



CEDIM Forensic Disaster Analysis Group & CATDAT and Earthquake-Report.com



Nepal Earthquake – Report #1
27.04.2015 – Situation Report No. 1 – 20:00 GMT



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| Official Disaster Name | Date | UTC | Local | CATDAT_ID |
|------------------------|--------------------|-----------------|--------------|-----------------|
| Nepal EQ | 25-Apr-2015 | 06:11:26 | +5.45 | 2015-128 |

Preferred Hazard Information:

| EQ_Latitude | EQ_Longitude | Magnitude | Hyp. Depth(km) | Fault Mech. | Source | Spectra |
|---------------|---------------|---------------|----------------|---------------|-------------|---------------|
| 28.147 | 84.708 | 7.76Mw | 10-18 | Thrust | USGS | Avail. |

Duration: 80 secs

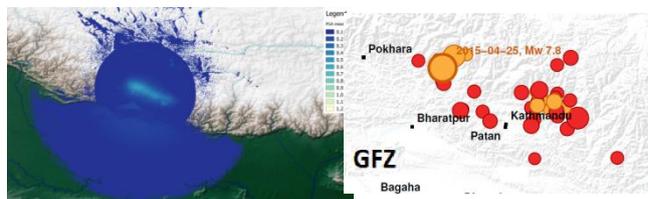
Location Information:

| Country | ISO | Dev. Region | Most Impact | Building PF | HDI (2015) | GDP nom. USD | Pop. (2015) |
|--------------|-----------|----------------|------------------|----------------|--------------|-------------------|--------------------|
| Nepal | NP | Western | Gorkha | Average | 0.542 | 3.48 bill. | 5.27 mill. |
| Nepal | NP | Central | Kathmandu | Average | 0.558 | 8.84 bill. | 10.35 mill. |

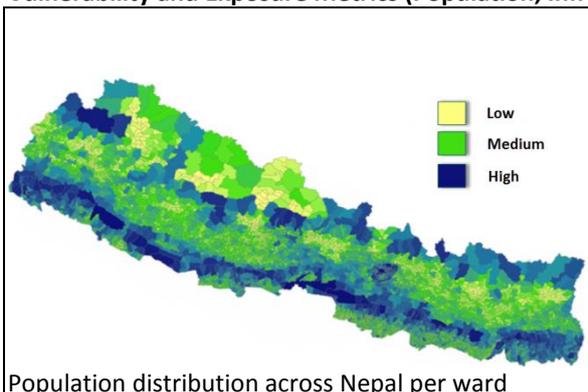
Preferred Hazard Information:

| MSK-64 | MMI | PGA | Key Hazard Metrics |
|-----------------------------------------------------------|---------|------|-----------------------------------------------------------------------------------------------------------------------------|
| VIII-IX | VIII-IX | 0.8g | Gorkha (VIII), Bharatpur (VIII), Kathmandu (VII-VIII, 0.3g), Pokhara, Darbhanga (VI), Patna, Ara (IV-V), New Delhi (II-III) |
| Hazard Description (Intensities and Ground Motion) | | | |

Intensities reached VIII on the MMI scale – very well built structures received slight damage. Older buildings suffered great damage. There was also limited liquefaction. The damage seen corresponds to VIII and perhaps very isolated VIII-IX locations on the MMI scale. Over 44 aftershocks > Mw4.7 have occurred, with magnitude 5 and 6 earthquakes continuing to pepper the region east of the epicenter. The fault sense can be seen well from USGS, Chinese and Geofon data, with the fault break running parallel to Himalayas toward Kathmandu. At least 60 aftershocks have been strong enough to be felt.



Vulnerability and Exposure Metrics (Population, Infrastructure, Economic)



Population distribution across Nepal per ward

Nepal has a net capital stock around \$36 billion USD with approximately 28.8 million inhabitants. In terms of capital and GDP it is an extremely poor nation with less than \$700 (USD) GDP per capita in 2015. It is mountainous in nature and has the chance for many landslides. Kathmandu and the Central and Western regions are key tourist areas for Nepal among others with the area accounting for 5% of GDP through tourism (direct/ indirect). The Kathmandu area has a GDP slightly higher than the rest of Nepal. The direct epicentral region has a lower GDP per capita in comparison. Agriculture (outside Central) and trade are the key components of GDP.

What have been the 2 largest comparable damaging events in the past? None exactly in this region.

| Date - Name | Impact Size | Damage % | Social % or Insured % | Economic Loss |
|--------------|-------------|---------------------------|-----------------------------|----------------|
| 1934 Bihar | Mw8.0, IX | 80,000 bldgs destroyed | 10,700 deaths | Ca. \$25m USD |
| 1988 Western | Mw6.8, VIII | 78,000 dest./ 76,000 dam. | 1004 dead, 300,000 homeless | Ca. \$130m USD |

Preferred Building Damage Information: (Damage states will be filled in later when more info available)

Description: *Many government, religious and private buildings destroyed.*
The counting of destroyed buildings has not been undertaken yet with estimations only made via satellite imagery and photos. Based on displaced families, this value could be up to at least 50,000 destroyed. In Kathmandu not as many are destroyed. Some smaller towns around the epicentre in Gorkha District have a high % of destroyed buildings (>40%).



Twitter photos of damage

Secondary Effect Information:

For weather impacts see <http://www.wettergefahren-fruehwarnung.de/>

| Type | Impact | Damage % | Social % | Economic % |
|------------|-------------------------------------------|----------|--------------------|------------|
| Landslides | Many roads blocked, infrastructure damage | Minor | At least 10 deaths | <2% |
| Avalanches | Camps destroyed, many deaths | Minor | At least 20 deaths | minor |

Preferred Social Impact Information:

| Type | Median | Accepted Range | Description | Source |
|--------------------|----------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------|-----------------------------|
| Deaths | 4005 | May rise | 1400-7500* = initial estimate 7560 (3570-11970)* = updated intensities | Daniell, CATDAT, EQ Report. |
| | **NB: 3862 Nepal, 20 China, 68 India and 4 Bangladesh as of 16.15UTC 27.05 | | | |
| Injuries | 7119 | May rise | | News |
| Homeless/Displaced | Unknown | | Currently unknown numbers | |

*predicted

Preferred Current Economic Impact Information:

\$million int. event-day dollars

| Type | Median | Accepted Range | Description | Source |
|------------------|-------------------|-------------------------|------------------------------------------------------------------------|----------------|
| Replacement Cost | \$5330m | \$4280m-\$6840m | Replacement Cost (without indirect/life) | CATDAT |
| Total Loss | \$3450m | \$2810m-\$4520m | Total estimate (using rapid loss model combined with damage for range) | CATDAT/Daniell |
| Insured Loss | <\$100m | unknown | Could be some business interruption | CATDAT |
| Aid Impact | \$65m | And many relief workers | UK: \$10m, Aus: \$5m, Nor:\$4m EU: \$4m, China: \$3.3mn, US: \$1mn | EQ Report |

Direct Economic Damage (Total) - Summary

Social Sensors & Disaster Response

| | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • There have been only rapid estimates as yet of economic losses resulting from this earthquake. • The rapid loss estimation of CATDAT/James Daniell, gives a total damage value coming out to between 3-3.5 billion USD with a replacement cost totalling over 25% of GDP. • This is a significant percentage of the gross capital stock of the location, being around 10% of capital stock. | <ul style="list-style-type: none"> • The alerts came out from twitter TENAS, within a couple of minutes after the event, with EQ Report alerts coming a minute later after Indian felt reports. • Twitter and Facebook have been monitored since for use in these analyses. |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Insured Loss Estimates:

Much public and critical infrastructure damage occurred, and in addition there was damage to tourist facilities in various locations. It is still expected that the damage will be insignificant for the insurance industry. There could be global supply chain issues with export/imports however major impacts are unlikely.

