the large May 12 aftershock. The loss of power affected the water distribution system. As of May 2016, power has been returned to pre-earthquake levels. These are insufficient to meet demand, and blackouts continue.

- Telephone: Most citizens have cell phones. Many cell phone towers were fixed to multilevel buildings which performed badly reducing cell phone coverage. Cell towers were being repaired or replaced at the time of our visit, but cell phone service was available. Landline phone service was still down. As of May 2016, both cell phone service and the landline serviced are working well.
- Fuel: There was no local fuel service at the time of our visit. As of May 2016, it has returned to pre-earthquake levels, but capacity and availability remain less than desired.
- Debris Removal: The International Organization for Migration (IOM) was managing this at the time of the reconnaissance visit. Access to heavy equipment was limited. In Chautara, we noted a backhoe tractor was the sole piece of demolition equipment. Equipment and expertise are still limited in much of Nepal, with training being provided by consultants from New Zealand. As of May 2016, in Chautara, formal demolition has stopped, but informal demolition of about ten houses is ongoing.

5. Community Resilience: Disaster Attributions, Cohesion, Stress and Coping

In the Sindhupalchok district, 59% of the population is Hindu and 38% is Buddhist; 52% are female, 48% are male. The mean household size is six persons. There are an estimated 24% female-headed households, slightly lower than the national average. There are four major ethnic/caste groups in the district: Tamang, Chetri, Newar, and Brahmin, with smaller numbers of another 22 ethnic groups [16, 17].

Chautara Municipality is an agricultural and business hub for the district, and is situated around a main bazaar that sustained heavy damage in the April 2015 earthquake and associated aftershocks. Given the extent of damage to buildings, an informal settlement camp was established in Chautara. The camp was managed by the International Organization for Migration (IOM) and coordinated through the UN Cluster system. At the time of the reconnaissance team's visit, the camp director indicated there were over 410 displaced persons living in tents, with humanitarian agency personnel also living on-site. The camp provided food, water, and restroom facilities. 'Safe spaces' for children had also been established. Due to the loss of the primary hospital in the area, temporary medical facilities were also located in the camp.

In addition to making observations about the state of buildings, the reconnaissance team spoke with about 30+ adults in Chautara, including local community members, NGO staff, and government officials. Interviews were semi-structured, but focused on the following components: 1) disaster attributions; 2) current circumstances - with regard to damaged residences and businesses; 3) plans for rebuilding; 4) community cohesion and conflict; 5) perceptions of aid providers; and 6) stress and coping, including mental health concerns.

Many community members shared a belief that the earthquake had occurred because people have not been true to their religious beliefs. Others emphasized the role of past karma (past bad acts creating current bad luck), or the need for adequate preparation, in the form of blessings from a religious figure, when preparing the land and building a new house. A sampling of quotes addressing some of this issues is included below in Table 4.

Table 4 - Disaster Attributions

Person	Quote
Middle-aged man, Gurung	"People started leaving their religion and they bulldozed the 'people tree' – they have lost their faith in God."
Middle-aged woman, Newari	"In some houses children died because of the family's karma."
Older male shop owner	"Most people think that the earthquake and aftershocks are happening because most people don't follow religion. The older generation just focuses on religion and doesn't want to learn about disaster preparedness, but the younger people base their ideas on understanding science."
Middle-age woman, Newari	"When people buy land, the people should do 'puja' with a Brahmin priest. If they don't follow the path of dharma earthquakes and other bad things can happen.

Some people were reticent to evacuate damaged buildings, despite government efforts. The Associated Press [18] reported that government officials walked through Chautara on May 13, 2015 telling people to leave unsafe buildings, one day after the M_w 7.3 aftershock caused additional damage to buildings in the main bazaar and surrounding areas. As noted above, many shop owners in damaged buildings occupied the shop during the day, but slept in tents at night. Several community members remarked that they would like to rebuild in the same area. Some indicated that they would rebuild, but with fewer upper stories in order to mitigate future risk. For example, one man explained that there is some damage to their four-story house, but they believe they can repair it. He also stated that they would like to remove the top two floors, reducing the four stories into two. Although one family indicated that they will leave and go to Kathmandu, nearly all of the community members we spoke with indicated they will stay and rebuild. However, many were concerned about resource constraints and wondered why the government has not provided full compensation.

