EARTHQUAKES WITHOUT FRONTIERS

# Country Team Updates

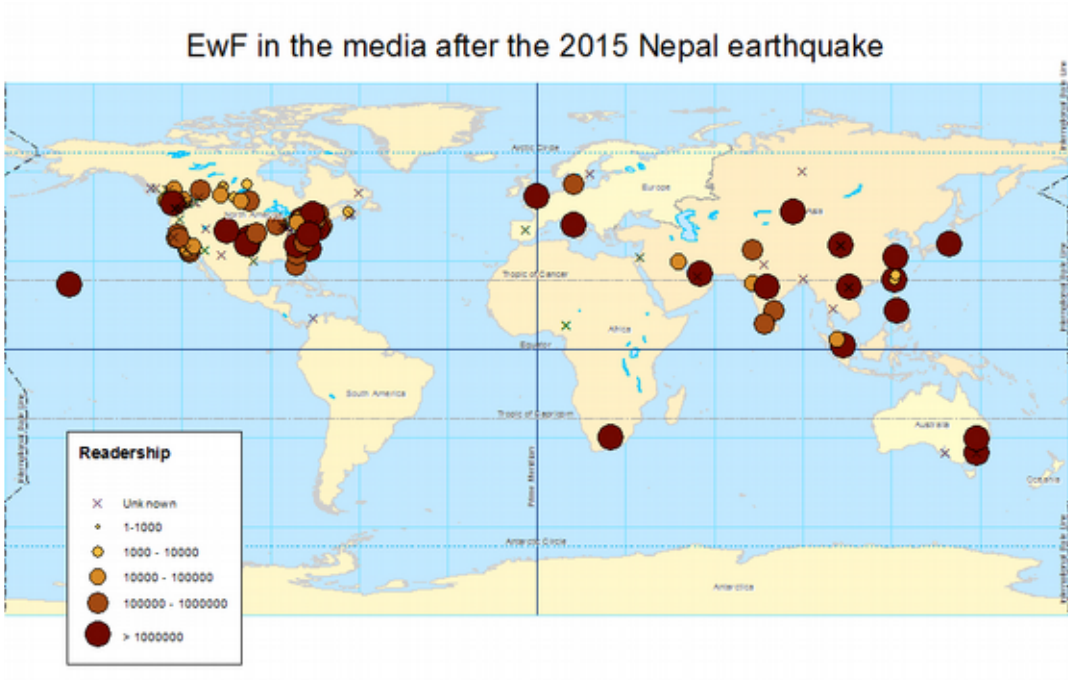
## 3rd Newsletter
## July 2017

In this newsletter

# 1.

# EwF in the media after the 2015 Nepal earthquake

*Contribution by Susanne Sargeant, BGS*




EwF researchers gave numerous media interviews following the 2015 Gorkha earthquake and Jennifer Findlay, a work experience student from Edinburgh University undertook a small project at BGS to find out more about where these interviews ended up. BGS has been tracking mentions online of the phrase 'Earthquakes without Frontiers' since the start of the project.

Using this information, Jennifer conducted a basic analysis of the EwF media response by investigating when and where 'Earthquakes without Frontiers' appeared in the media between 25 April and 5 May 2015. There were 1167 web links to reports mentioning 'Earthquakes without Frontiers' during this time. Of these, 347 links were still active when Jennifer started her analysis in August 2015.

The material associated with the majority of these links referred to one interview by Associated Press with James Jackson. This focused on why Nepal is exposed to earthquakes and what makes people so vulnerable to them. Two other interviews with EwF team members were also identified – one with Tim Wright on how data from the Sentinel-1a satellite was used to investigate ground movement and another with James Jackson, Philip England and Richard Walters on what makes Nepal so susceptible to earthquakes.

Jennifer used the active web links to find out more about the outlets in which the interviews appeared: the media type, monthly readership and readership location (this was global in some cases). This map shows the 'location' of these outlets and the size of readership associated with each (e.g. the BBC news website, a local newspaper in Canada).