Abridged Summary Description from full CATDAT description sources:

A catastrophic earthquake hit the densely populated area of Nepal, west of the capital Kathmandu, causing much damage near the epicenter and also the surrounding regions. Much rural damage, major infrastructure damage.

| | | | |
|------------------------------------|------------------|----------------------------------|---------------------|
| CATDAT Economic Index Rank: | 8: Very Damaging | CATDAT Social Index Rank: | 9: Very Destructive |
|------------------------------------|------------------|----------------------------------|---------------------|

This report was produced in conjunction with the CATDAT database, earthquake-report.com, GEOFON and USGS data. As shown below is full size documentation of the diagrams shown in the summary above. The data is current as of 27th April 2015, 4:00pm European Standard Time. For the current data on losses, go to www.earthquake-report.com via www.cedim.de

The following report contains:-

1. [Seismological Information](#)
2. [Social Sensors](#)
3. [Current Situation on the ground for the next 96 hours \(weather reports etc.\)](#)
4. [Population and the Effects on Casualties](#)
5. [Shelter and Damage to homes](#)
6. [Economic Effects](#)
7. [Information Gap Analysis](#)
8. [References](#)

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KIT Karlsruhe Institute of Technology, www.kit.edu

SAI South Asia Institute, University of Heidelberg, <http://www.sai.uni-heidelberg.de/>

Earthquake-Report.com, SOS Earthquakes, www.earthquake-report.com

CATDAT Global Natural Disaster Loss and Exposure Databases, www.catdat.de

1 Seismological Information (and Aftershocks)

The earthquake occurred on Saturday April 25, 2015 at 11:56 local time (ca. 6.11 UTC) with moment magnitude 7.7-8.0 (preferred solution Mw7.8). The epicentral location: 28.15 N 84.71 E (roughly between Pokhara and Kathmandu) is densely populated and the earthquake had a hypocentral depth of 10-15km.

The moment tensor solution indicates a shallow dipping fault plane (auxiliary plane solution less probable for tectonic reasons). The rupture plane strikes parallel to the Himalayan Belt WNW to ESE, and dips with 10° to the North. The rupture process lasted for about 80 sec. Due to sedimentary basin effects the duration of shaking in Kathmandu Valley was probably longer and thus also more damaging.

Aftershocks are concentrated in the region of the epicentre as well as the region 150 kilometres to the east (at the end of the rupture). With magnitudes of 6.6 and 6.7 these should be the largest magnitudes in an average statistical sense (although this is not always the case).

Earthquake mechanism/Tectonic setting/Seismic hazard

The east-west trending plate boundary between India and Eurasia comprises several main- and minor faults distributed on a roughly 200 km wide strip between the Himalaya front and the main central thrust to the north. The seismic activity is caused by the convergence of the Indian tectonic plate to the north towards the Eurasian plate with a relative rate of approximately 40 mm per year.

The shortening is accommodated by several parallel faults, hence we speak of a diffuse plate boundary. The plate boundary at the foot of the Himalaya is one of the most active continental boundaries worldwide and host of the largest earthquakes in the region. The rupture plane across which the earth was displaced a few meters extends about 180 km along strike and 80 km perpendicular to it (USGS finite source model). The largest displacements occurred about 100 km to the East of the epicentre close to Kathmandu and should be responsible for high ground shaking in the Kathmandu Valley. The rupture occurred on the Main Frontal Thrust (MFT, Avouac, 2001; <http://web.gps.caltech.edu/~avouac/research/himalaya.html>).

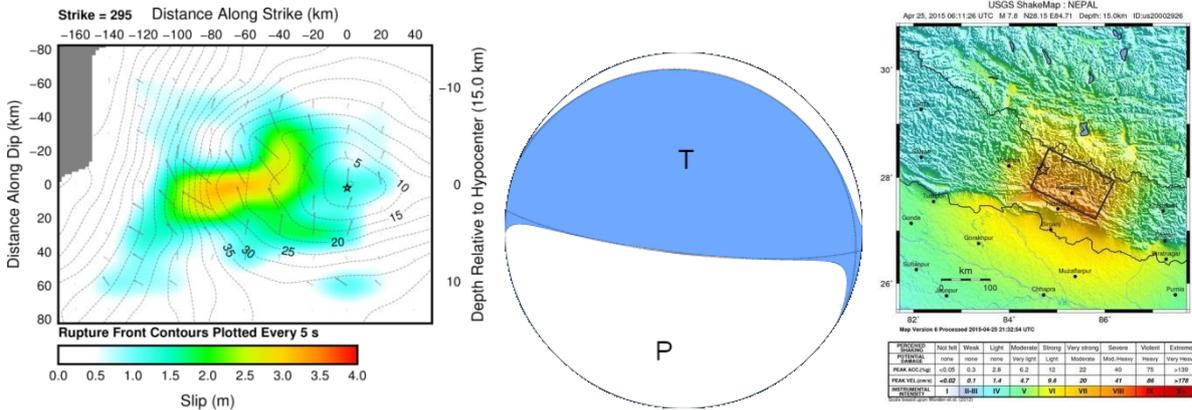
The largest instrumentally recorded earthquake within a radius of 300 km happened on 15. January 1934 at Bihar, Nepal with a magnitude Mw of 8.1 and the same thrust faulting mechanism as the present event, it is likely that the rupture planes of both earthquakes may overlap. Thus, this earthquake did not close the seismic gap between the Kangra earthquake in 1905 (M7.8) and the Bihar event, so that in the future more large earthquakes might occur, although further to the West. A detailed comparison with historic events and the tectonic implications will be taken out in the next report along with analyses from the CATDAT damaging earthquakes database.

The collision and underthrusting of the Indian beneath the Eurasian tectonic plate frequently causes strong shallow earthquakes and thus poses a significant seismic hazard. For the region of the present event the seismic hazard map shows a probability of 10% for exceeding peak ground accelerations of 5 m/s² within 50 years (GSHAP). Besides the impact caused directly by ground shaking, secondary effects like landslides and liquefaction pose an additional threat.

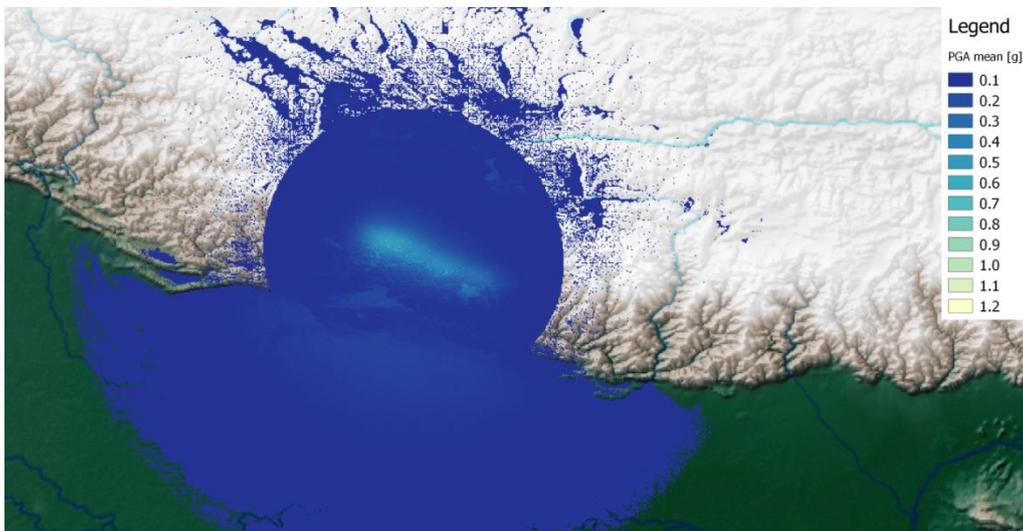
GEOFON Nepal event: <http://geofon.gfz-potsdam.de/eqinfo/special/gfz2015iatp/>