An Internews assessment team conducted interviews with displaced community members living in the camp in Chautara just a few weeks after the April 25, 2015 earthquake [19]. The report indicated a lack of information about earthquake risks and preparedness strategies, humanitarian aid, and strained social networks, fueling community conflict, and potentially decreasing the ability of community members to cope with ongoing stressors in the camp. One man we spoke with indicated that he has no social support, no immediate family in the area, and no close relationships in Chautara. He explained that this may be because he is Gurung with most of the people around him being Newar. “I am not considered as much a part of the community.” Others indicated that “this is a helpful community with strong relationships.” However, we heard quite a bit about recent conflicts, “The community here is not strong. We don’t have the feeling to work together for everyone. A few days before the earthquake there was a conflict at the water tank. It will be hard to rebuild.”

A few people the team interviewed expressed concern about fair distribution of aid, citing government corruption. For example, one woman stated, “only the powerful have access to supplies. Political leaders have all of the influence in society. Relief groups hand the resources over to the local political leaders and they store everything for themselves and just give some small things to the rest of us. There is a lack of trust in local leaders.”

Stress and coping and associated mental health issues came up several times. A doctor in the Chautara tent clinic indicated: “Many people in Sindhupalchowk suffer from post-traumatic stress disorder…. ‘They're afraid of every little thing; they have sleep and eating disorders.’ Some of them, she says, are extremely depressed, because they lost family members, their house, or all of their possessions in the earthquake. However, she estimates that only about 30 to 40 percent of those suffering from mental illness will even come to the hospital” [20]. This view is consistent with quotes from those in the community: “In our village communities, mental illness carries a stigma, people who are mentally ill are often discriminated against." Others indicated that “many people get angry easily and are very afraid, and because of this they behave badly with each other. In the past there was not much problem with alcohol, but alcohol use is on the rise.” This same person went on to explain that people seem to be using alcohol to manage the stress of what happened. A family we spoke with in the camp expressed concern for “[a] woman [who] lost her husband and child in the earthquake and wanders around in the camp crying….” Members of Transcultural Psychosocial Organization Nepal, a local organization providing mental health services to earthquake victims, was in Sindhupalchok recently. One of the TPO staff explained that many people are still experiencing significant distress, and that several suicides have also been reported in recent months (Joshila Rai, personal communication).

Religious belief systems and practices such as ‘puja’ (offerings to the gods), may function as a form of coping. However, such religious beliefs may also be the source of distress. For example, if community members believe that God has abandoned them, this may exacerbate distress. One woman explained that she has noticed that for some people religious practices have increased since the earthquake and for others such practices have decreased, “because some believe there is no God if something like this can happen.”

Since the EERI reconnaissance team visited Chautara in June 2015, community members have become increasingly frustrated at the slow pace of reconstruction. As reported by Channel NewsAsia [21], many people have left the area. Those who have stayed behind do not have the resources to rebuild on their own. Many are still living in tents, while others have returned to damaged homes, believing they have no alternative. The government has been assuring the community that additional funds for rebuilding will be forthcoming, but many community members remain skeptical.

Future reconnaissance teams should consider how disaster attributions, rebuilding efforts, community cohesion and conflict, perceptions of aid providers, and stress and coping - including mental health concerns, evolve over time.

6. Recovery

Recovery throughout Nepal has been slow due to political discord and administrative difficulties. The National Reconstruction Authority (NRA) was not established until December 2015. It first chief executive officer was replaced, and the new CEO is under investigation for graft [21]. One year following the April 25, 2015 mainshock, "Prime Minister KP Sharma Oli formally inaugurated the reconstruction campaign in [Chautara] Sindhupalchok" by laying a foundation stone for a new home and announcing the first signed agreement to rebuild a damaged home [22]. The Prime Minister noted that the blockade along the Nepal-India border by protesters and the delay in formation of the NRA had slowed recovery. The Prime Minister "also claimed that the government had received only one-fourth of the financial support pledged by the donors." And he noted "The donors have said they will extend financial support only after conducting a survey of the victims' newly built houses, which is not practical" [22].

Since early 2016, the government has deployed nearly 1,600 engineers to carry out eligibility surveys in rural areas hardest hit by the earthquakes. These teams are accompanied by social mobilizers to help understand and address grievances. As of April 1, 550,000 houses have been technically assessed for earthquake damage. The government expects to complete the damage survey by the end of April [23].

The following summary provides some highlights on how recovery is proceeding in Chautara outside of lifelines. The status of lifeline recovery is described above in Section 4.