The analysis has some important limitations. First, the registered location of the outlet (e.g. the BBC news website located in London) does not give a good indication of where the people who read the articles were located (in the case of the BBC, potentially all over the world). Second, the readership is not a measure of the number of people who read the articles referring the interviews above but gives an indication of what the potential readership may have been. Third, it is only a partial representation of what happened since only about 30% of the links still active when the analysis was done. Despite this, it does give an interesting first impression of the global reach of the three interviews.

For further information, please contact Dr. Susanne Sargeant, BGS, slsa@bgs.ac.uk

# 2.
# End of EwF (China) Symposium
# 28 June 2017, Xi'an, China

*Contribution by Tim Sim, Hong Kong Poly-U*


*Group photo at the symposium on 28 June 2017, Novotel, Xi'an China.*

The end of EwF (China) Symposium was convened by Earthquakes without Frontiers and hosted by Gender Development Solution (GDS) and the Hong Kong Polytechnic University on 28th June 2017 at Xi'an, China. The objectives of the symposium are to:

- Summarize and highlight key findings and knowledge about earthquakes and the experiences and challenges on social determinants of disaster risk reduction to earthquakes;
- Launch the Chinese publication of Writeshop; and
- Provide a platform to establish network and discuss future plans for disaster risk reduction in local areas.

The symposium brought together 76 participants and representatives from the government within Shaanxi Province, ranging from the prefecture, county, township and village level; non-governmental organizations with special attention on DRR; academia and research groups.

***Book launch – Chinese publication of the Writeshop***

The Chinese publication of Writeshop was officially launched at the symposium. The goal of the book is to integrate and share the experience of community-based earthquake disaster risk reduction at home and abroad, and to form a platform in Shaanxi Province to enhance the capacity of earthquake disaster reduction resilience building. In October 2015, Overseas Development Institute (ODI) produced

an English publication entitled Pathways to Earthquake Resilience in China[1]. The book launched at the symposium is the product of translation of the publication into simplified Chinese, yet the Chinese version has added a new chapter, which mainly introduces a newly developed baseline survey tool for disaster risk reduction in the context of rural China.

***Morning Session – EwF physical sciences findings sharing***

The morning session was kicked off with the introduction of EwF by Mr. John Young from ODI. It was then followed by the presentations from Prof. Philip England from the University of Oxford who shared EwF's physical sciences findings in Shaanxi Province, namely, active faulting and historical seismological analysis. Ms. Ji Ma, from Shaanxi Seismological Bureau, then provided a brief summary and response to Prof. England's studies in Chinese.

***Lunch side-event – Interactive learning of natural hazards***

Dr. Emily So from the Cambridge University hosted the lunch side-event for participants to learn about a number of natural hazards in an interactive way.

***Afternoon session – EwF social sciences findings sharing***

The afternoon session mainly focused on stakeholder's experiences and voices in doing disaster risk reduction (DRR) work in China. Mr. Jun Zhang from GDS and Mr. Hong Ki from One Foundation shared their challenges and future plans to do DRR from a Chinese NGO perspective.

*Participants were listening to the pre-recorded sound of flooding together with the display of posters showcasing different strategies for household in respond to flooding.*

*Participants were learning about the different sizes of hailstones and their potential impact.*

*Dr. Emily So was explaining the anti-seismic engineering technique.*

1 The English publication is available at: https://www.odi.org/publications/9440-pathways-earthquake-resilience-china

Dr. Timothy Sim and Prof. Lena Dominelli presented their findings on their studies on community-based disaster risk reduction (CBDRR) in the EwF demonstration project in a rural Chinese context.Ms. Shulan Zhan, village leader of Cheng Hou Village, shared with participants her story in combating natural disasters, particularly hailstorm, and the needs for stronger DRR initiatives and support at the village level.

***Future plans and discussions***

This session featured with the introduction of PAGER-O which is seen as an impact of EwF.
Mr. John Young and Prof. Philip England continued to welcome and encourage the sharing of experiences and challenges in doing DRR work in the local context. Specifically, Ms. Janise Rodgers from GeoHazards International presented the use of scenarios as a tool to showcase and communicate the risks of natural hazards to various stakeholders. This session chiefly aimed to engage the voices and ideas from various stakeholders and community members and to attract stakeholders for further collaborations.