GSHAP: <http://www.gfz-potsdam.de/gshap/>

WSM: <http://dc-app3-14.gfz-potsdam.de/index.html>

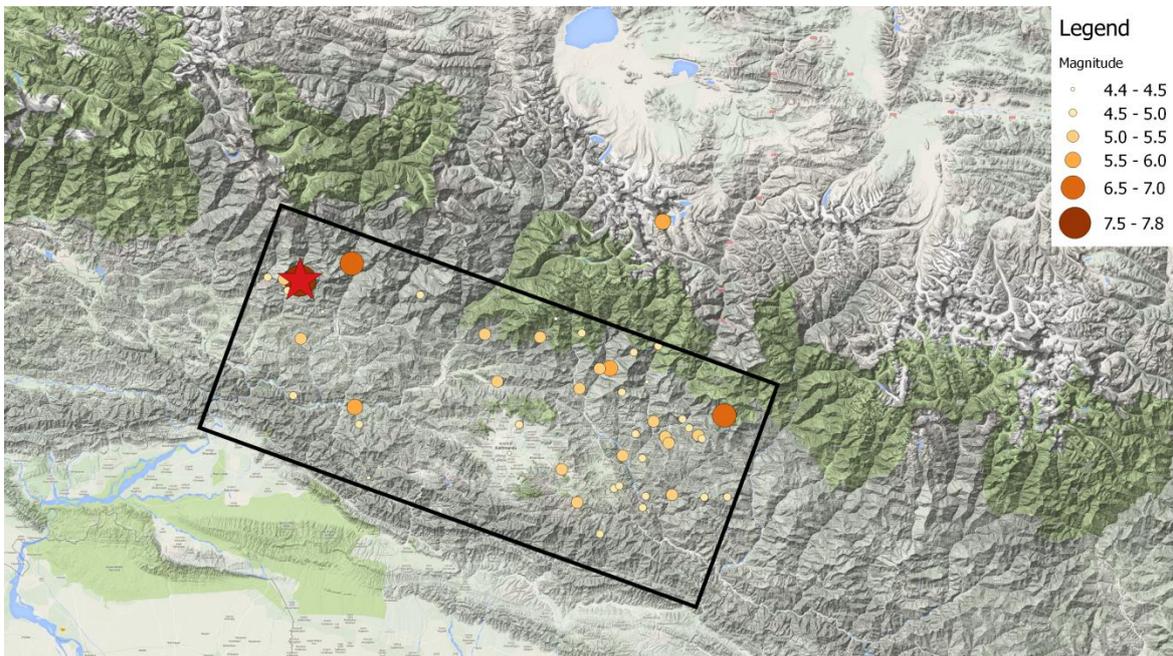


USGS slip map (Mwc=7.76) (left). PAGER Intensity Map (right) from USGS. This shows a different picture, with higher ground motions seen at the southerly fault plane end, with around 1g along this southern tip as per Shakemap. (<http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/b000kdb4/download/stationlist.txt>).



Modelled PGA (CEDIM) based on stochastic rupture modelling.

The peak ground acceleration was likely around 0.8g however in most cases the shaking was far lower. Around Kathmandu, the peak ground acceleration was around 0.3-0.4g according to the modelling.



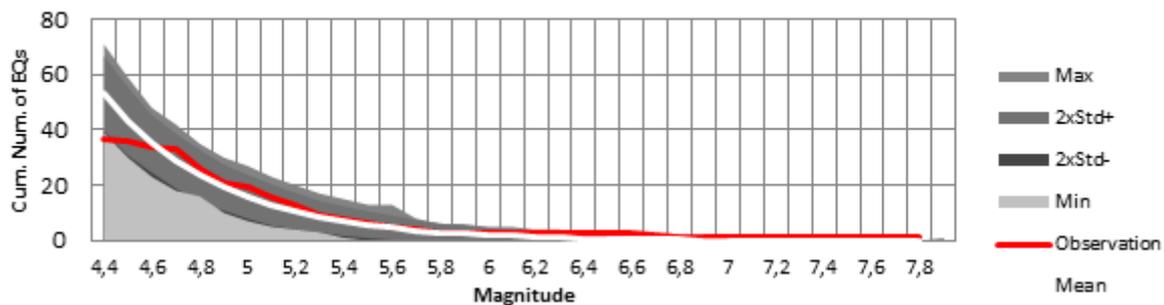
Overview of Modelled Aftershocks for the 26th April, 2015 Nepal earthquake

Using clustered seismicity since 1960 in Nepal and adjacent areas the cumulative number of aftershocks has been estimated. Hereby, clustering parameters (Omori-Utsu, Gutenberg-Richter, etc.) are estimated based on a nearest neighbour modelling with respect to space and magnitude. Clusters which have been taken into account are:

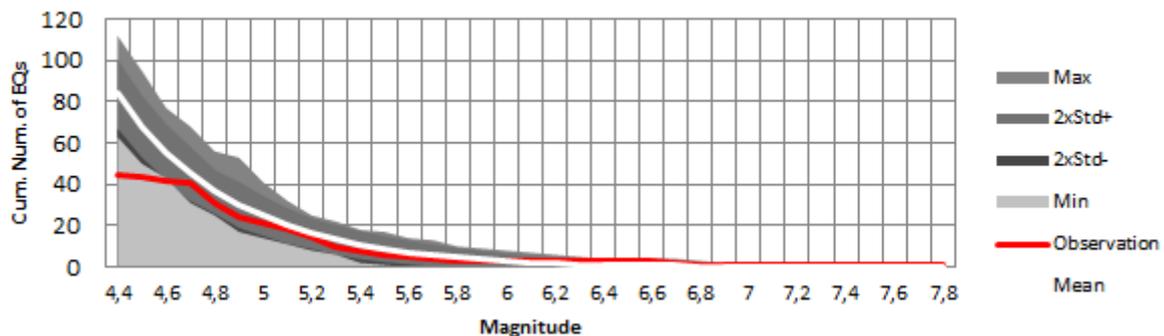
| Date | Latitude | Longitude | Mw (of mainshock) | #Events | Compl. Mag. |
|------------|----------|-----------|-------------------|---------|-------------|
| 20.03.2008 | 81,480 | 35,410 | 7,2 | 210 | 3.7 |
| 25.08.2008 | 83,357 | 30,741 | 6,7 | 112 | 3.8 |
| 28.03.1999 | 73,320 | 30,318 | 6,6 | 18 | 4.6 |
| 09.01.2008 | 85,141 | 32,300 | 6,4 | 47 | 3.8 |
| 06.10.2008 | 90,471 | 29,748 | 6,3 | 38 | 4.1 |

It is likely that the earthquake record of magnitudes smaller than 4.7 is not complete, since the seismographs are quite a distance from the epicentre and the data originates from the USGS earthquake feed. The following diagrams show a comparison of observed seismicity with the modelled estimation. So far, 24h and 48h models represent the complete observations.

24h Aftershock Activity - Nepal - April 25th, 2015



48h Aftershock Activity - Nepal - April 25th, 2015



Red Line: Cumulative distribution of earthquake magnitudes

White Line: Mean of 100 stochastic cluster models

2xStd +/-: Uncertainty range for +/- 2σ

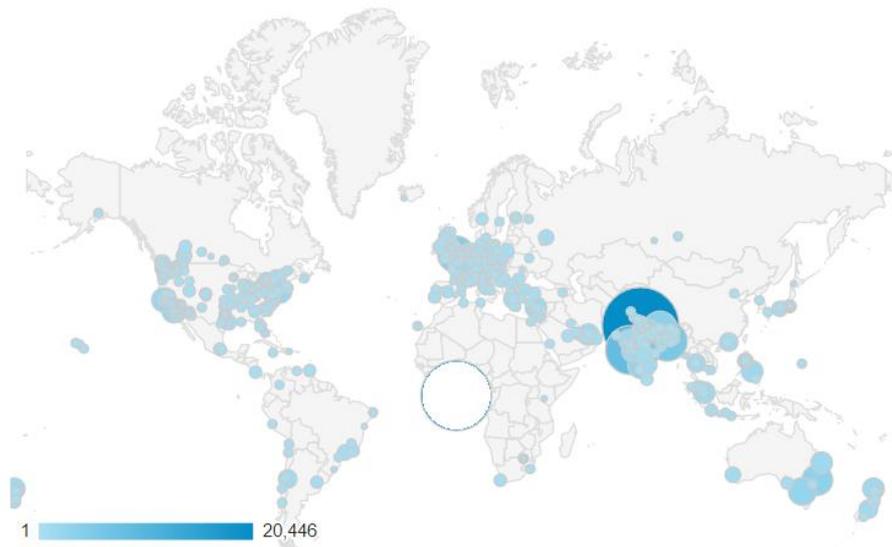
Min/Max: Minimum and Maximum number of modelled aftershocks per magnitude bin.