- Building Code Enforcement and Rebuilding in Chautara: An overview of building code issues in Nepal is provided in [4]. Chautara became a municipality in 2014 with the merging of several smaller communities. With the transition to municipality, the district engineer reported that additional government administrators were added and a more rigorous approach to building code enforcement was taken. As one interesting example, even before the earthquake, the municipality had been advertising on radio the new requirement to obtain a building permit.

  At the time of the reconnaissance team visit, per the district engineer, the government had just begun to distribute payments 15,000 Nepal Rupees (approximately US $150 at the time) to those without homes. These were typically used to buy corrugated galvanized iron (CGI) sheets for shelter. As of May 2016, per the municipal engineer, the informal settlement camp has been removed and returned to open space. However, a reporter noted that "The main street of Chautara still looks as if the shaking has only just stopped, and there certainly hasn't been any determined effort at reconstruction. Locals complain about the lethargic government" [20]. A survey of residents in districts heavily affected by the earthquake found that respondents "have a lack of information on when support will be received, how they can access reconstruction support and how they can rebuild using safe construction practices…. The majority of respondents (96%) believe they will need additional support to build back safely," primarily with financial assistance [24].

  A total of 3,855 houses in Chautara have been identified for reconstruction by the government, and there is an initial agreement with owners have been completed for 2,120 houses. The owners will receive 50,000 Nepal Rupees (US $470 in May 2016) initially, and eventually 200,000 Nepal Rupees (US $1,870). However, the amount has not been released by the government yet. For the first installment of 50,000 Nepal Rupees, the homeowner does not need to submit the building drawings, but for the other installments, they have to have submitted drawings and obtained a permit from the city. No one has yet submitted an application for permit to the Chautara municipal government within the framework for the grant.

  However, those who can afford to proceed without a government grant have already started the reconstruction work. So far, 13 new houses have received a foundation (or plinth level) permit, two have received a superstructure permit, and one has received a construction completion certificate. (Building permits in Nepal are is issued in three stages). These new buildings have generally followed the Nepal Building Code. Although inspection during construction is performed as part of specific programs in some Nepal cities, it remains limited in Chautara. The United Nations Development Program recruited a civil engineer to help the municipality check drawings for code compliance. Recently, structural analyses were submitted with drawings for two buildings greater than three stories; the submissions are being reviewed.

- Retrofitting in Chautara: Per the municipal engineer, informal retrofitting of some damaged buildings has been done. They have not consulted the municipality or received a permit for the work. The structural analysis and design of the retrofitting has been done by the consultants in Kathmandu because the municipality lacks competent structural engineers/consultants. Some steel frames been added, but only a few have done any retrofitting of foundations. A formal retrofit of the Divisional Office of Department of Urban Development and Building Construction (DUDBC) was completed. The Nepal Building Code does not have explicit provisions for seismic retrofitting. Indian and US standards are sometimes used. DUDBC developed their own draft guidelines, but they have not yet been endorsed by the government.
- Healthcare in Chautara: At the time of the reconnaissance team visit, it was expected that the damaged Chautara hospital would be demolished and eventually replaced. The settlement camp director noted that there were plans to move the temporary medical facility from the settlement camp to the large level grounds adjacent to the hospital. There were concerns with the coming monsoons that the settlement camp drainage would be insufficient. Mobile clinics were used to provide health care service to surrounding villages. As of May 2016, per the municipal engineer, the Ministry of Health is planning to retrofit the damaged hospital, and retrofit designs are being developed. A temporary medical facility remains [20]. "The majority of people in Sindhupalchowk are still living in makeshift huts. "Infectious diseases, vomiting or diarrhea spread quickly because there are a lot of people in the emergency shelters, living in very close proximity," noted one of the Chautara doctors [20].
- Schools: As of May 2016, schools remain in Temporary Learning Centers, which are tents with some additional improvements. No school buildings have been reconstructed to replace those that were damaged.
- Planning: Planning is done at the central government level, with yearly plans due in October. Due to the earthquake, this process was cancelled. As of May 2016, the municipal engineer notes that with the support of UNDP, development of a Risk Sensitive Land Use Plan (RSLUP) has been started.

7. Closure

Chautara provides an excellent example for a case study in community resilience. Discussion has been provided on how building performance, geotechnical issues, lifeline performance, and social and psychological factors in the earthquakes and in the ongoing recovery relate to community resilience.

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