For further information, please contact Dr. Tim Sim, Hong Kong Poly-U, timothy.sim@polyu.edu.hk


*All presenters were invited to the stage for a Q&A session open to the floor to conclude the symposium. From right to left: Dr. Emily So, Ms. Shulan Zhan, Mr. Hong Li, Mr. Jun Zhang, Ms. Janise Rodgers, Prof. Lena Dominelli, Dr. Timothy Sim, Prof. Philip England, Mr. John Young, Ms. Ji Ma.*

# 3.

# View from a Chinese partner

# Gender Development Solution's perspective of engaging with EwF

## The international collaboration coexists with challenges and opportunities

*Contribution by Jun Zhang,*
*Director of Gender Development Solution in China*

The year of 2008 has been considered as the origin of the development for Chinese non-government organizations (NGOs). The Wenchuan earthquake, dated 12 May, has awakened the awareness of Chinese citizens on the issues of philanthropy and charity. Gender Development Solution (GDS) was then found and officially registered in 2008 as a grass-root NGO to provide post-disaster reconstruction work at the affected area in northern Shaanxi, with a focus on the well-being and development of vulnerable groups, namely, women and children.

When we met with Dr. Timothy Sim and his colleagues from Earthquakes without Frontiers (EwF) at Northwest University in late 2013, we were being struck by a question: "Are we ready for the quake if the 1556 Shaanxi earthquake were to occur again?". Our staff who have been working on post-disaster reconstruction in rural areas were all stunned by this challenging question. We then began to investigate the damage brought by earthquakes occurred in Shaanxi. We learned that over hundreds of sensible earthquakes were historically recorded within the province. Among which, over 60 of them were registered at 4.75 on Richter magnitude or above, and 9 6-magnitude or above earthquakes.

The most devastating one happened in 1556 at *Huaxian*, located in the *Guanzhong* area of Shaanxi, registered at 8 on Richter magnitude. Casualties were estimated to reach 830,000 and infrastructures were severely damaged. We are definitely not ready for another earthquake of this scale.

GDS works on the community level, so are the communities ready for earthquakes? It was then that the collaboration with EwF began. Despite challenges, we have also been presented with opportunities throughout the progress.

Challenges:

1. **Integration of natural and social sciences to develop disaster risk reduction (DRR) efforts in communities**

EwF is led by Prof. James Jackson from University of Cambridge, working hand in hand with specialists and scholars from both the natural and social sciences fields from multiple academic institutions such as Durham University, University of Hull, University of Leeds, Northumbria University, University of Oxford and Hong Kong Polytechnic University. It is joint with research institutes such as British Department for International Development, British Geological Survey and so on. In China, EwF also works closely with China Earthquake Administration (CEA). However, when the project was introduced to our targeted site – Cheng Hou village – the community's culture, tradition, DRR awareness, or even common sense of everyday life, do not live up to that scientific standard.

2. **Collaboration between the government and NGOs**

In face of natural disasters in China, the government has always resumed a dominant role in emergency rescue and relief efforts; while work of NGOs during that phase might usually be considered as obstacles instead. For example, during the emergency rescue phase of the Wenchuan earthquake, certain external NGOs had in fact caused negative effects to the rescue and relief progress.

3. **Mainstream DRR services into social development**

The nature of development on which Chinese rural communities usually focuses are mostly livelihood and economically-related. With a goal to cope with poverty and achieve prosperity in a short period of time, DRR is not being prioritised on the agenda of community development. The situation could in fact be exacerbated by the cause of disasters which would strip off the progress made by an abundant of rural households to return to poverty again. Take Cheng Hou village as an example, the attempt to prioritize DRR in the village development agenda remains as a challenging task to the design of our future projects in the village.