Interpretation

So far, the aftershock activity in terms of time and magnitude remains within an expected range. An underestimation of activity within the first couple of hours is usual and is compensated in the following hours and days of activity. Regarding the general expected distribution and with respect to the M6.7 aftershock, another >M6 event is unlikely, but possible during the next days. The total number of aftershocks >M5 will most likely increase by 30-50% within 7 days, accumulation effects of large aftershocks not included. Thus, per day on average 3-5 >M4.5 aftershocks are possible.

2 Social Sensors

Over 50% of people logging into the Earthquake Report website in the first 10 mins were from New Delhi and the surrounding regions, with around 25% from India, and around 5% from Nepal. The following diagram shows visitors in the first 6 hours from each city. The darker circle is New Delhi (the white circle indicates blocked IPs). Individual peaks were seen with each major aftershock and the initial alert after 1 minute was from IP address increases.



Earthquake Report website visitors inside of the first 24 hours.

TENAS – Twitter Event Notification and Analysis Service - KIT (Andre Dittrich)

(spatial resolution: 0.25° x 0.25°; temporal resolution: approx. 1 minute)

The detection system worked. However, the first alert (the automatic e-mail) was issued as:

Date: 25.4.2015

Time: 6:16:0 UTC

Place: New Delhi, Delhi, India

Longitude: 77.3031°

Latitude: 28.61852°

That was about 4.5 minutes after the earthquake and approx. 730 km distance from epicenter. So detection was pretty fast, but the first actual alert from Kathmandu only occurred at 6:45 UTC. The reason that the system could not detect more accurately concerning the location is that unfortunately the language Nepali and the other approx. 140 dialects spoken in Nepal are not among our 42 languages of the system currently.

3 Current Situation on the ground with respect to Weather and other elements at play

Issued: 27 April 2015, 13 UTC

April in Nepal is still pre-monsoon. In the Kathmandu area the onset of the south-west monsoon usually is around the middle of June. As the monsoon hasn't started, widespread and extraordinary heavy rainfall are not to be expected. However, pre-monsoon weeks are not dry and they come with isolated showers and thunderstorms which might be heavy in places. There is a chance for few landslides, where localized heavy rain meets destabilized slopes.

Forecast until 02 May 2015, 00 UTC

According to the latest GFS model run (27 April 2015, 00 UTC), accumulated rain amounts for the next 120 hours may exceed 100 mm in parts of Nepal. As the rain is mainly of the convective type, intensity and spatial distribution is hard to predict. Most showers and thunderstorms develop in the course of the day along or near mountain crests.

On all days, localized shower and thunderstorm activity must be taken into account, possibly causing local flooding or landslides. However, most parts of the earthquake affected area will not see heavy rain.

Temperatures in and around Kathmandu will be in the range of 22 to 26 °C in the afternoon and 11 to 15 °C during nighttime.

Outlook: no significant changes.

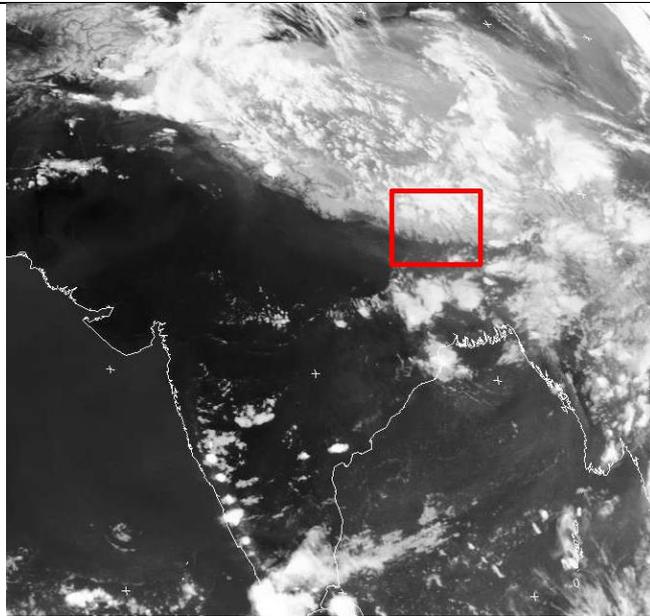


Figure 5: Satellite image, 27 April 2015, 12 UTC
Image credit: NERC Satellite Receiving Station, Dundee University, Scotland
<http://www.sat.dundee.ac.uk/>

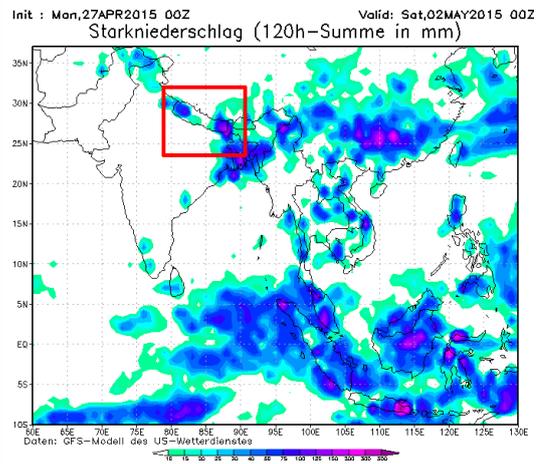
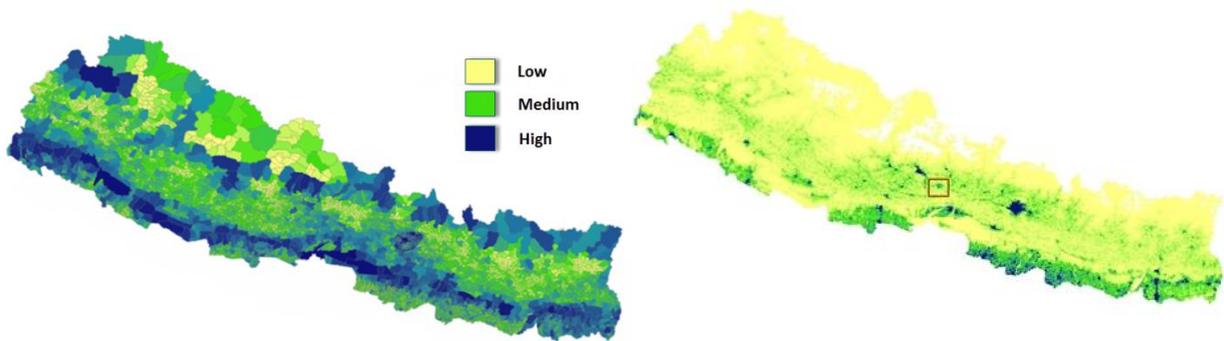


Figure 6: 120 h cumulative rain until 02 May 2015, 00 UTC
Image source: Wettergefahren Frühwarnung

4 General Information on Population and the effects of casualties

Population

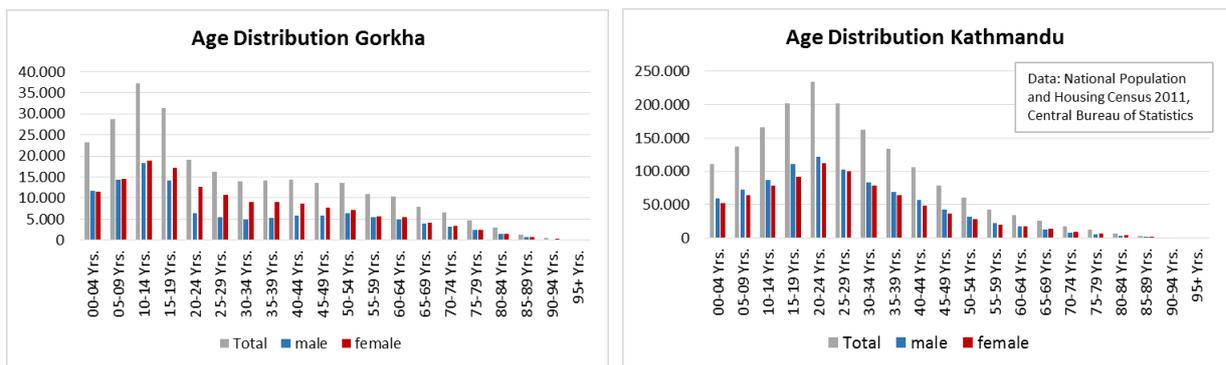
28.38 million (as of April 2015) people live in Nepal. The two regions most affected are the Central and Western regions, with 15.62 million people living here. In terms of exposed population, these are very large numbers, with over 140 million people in other countries having felt this earthquake strongly (IV and above) also. The population density in Kathmandu is extremely high.



Left: Population census data derived for 2015 through NBS, Nepal and adjusted via CATDAT (absolute);
 Right: Tatem WorldPop Data showing population density (relative) (Tatem, 2015)

Age Distribution of people from 2 of the most strongly affected locations

According to the Population and Housing Census, the two municipalities reported being mostly impacted at the moment, Ghorka and Kathmandu, show different age distributions. Out of the 271,000 inhabitants of Ghorka in the Census, almost 45% are younger than 19 years old with the biggest group aged 10-14 years old. Compared to this, in Kathmandu the age distribution of the 1.74 million inhabitants in the Census is somewhat different, yet the younger age groups of 15 to 29 still show the biggest proportion. The age distributions indicate the different social structures of a more rural area (Ghorka) with a shrinking population in working-age, and an urban area (Kathmandu) with a high proportion in the working-age population. In both cases the group of elderly is comparably small.



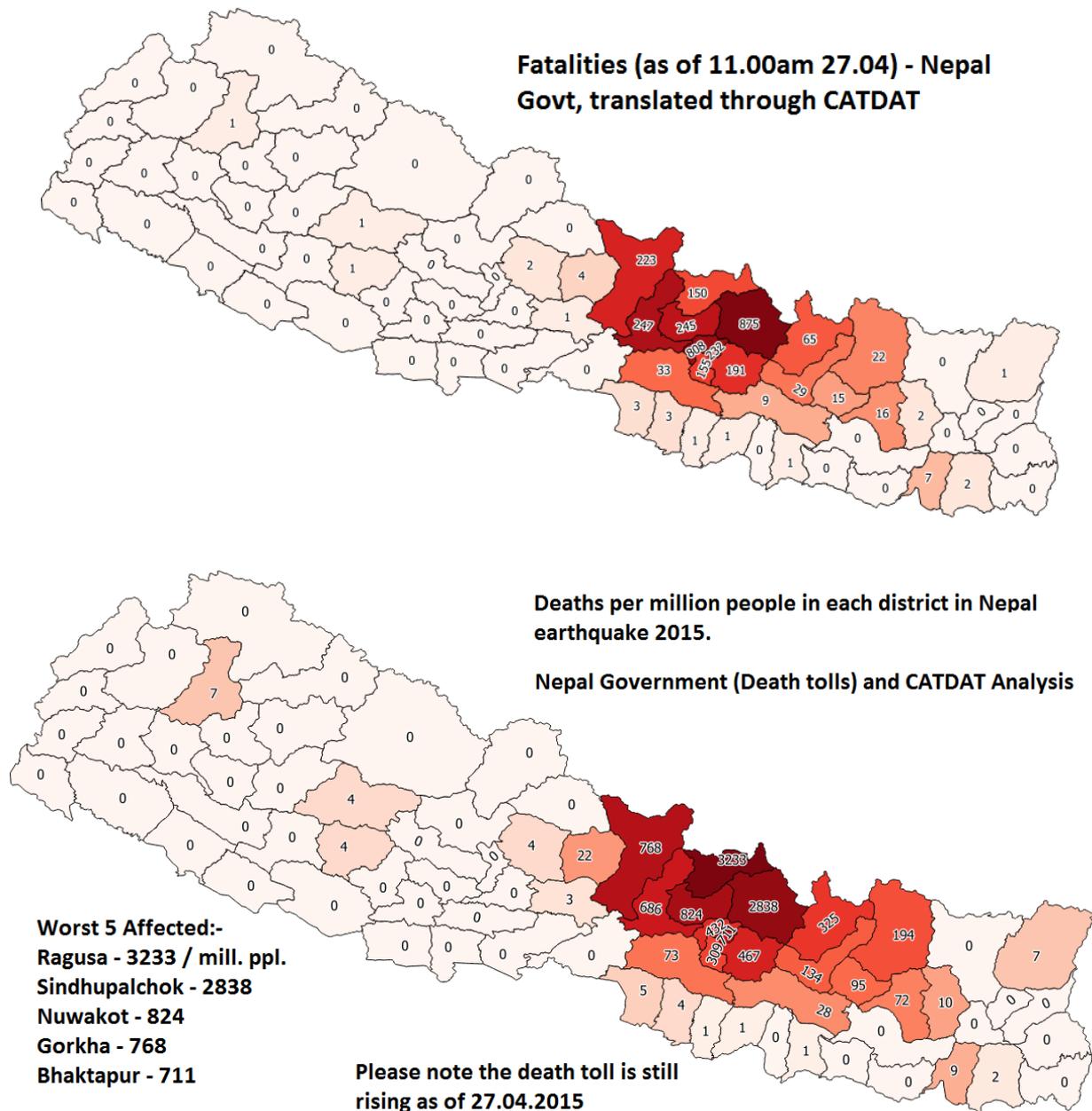
Death Toll

From the initial theoretical model, between 1400 and 7500 fatalities were calculated (released on Earthquake Report after 20 min). This was then adjusted to 300-7500 fatalities, as initial intensity releases were lower in the epicentral region and Kathmandu than expected. Using current intensity information and damage information, the death toll is expected to rise.

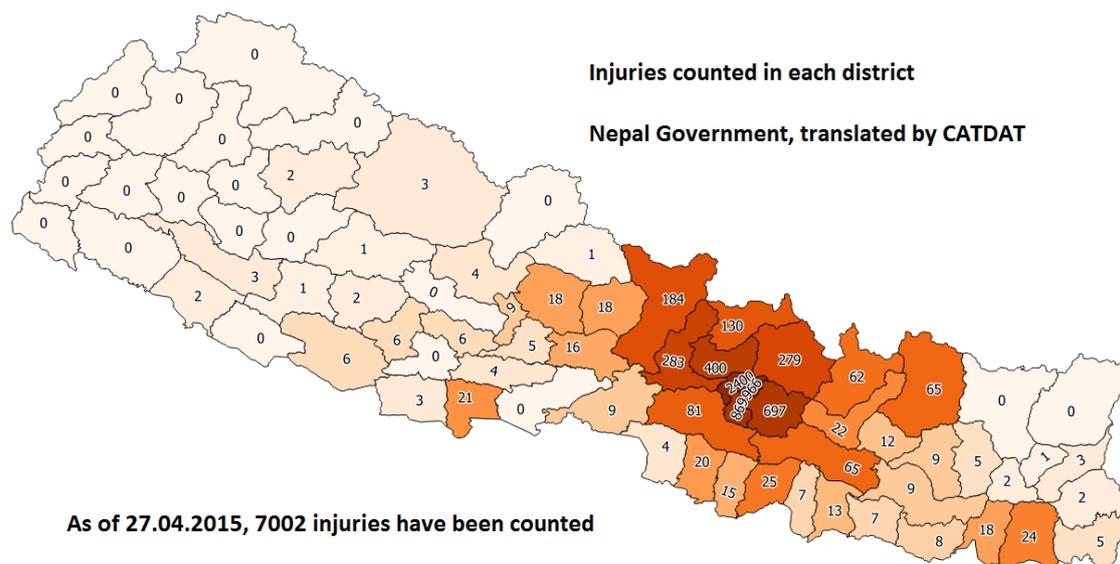
As of the 27th April, a reanalysis was made using the theoretical empirical fragility function of Daniell (2014), and if the intensities are to be believed, the death toll may be expected to rise further. Updating what we have seen in the areas closer to the epicenter and the theoretical model, gives a more dire picture with the likely death toll being around 7500 (3025-10050).

There have been numerous landslides and avalanches reported throughout the mountains. The Everest landslide killed 20 people. An earthquake in April in Nepal will trigger fewer landslides than after the monsoon season (mid-June to mid-September). Earthquakes around noon typically cause fewer fatalities as compared to late night/ early morning events, when most people sleep at home and are trapped in collapsing buildings. A more detailed landslide analysis will be undertaken in the next report.

Currently 4005 deaths have been reported. (3904 Nepal, 20 China , 68 India and 4 Bangladesh). The death toll will rise, and comparative analysis is to be shown in following reports.



At least 20 deaths are due to landslides. Most however, are caused by the collapse of buildings.