Opportunities:

1. **GDS has engaged internationally on the field of DRR**

Over the past three years, EwF has organised numerous activities ranging from seminars to field trips at Nepal. All these not only widened the horizons of the staff of GDS, but also provided opportunities for them to discuss with Prof. Jackson and Philip in person, which enabled the NGO to look at DRR work from a different perspective.

2. **DRR facilitates community development**

The fact that Dr. Tim and Prof. Lena led our staff on field study to re-order the needs of villagers and realised that, instead of earthquakes, villagers are most concerned about hailstorm, this lent us an opportunity to include hailstorm prevention and mitigation work in the community development agenda.

**3. Elevated DRR skills of our staff**

Writeshop is a constructive process for capacity building. With experts of various background coming from different countries, government officials and NGO staff who specialises on delivering different service types, coming together on the same platform to share and discuss their DRR experiences, it enhanced the capacity of our staff. The effect of working interactively is more beneficial than just passively listening.

**4. NGOs could take up a complementary role along with government's work for disaster prevention, mitigation, rescue and relief as well as reconstruction.**

GDS is a grass-root NGO, which does not usually get the chance to work with experts and professors from China Earthquake Administration, or officials from Shaanxi Seismic Bureau. Through this collaborative project with EwF, we are given an opportunity to showcase our work and impact to the government officials, as well as to get a better understanding of the mode of practices and standards of the government. We are able to turn the relationship with government from competitor to partner, and to work collaboratively on disaster prevention, mitigation, rescue and relief and reconstruction in the future.

Today, a new framework of collaboration has been formed. We will be working with EwF to deliver DRR services with collaborations on the community, township, to municipality, province and even national levels. We consider this as an institutional change in the DRR mechanism. We are confident that GDS, as a grass-root NGO, could take on the challenges as opportunities, which in turn benefiting our targeted service groups, namely, women, children and elderly, through the collaborative project.

For further information, please contact Prof Zhang Jun, Gender Development Solution in China
Zhangjun_tony@aliyun.com

# 4.

# Review of Nepal's 9 Minimum Characteristics of a Disaster Resilient Community

*Contribution by Katie Oven, Durham University*

Members of the EwF team, in collaboration with the Foundation for Development Management in Nepal, led a study examining the impact of the Government of Nepal's *Nine Minimum Characteristics of a Disaster Resilient Community*. The Characteristics are an innovative framework designed to enhance the consistency and effectiveness of community-based disaster risk reduction (CBDRR) interventions and include, for example, community funds to support disaster risk reduction (DRR) activities and community-based early warning systems (Figure 1).

The six-month research study was funded by the UK Department for International Development South Asia Research Hub and the NERC/ESRC-funded EwF Partnership at the request of the Government of Nepal's Ministry of Federal Affairs and Local Development (MoFALD), the International Federation of Red Cross and Red Crescent Societies, and the Nepal Risk Reduction Consortium's (NRRC) Flagship 4. The Review, designed in collaboration with policy makers and practitioners, set out to determine if CBDRR interventions based on the 9 Minimum Characteristics left communities in a stronger position to protect themselves from, and to recover after, a disaster event such as an earthquake, landslide or flood.

An in-depth, qualitative research approach was developed to capture the views of householders across 24 case study communities, along with local government representatives and project implementing partners. The communities spanned different geographical settings within Nepal, including both urban and rural locations, and were exposed to different hazards.

***The importance of a flexible and adaptive approach to CBDRR***

The research findings highlight the importance of a common framework that can be adapted and flexibly applied in different contexts to support CBDRR. Positive outcomes were observed around flood risk reduction, particularly where communities took ownership of early warning systems and shared DRR resources that had tangible community-wide benefits, such as raised grain stores and water pumps. However, the mechanisms through which CBDRR is coordinated and managed at the community level, for example, through the preparation of disaster management plans, were not always effective due to a lack of community ownership. A particular challenge was identified when NGOs with expertise in flooding were faced with supporting communities to implement risk reduction measures for the very different risks posed by landslides, water scarcity and earthquakes. In such circumstances, the relative importance of different Characteristics may change, again highlighting the need for a flexible approach.