Since the last update, consolidation has occurred with the numbers with 7119 injuries counted so far. It is expected that Ragusa, Sindhupalchok and Gorkha will increase in the coming days.

5 Shelter and damage to homes

The earthquake has caused extensive damage and we therefore expect a significant number of displaced people and a high demand for public shelter. Population displacement is driven by damaged buildings, utility outages and other forms of building habitability, but is also aggravated by socio-economic vulnerability. The frequent large aftershocks following the earthquake could lead to widespread concern about the safety of buildings and therefore additional population displacement.

Shelter Response in the Kathmandu Valley

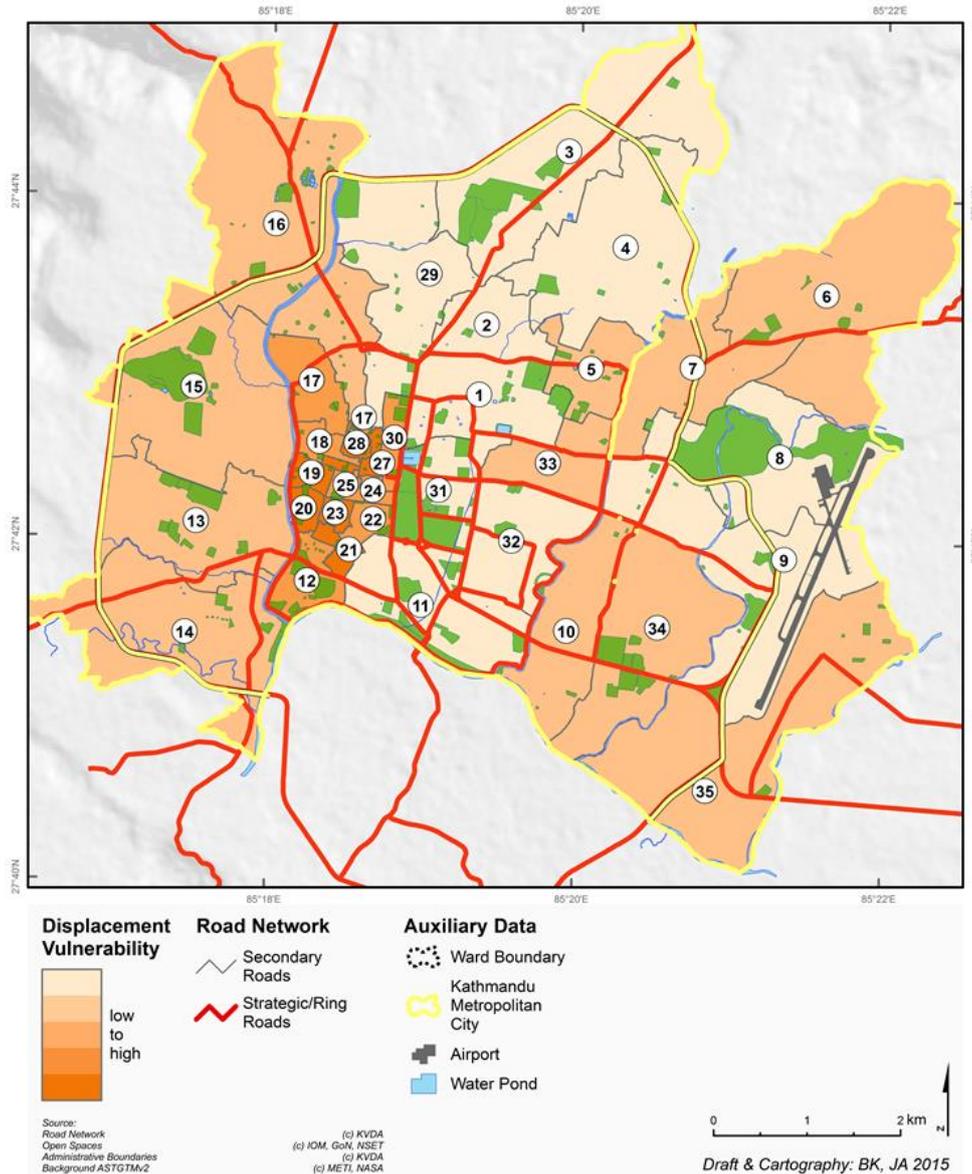
The 2012 shelter response strategy for the Kathmandu Valley prepared by the National Society for Earthquake Technology in Nepal (NSET, 2012) planned for a scenario that would occur if a Magnitude 8.0 earthquake in the middle of Nepal were to hit the Kathmandu Valley. Under this scenario 50% of the buildings in the valley were estimated to be heavily or partly damaged. While the information on damage extent is still unclear, from initial reports we know that the damage rate in the valley from the 26th of April earthquake in Kathmandu Valley was well below the anticipated 50% rate and few of the newer buildings in the rapidly expanding capital appeared to have been damaged. Most of the reported damages have been observed in earthen-mud, stone and adobe buildings.

The shelter response strategy is highly influenced by a number of factors. Amongst others these include: building typology based on tenureship (owner, renter, squatter) and materials (kucha – mud, grass, thatch; pakka – stone, brick, clay morta; and semi-pakka – combination of kucha and pakka styles); urban fabric (densely populated vs. scattered, high rise and low rise); and floating population and migration.

A displacement vulnerability index was developed for the Kathmandu Metropolitan City (KMC) based on three key factors: old and vulnerable building typology; urban fabric and migration. The methodology and data for developing the index was adapted from earlier research on post-earthquake emergency shelter by Anhorn and Khazai (2015). The displacement vulnerability index is generated on the premise

that most of the demand for emergency public shelter will be in (1) areas with older and weaker construction types where most of the concentration of damage and debris volume is assumed to come from; (2) in densely built urban areas where there is little open space, and a greater portion of the displaced population is likely to take up shelter on designated emergency shelter sites rather than their own property or nearby areas; and (3) in areas with less possibility for outward migration as the residents are homeowners and not working migrants. Thirty-five percent of the populations aged 5 years and above in the Kathmandu Valley have migrated from other places.

The map below shows the designated emergency shelter sites (open areas) according to the NSET shelter response plan and strategy overlaid on the displacement vulnerability map of KMC.



While power has been fully restored to main government offices, the airport and hospitals in Kathmandu (source: Nepal Electricity Authority), there are wider power blackouts in the rest of the city. There are few reports of water supply trucks compensating for the loss of water supplies, however, in many reported cases people go to their homes to draw water from their reserves and people may eventually be forced to use river water for drinking and washing. Many of the schools are being used as shelter, and school closure was announced for at least one week for more people to be accommodated at these sites.

Due to a fear of aftershocks and hesitation to leave their homes a majority of people remain outside their houses for the second consecutive night, where they are more prone to diseases due to cold and windy weather and lack of services. The stored food, water and fuel for back-up generators currently allow the displaced to shelter in place, however, as the event continues the feeling of belonging and connection to neighborhoods may get replaced with the need for adequate shelter. Thus, we expect that the open spaces that were identified by International Organization of Migration (IOM) and NSET that were not meant for immediate use but for setting up temporary shelter (i.e., tents, health centers, food distribution centers, etc.) will gradually become occupied. The CEDIM team is closely observing this situation and a key focus will be to compare the assumptions made in the past studies with situation evolving on the ground to draw key lessons.

Original Photos from the field, from SAI student – Verena Floerchinger – 27.04.2015



Campus Pulchowk
Locked “open” area, not publicly accessible.



Madan Smarak Higher Sec. School
Lack of water. No electricity available. No medical team. Toilets exist but no water. Unsanitary.



Jawalakhel
Enough water for today. Private KTM water supply tankers of water for free. “Save the Children” were purifying water in tanker. No electricity. Can go to NTC (local telecom provider) to make free calls and charge phones. No medical team but they heard one will come today. Public toilet next to camp but nobody uses it because no water. Unsanitary. 35+ from one local community and 10 families from outside (migrants). Tents given from police.