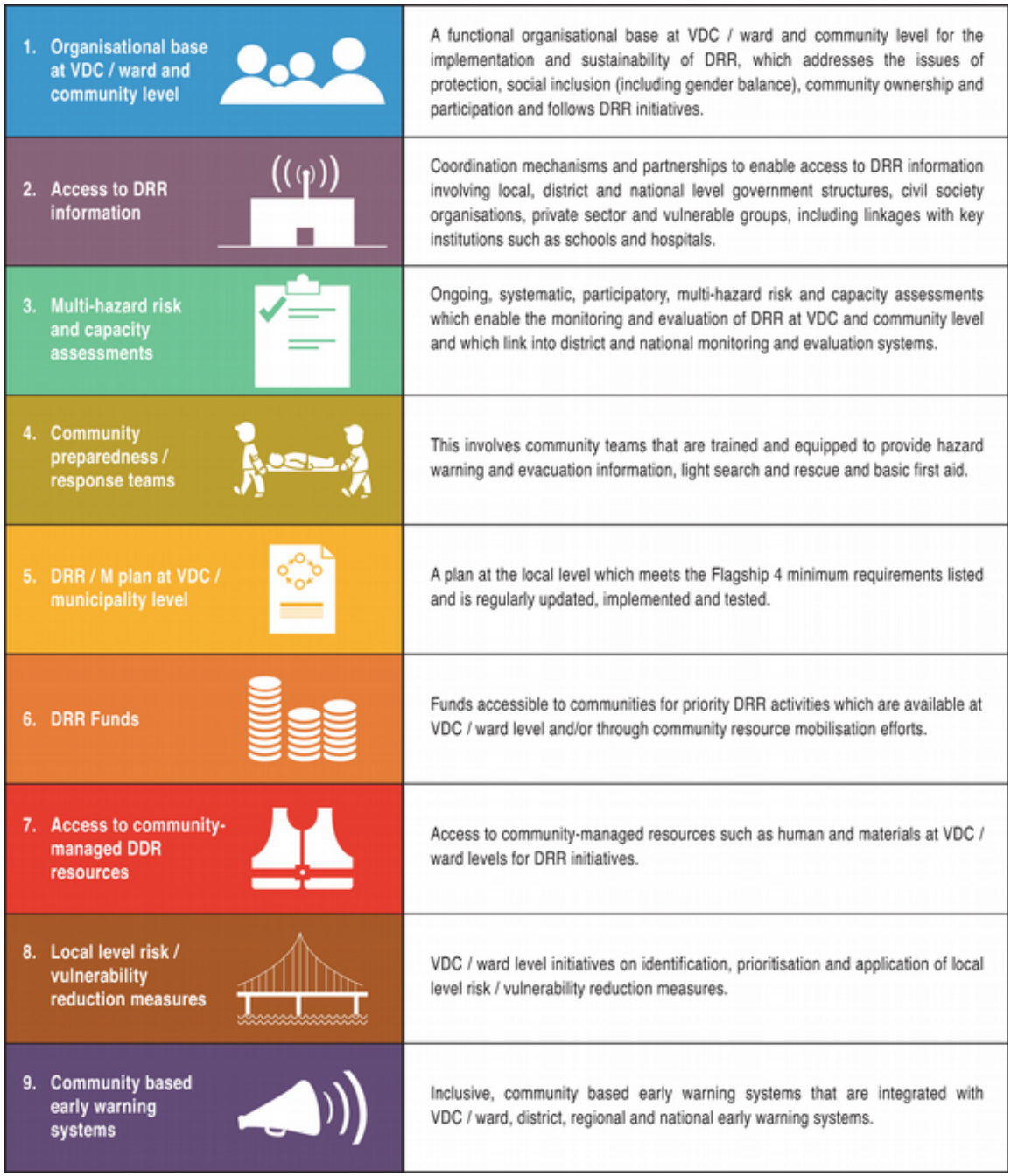



Figure 1: Nepal's 9 Minimum Characteristics of a Disaster Resilient Community

The breadth of the research across rural and urban contexts allowed specific local issues to be identified. For example, communities in urban areas are often highly heterogeneous, characterised by non-traditional social networks, which has consequences for community ownership and the governance of risk. At the same time, we also saw examples of DRR innovations based on the ideas and creativity of urban residents themselves. Providing space for such innovation through the flexible implementation of the Characteristics is therefore essential. An overarching finding across rural and urban communities was the importance of combining the benefits of CBDRR with wider development initiatives designed to strengthen livelihoods. Without such an integrated approach, the outcomes from the 9 Minimum Characteristics will at best support communities to prepare, rather than increasing their resilience.

***Evidence-informed policy and practice***

The findings from the research were shared at a dissemination workshop in August 2016 involving representatives from the Government of Nepal and the donor, UN, and INGO communities, with the aim of co-producing a set of final recommendations to guide future CBDRR policy and programming in Nepal. This included a table of example questions to guide the flexible implementation of the Characteristics with the aim of moving away from a more reductionist mode of implementation, monitoring and evaluation. The final report was launched in January 2017 by MoFALD, and the research team is working closely with the Ministry, the IFRC and the NRRC's Flagship 4 to implement the recommendations.

For further information, please contact:
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# 5.

# EwF Nepal: Project update
# Community-based landslide risk reduction

*Contribution by Katie Oven, Durham University*

Research undertaken by the EwF team in Nepal has highlighted the impact of landslides on rural lives and livelihoods, and the need to build capacity within NGOs and local government to better support communities to reduce the risks faced. While communities have been living with landslides for generations, and have a wealth of knowledge about the hazard which should be the starting point for any community-based disaster risk reduction (CBDRR) intervention, local knowledge alone may not be enough. For example, it is unclear how the landscape will continue to respond to the 2015 Gorkha earthquake and the implications that this will have on the landslide risk that communities face.

Landslide risk reduction in Nepal often involves physical measures, such as the construction of gabion walls or bioengineering. However, research findings suggest that such approaches are commonly not appropriate, highlighting the need for site specific landslide hazard assessments to identify the most appropriate management options. In addition to suitability, the scale and extent of some landslides that impact communities can mean that even simple measures can be cost prohibitive. In these circumstances, reducing risk through awareness-raising which builds on local knowledge may be the most practicable means of mitigation.

Landslide early warning systems, which often rely on monitoring data and the identification of rainfall thresholds above which hazard levels are elevated, are often the focus of CBDRR projects. However, the science of landslide early warning systems particularly for landsliding is not well developed. It is very difficult, and in many cases impossible, to provide a warning that predicts exactly when (day and time) and where a landslide will occur.

***Our research in Central and Eastern Nepal***

The EwF team has been working with a community in Dhankuta District, Eastern Nepal, to better understand the risks associated with a large landslide that threatens a village. The landslide began more then 90 years ago, destroying houses and farmland, and is a continuing concern for the community who live directly upslope. The community is aware that the > 1 km wide landslide cannot be stopped. Indeed, a great deal of the community's resources have been devoted to constructing gabion boxes and on bioengineering, which have subsequently had no effect. The question remains as to whether any actions can be taken to reduce the risk to people's lives and livelihoods in this location?

The EwF team has been working with concerned householders to develop a

low-tech approach to monitoring the landslide (illustration 1) as a means of increasing awareness and building a dataset that the community can use to lobby government for support to help them with the risk that they face. To monitor the slope, the community has installed a monitoring system based around a series of bamboo poles distributed in lines across and down the slope. The distance between the poles is being measured on a bi-monthly basis during, and in the months following, the summer monsoon to record the movement taking place.

The slope monitoring can help the community to identify the area of land that is moving, and how quickly it is moving and when, with the aim of delimiting the area at risk, assessing what drives the movement, and assessing how quickly the surrounding land may become unstable. The information gathered will be used to inform future agricultural planning, such as choosing the most appropriate crops that may help to reduce landslide movement, and for advocacy with local government.