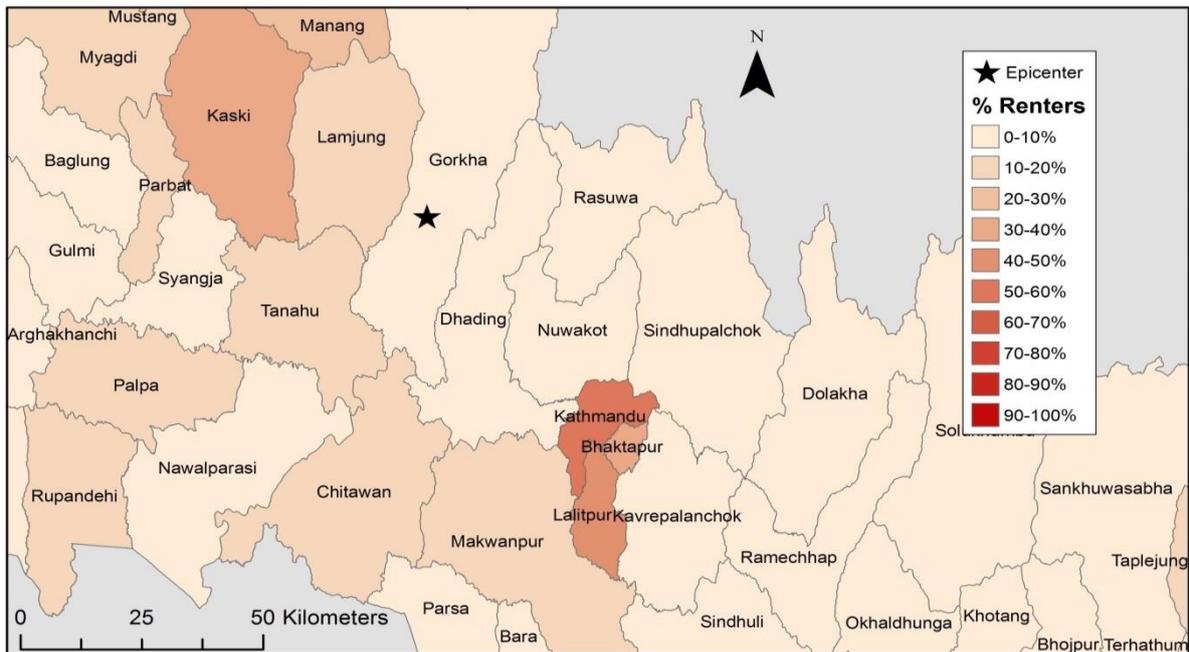
Football ground
Gov. distributed purification. Most people use stored water from home. No electricity. No medical team but will come this evening. Toilet available but few people use it. Some have returned home. This shelter area is organized by gov. There is a 7 day program (subta). Starts at 6am. Talk also about earthquake. Now the space is quite empty. At 6pm it will be packed. When the program is finished people go into big tent.

Along the main roads and the ring road people have set up tents. There are no services, no toilets, water delivery or electricity. Most people come from nearby places.



Shelter Response in greater Nepal

Nepal is a low income country with about 25% of the country in poverty (<http://data.worldbank.org/country/nepal>). In addition, this earthquake has occurred during the season associated with food scarcity and increased poverty (<http://cbs.gov.np/?p=186>).



We analyzed data from the 2011 census for vulnerability that could affect displacement. Regionally there are differences in vulnerability to population displacement. Most notably Kathmandu and the surrounding areas have high levels of renters compared to the rest of the country. This has the potential to lead to high levels of displacement as renters are less likely to remain in the area than households that own their residence.

Another important consideration is the tendency for people to be immobile and unable to evacuate. Some people may not be able to access public shelter unless transportation is provided. According to the 2011 census, less than 2% of Nepalese households have a car and less than 10% have a motorcycle. Some special needs groups including the elderly and disabled are more likely to be immobile and unable or unwilling to evacuate. The Gorkha district where the epicentre of the earthquake hit is the district with the highest percentage of elderly in the nation with almost 9% of the population 65 years and older.

| District | Population density (person/sq.km) | % housing ownership | % households with car or motorcycle | % households with 8+ people | Female headed households (%) | Education (% completed secondary school) | Children (% 0-9 years) | Elderly (% 65+ years) | Disabilities (%) |
|---------------|-----------------------------------|---------------------|-------------------------------------|-----------------------------|------------------------------|------------------------------------------|------------------------|-----------------------|------------------|
| Dhading | 174 | 93% | 3% | 8% | 28% | 22% | 20% | 8% | 2.3% |
| Dolakha | 85 | 95% | 1% | 5% | 34% | 23% | 20% | 8% | 3.0% |
| Gorkha | 75 | 92% | 2% | 5% | 37% | 21% | 19% | 9% | 2.3% |
| Kathmandu | 4,416 | 40% | 35% | 5% | 28% | 58% | 14% | 4% | 1.0% |
| Nuwakot | 248 | 96% | 4% | 9% | 21% | 26% | 19% | 8% | 1.7% |
| Rasuwa | 28 | 93% | 2% | 8% | 22% | 25% | 20% | 7% | 2.3% |
| Sindhupalchok | 113 | 95% | 2% | 6% | 24% | 22% | 19% | 8% | 2.3% |

As the response community begins to provide alternate shelter for the displaced people, it is important to consider the most vulnerable people. There is variation in vulnerability over the affected area. Nationally, 25% of households are headed by females, 12% of households have 8 or more members and 9% of the country is under the age of 5. Shelter providers should take particular care to ensure that camps provide safe appropriate places for these vulnerable groups.

6 Economic Effects

The GDP of Nepal is currently around 19.71 billion US\$ as of April 25th 2015, using forward projections and current exchange rates of 101.8 Nepalese Rupees to the USD.

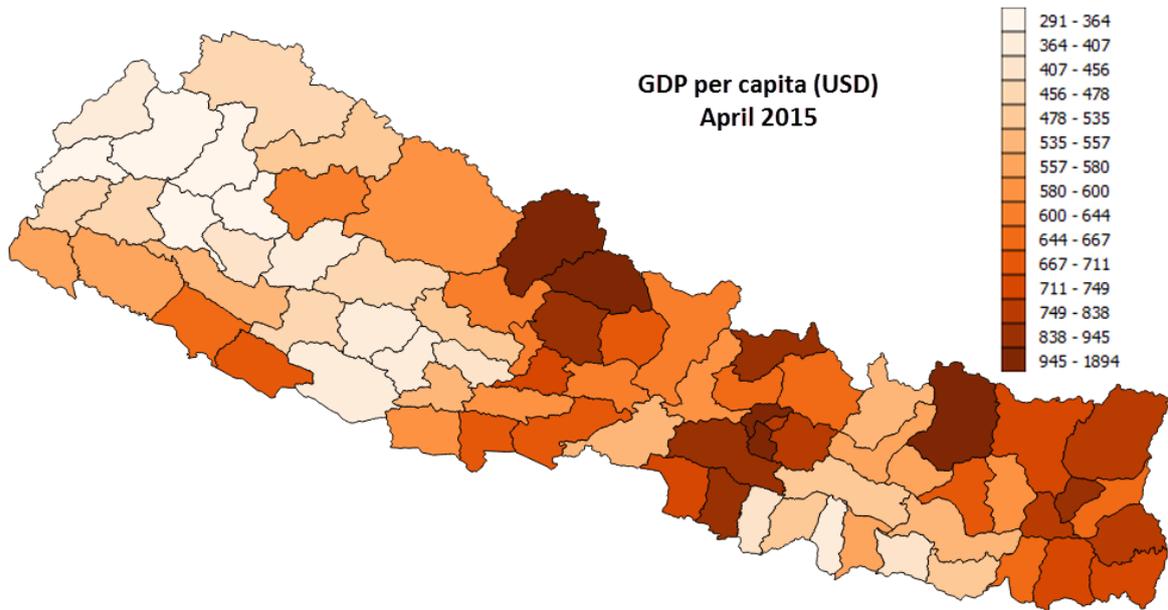
The capital stock of Nepal is very low comparatively in the region, and the country has a combined building and infrastructure net capital stock as calculated using the method in Daniell and Wenzel (2014) on data up until 2015, of 38.8 billion USD. The gross capital stock of all structures, contents, equipment and materials is equal to around 59.1 billion USD.

The modelled effects of the earthquake have been created using modified intensity data. The following estimates have been released using the empirical socioeconomic fragility functions of Daniell (2014) based on historic earthquakes globally.