*Installing bamboo poles to measure slope movement.*

*Illustration 1: Meeting with community members to explore options for monitoring the landslide.*

The EwF team has also working with communities in Sindhupalchok District to monitor cracks in the ground which have developed following the 2015 Gorkha earthquake, and that pose a potential future landslide risk to communities. Instruments have been installed across eight potentially unstable sites with the aim of determining if cracks that have appeared are growing and if these present a developing risk to the communities living nearby, as they look to rebuild their homes following the earthquake. The instrumentation, which includes a rain gauge and extensometer, was funded through a NERC-Urgency grant, and is being maintained by NSET-Nepal and Durham University.

We have been sharing our experience from Dhankuta and Sindhupalchok Districts, with the INGO Mission East, who is working on a European Commission-funded landslide risk reduction project in the earthquake-affected districts of Nepal. Through a NERC/ESRC/AHRC GCRF-funded project on "Harnessing 'citizen science' to reinforce resilience to environmental disasters: creating an evidence base and community of practice", which is bringing together researchers from EwF and *sister* project STREVA, members of the EwF

team visited a community affected by a landslide in Ramechhap District in Eastern Nepal with staff from Mission East in March this year. The aims of the visit were to learn more about the landslide by drawing on the community's own knowledge and experience; to better understand the impact the landslide is having on people's lives and livelihoods and what the community would like to know about the landslide and why;
and to begin to explore landslide risk reduction options with the community and the local NGO implementing the project.

The team is currently developing a toolkit to support local government and NGOs working with communities affected by landslides to better understand the hazard, and to co-design appropriate and effective mitigation and management strategies which address community concerns. The toolkit will be piloted by Mission East in Nepal over the coming months. As part of the GCRF project, the team will share the learning with communities and local government risk managers at a workshop on the volcanic Caribbean island of St Vincent later in the year, which faces ongoing landslide risks in the volcanic soils.

For further information, please contact Dr Katie Oven: k.j.oven@dur.ac.uk

# 6.

# Economic development, livelihoods and resilience in Nepal

*Contribution by Katie Oven, Durham University*

The building of social resilience has become a normative goal of the development sector. This is based on the assumption that social resilience is best achieved through market-led economic growth, which raises incomes and reduces poverty. However, while at a general level such an approach can be resilience-building, the underpinning logics and policies can also be resilience-eroding.

In this policy brief we reflect on research undertaken as part of the *EwF Partnership* exploring the impacts of market-led economic development on livelihoods in Nepal, and what this means for social resilience more broadly in the global South. We do this by examining three cross-cutting themes: livelihood diversification, mobility and migration, and governance.

The findings highlight that vulnerability is not merely accentuated or ameliorated over time, but is reworked because the causes, dynamics and nature of vulnerability also change. This, we argue, requires further consideration by the development sector seeking to promote both economic growth and the building of societal resilience.

For further information, please contact Dr Katie Oven: k.j.oven@dur.ac.uk

***Underpinning papers***

Rigg, J., Oven, K.J., Basyal, G.K. & Lamichhane, R. (2016) Between a rock and a hard place: vulnerability and precarity in rural Nepal. *Geoforum* 76: 63-74.

Rigg, J. and Oven, K. (2015) Building liberal resilience? A critical review from developing rural Asia. *Global Environmental Change* 32: 175-186.

# 7.

# Earthquake contingency planning in Nepal: Assessing earthquake disaster risk

*Contribution by Tom Robinson, Durham University*

Measuring and understanding the risk posed by earthquakes at a national- and regional-scale is crucial for developing appropriate contingency plans to respond to future events. However, recent large earthquakes globally have highlighted gaps in our understanding of earthquake hazard and vulnerability that have resulted in large-scale impacts. Much of the issue lies in the way in which we model and assess earthquake risk. Current approaches are well-suited to addressing specific problems, such as the maximum strength of shaking a hospital will experience in the next 100 years, or the damage a specific scenario may inflict. However, these approaches are not well suited to national-scale contingency planning.

Recent research at Durham University in collaboration with NSET-Nepal has sought to address this issue. Working in Nepal with the UN Resident Coordinators Office (RCO) and Humanitarian Country Team (HCT), this research has worked to identify the information (I)NGO's and central governments require in order to inform contingency plans (Illustration 1).

In particular, this work has highlighted the need for a greater focus on the potential impacts that may result from future earthquakes rather than the earthquake hazard itself. For instance, when developing contingency plans, understanding the likely numbers of casualties and buildings damaged is more important to stakeholders engaged in response planning than the precise earthquake magnitude. Typically, this is addressed through scenario planning for a specific earthquake however, in most seismically-active parts of the world knowledge on earthquake hazard is insufficient to prioritise planning for any one specific earthquake scenario. It is almost certain that the exact scenario chosen will not represent the next earthquake, or its impacts. Consequently, basing national- and regional scale contingency plans around a single scenario can be misleading.

*Illustration 1: A member of the Nepal Army considers a map showing expected impacts from a future earthquake scenario in Nepal.*
*Illustration 2: Members of various international militaries from the Multi National Planning Augmentation Team (MPAT) discuss contingency plans for a future earthquake in Nepal as part of the 2016 Tempest Express 28 simulation.*

***Earthquake modelling in Nepal***

Our research has taken a new approach to assessing earthquake disaster risk with a precise focus on developing the information planners require. This has focussed on modelling the impacts that are most common across a suite of plausible earthquake scenarios so that contingency plans can account for these losses irrespective of what the next earthquake actually looks like. This allows planners to focus on the impacts which they are most likely to be presented with rather than having to consider what the next earthquake will be, something which we are currently unable to do.

By assessing the known earthquake history of the entire Himalayan Arc, as well as assessing the earthquake potential of faults known to be active, but for which past earthquakes are yet to be identified, we have developed an ensemble of 30 different plausible earthquake scenarios that could cause large-scale impacts in Nepal (i.e. requiring national-level response or greater). Using census data from the Government of Nepal, which contains information on residential building materials, we are able to assess both the exposure of the population and the vulnerability of residential buildings to all 30 earthquakes consistently.

Accounting for different times of day and week allows us to increase our ensemble to contain a total of 90 different plausible earthquake scenarios that could affect Nepal in the near future.

Building on NSET-Nepal's work to model the response of different Nepali building types to ground shaking, we have estimated the total number of damaged buildings and consequent casualties for all 90 scenarios. This allows us to compare the losses, rather than the ground shaking, and identify common elements. For instance, we find that the majority of scenarios result in casualties in Kathmandu district; however, the total number of casualties is highly variable depending on the scenario. Conversely, in Mustang district, a minority of scenarios inflict casualties; however, when casualties do occur they are fairly consistent in number. This means that contingency planners can be reasonably sure that future earthquakes will result in casualties in Kathmandu, but that the exact number is dependent on the earthquake that occurs. Planning for the worst-case in Kathmandu may therefore be a prudent approach. While in Mustang, the likelihood of future earthquakes resulting in casualties is lower, when causalities do occur, planners can be reasonably confident of the scale of response required and can therefore plan accordingly.

***Secondary earthquake hazards***

A current limitation of these models is that they do not account for secondary earthquake hazards such as landslides. The 2015 Gorkha earthquake has shown that landsliding during earthquakes in Nepal is a major hazard that can significantly increase the impacts as well as hamper the response by blocking key access routes. The

next steps in this research aims to integrate secondary hazards and their impacts by building on research currently underway by members of the EwF team. Expanding the earthquake modelling to include these impacts is expected to provide planners with a wider view of total earthquake risk, and to allow contingency planning to not only consider the level of building damage and casualties, but also the access constraints that are likely to severely impact earthquake response.

For further information, please contact Dr Tom Robinson: tom.robinson@durham.ac.uk

***Related publications:***

T Robinson & N Rosser (2017) Multi-scenario analysis: a new hybrid approach to inform earthquake disaster risk planning. *Geophysical Research Abstracts, 19,* EGU2017-5239. Available from: http://meetingorganizer.copernicus.org/EGU2017/EGU2017-5239.pdf