The economic loss stays reasonably similar at **around 3.5 billion USD (2.8-4.6 billion USD) from the CATDAT model as released through Earthquake-Report and CEDIM.** The replacement cost will be

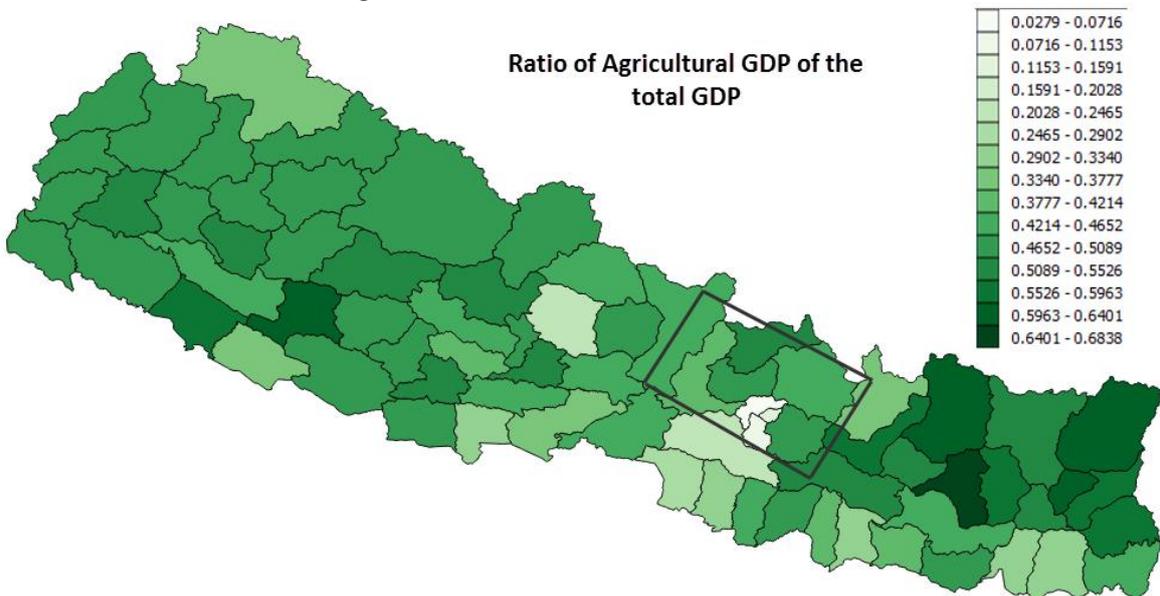
around **5.3 billion USD (4.28-6.84 billion USD)** using the intensity patterns and historically observed losses. In following reports, the distribution of these losses will be examined with regard to the observed loss patterns.

Compared to Haiti, the direct damage of the event was around 4.24 billion USD (2010). The Kashmir 2005 earthquake also had 2.25 – 4 billion USD (2005) damage (differing estimates). Further analysis will be shown in the following reports.



As the International Monetary Fund (IMF) stated in November 2014, the economic development and status of the country is stable. For 2014/15 a growth of 5.5% was expected, and was calculated as 4.5% into the April 2015 assessment of GDP in CATDAT as shown below in the figure. Regarding its global interconnectedness, the Nepal – India Chamber of Commerce & Industry lists India as one of the most important investors in 2014-15.

There is a major outgoing of young workers however, as from July 2013 to May 2014, 411,589 young people left the Nepal due to a general job scarcity and economic volatility. Their destinations were Malaysia (158,027), Qatar (103,059), Saudi Arabia, the United Arab Emirates and other Arabic countries as seen in some districts in the age distribution.



The economy of Nepal is highly dependent on agriculture and forestry that contribute about a third of the GDP of the country, whereas the industry sector comprises a mere 15% of GDP (FY2014). Agricultural value adding depends very much on the monsoon pattern, and the monsoon has a direct impact on GDP growth. The current large-scale disaster with mass destruction of transportation infrastructure will – dependent on reconstruction speed – have a negative impact on agricultural value added as products cannot be shipped to markets.

The current predictions of real GDP growth are 4.8% (for FY2015), 4.6% (for FY2016), and 4.5% (FY2017). If this will materialize given the economic impact of the earthquake remains to be seen. The manufacturing share of GDP declined from 8.2 to 5.6% over the past 12 years. Apart from the lack of skilled labour, lack of raw materials and frequent shortage of electric power seems to be a major obstacle. The current power system is not able to provide the boundary conditions for industrial growth. This system is – as incoming reports suggest - significantly damaged by the earthquake and thus another factor of negative impact on the economy. The direct contribution of travel and tourism to GDP was 3.9% of total GDP in 2015 (the indirect contribution was another 4%). In 2014 travel and tourism directly supported 487,500 jobs (3.5% of total employment). This was expected to rise by 4.0% in 2015. Whether these predictions still hold depends very much on the speed of recovery.

World Bank and the Asian Development Bank identified major gaps in infrastructure investment in Nepal that hamper development. These investments are currently at a level of 5% of GDP but need to increase to about 10% to meet future demands on transportation, power supply, and other sectors. Assuming that 20% of all infrastructure earthquake losses are losses to infrastructure and thus range at 0.7-1.0 billion US\$, an annual investment of infrastructure is lost, ca. 10% of infrastructure in Nepal. Thus, boosting infrastructure investments in the recovery process will become a key issue. Since recovery progress in Nepal will highly depend on external financial support, long-term aid for rehabilitation and development – as recently offered to Nepal by the Asian Development Bank– will be required besides the immediate humanitarian relief and support which is now provided by multiple countries and international aid organisations.

7 Information Gap Analysis

Disaster Response Information: Districts Affected

Reports on mainstream media continue to focus on the devastation in Kathmandu and at Mount Everest. Lack of details describing the impacts to districts outside of Kathmandu represents a serious information gap. The following provides details of impacts outside of Kathmandu but are based on Twitter and Facebook messages rather than confirmations from authorities. It will be crucial to confirm the extent of impacts in these and other areas at risk. Details however are currently limited describing who will be accessing which areas, when and how, to make such assessments.

Lamjung District: entire villages damaged, immediate need of relief materials [1].

Gorkha District (in some towns): 80% of some parts of Gorkha destroyed - 94 dead. In Barpak – all but 4 of 1200 houses destroyed. Many areas inaccessible due to destroyed roads [1].

Dhading District: entire villages damaged, hospital overflowing, no power, and need for immediate rescue operations [1].

Rasuwa District: most buildings destroyed, 77 people trapped under rubble in Trisuli hydropower tunnel, avalanche engulfs Langtang village with 100 feared dead [1].

Nuwakot District: 126 deaths, most houses destroyed, lack shelter [1].

Sindhupalchowk District: collapsed buildings and people sleeping outside [1].

Dolakha District: many houses destroyed [1].

Kavre District: death toll at 60, destroyed hospital, and threats of landslides [1].

Lalitpur District: disruptions to power, water supply, food and medicine [1].

Parbat District: according to twitter messages, 800 houses destroyed and multiple landslides have occurred [2].

Tahanu District : poor areas identified as being heavily impacted [1].

Palpa: pictures from Tansen, Palpa show some damaged buildings and people gathering outside [3].

Other districts to note: **Syangja, Rupandehi, Parsa District** and **Rautahat** districts - OCHA's Coordinated Assessment Support Section has estimated these districts to be among the worst affected [4]. Reports describing impacts to these districts have yet to be observed at this time.

Number of affected and their needs:

There is also a lack of information confirming the number of affected and the subsequent quantities of relief needs required. To note is the fact that even though many people's homes have not been destroyed, they are sleeping in the streets and parks out of fear of aftershocks. The number of people living in such conditions without adequate shelter from the elements, access to water, cooking equipment, or sanitary facilities has not been reported.

[1] HumanityRoad: <http://humanityroad.org/apr25nepalquake/>

[2] Twitter: <https://twitter.com/search?q=parbat%20%23nepalearthquake&src=typd>

[3] Twitter: <https://twitter.com/search?src=typd&q=palpa%20%23nepalearthquake>

[4] Humanitarian Data Exchange: <https://data.hdx.rwllabs.org/dataset/estimated-population-exposed-to-earthquake-shaking>



Map Source: Travel Trend Nepal (www.traveltrendnepal.com)

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