Report

Pathways to earthquake resilience in China

October 2015

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ISSN: 2052-7209

Cover photo: Photo by GDS, Children receiving the GDS disaster risk reduction kit, Shaanxi Province, China

Contents

List of tables, figures and boxes

Tables

Figures

Boxes

Acknowledgements

The Overseas Development Institute and Earthquakes without Frontiers would like to thank all contributing authors and associated institutions: Lena Dominelli, Durham University, UK; Tony Zhang Jun and Zhao Bin, Gender Development Solution, China; Brian Tucker, Geohazards International, US; Cui Ke, Timonthy Sim and Yunxi Yang, Hong Kong Polytechnic-University, Hong Kong; John Young, Overseas Development Institute, UK; Philip England and Richard Walker, Oxford University, UK; and Ning Li, Patrick Zhang Jun, Ling Zhang and William Weizhong Chen, World Vision, China. In addition, we thank other members of the World Vision and Gender Development Solution who participated in the Writeshop in Xian, China in April 2015.

We express gratitude to the government of the People's Republic of China and in particular the National China Earthquake Administration and National Commission for Disaster Reduction.

We would like to acknowledge and thank Tongli International College, Shaanxi Province, China. Tongli International College is a valued partner of the Earthqaukes without Frontiers project and host of the Writeshop from which this publication was produced, April 2015.

Finally, we thank Anna Brown, Louise Ball, Cormac O'Brien and Sophie Hall for their editorial work and design.

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Acronyms

CBDM	community-based disaster management
CBDRR	community-based disaster risk reduction
CEA	China Earthquake Administration
CSO	civil society organisation
DRR	disaster risk reduction
EDRR	earthquake disaster risk reduction
EwF	Earthquakes without Frontiers
GDS	Gender Development Solution
GHI	GeoHazards International
GPS	global positioning system
HFA	Hyogo Framework for Action
NCDR	China's National Commission for Disaster Reduction
NGO	non-governmental organisation
ODI	Overseas Development Institute
RAPID	Research and Policy in Development Programme
UN	United Nations
UNISDR	United Nations International Strategy for Disaster Reduction
WV	World Vision

Glossary of terms

Active fault: A fault that has generated an earthquake in historical time (e.g. past 10,000 years) or recent geological time (e.g. past 500,000 years).

Coseismic: Relating to the time of the earthquake itself. For the few minutes during and immediately after the earthquake, there is severe ground shaking, which causes the collapse of buildings, dams, etc. and causes landslides. (See *interseismic* and *postseismic*.)

Crust: Outermost layer of the Earth, consisting of rocks that are less rich in iron, and are less dense, than those in the mantle. The crust in the continental regions is about 25 km to 75 km thick, and that in the oceanic area is about 5 km to 10 km thick. Earthquakes on the continents typically occur within the upper 10 km to 20 km of the crust.

Deformation: see *strain*.

Dip: The angle between a fault plane and the horizontal. Dips are measured between 0° and 90°. A fault that dips at 0° is horizontal and one that dips at 90° is vertical.

Epicentre: See *hypocentre*.

Fault, fault plane, fault break: A fault is an approximately planar surface in a body of rock, across which observable relative motion of the rock has occurred. The relative motion of the rocks on either side of the fault is called the slip. A fault that is believed to be capable of generating future earthquakes is said to be an active fault. The term 'fault break' is commonly used to describe disruption of the land surface by fault slip in an earthquake.

Global positioning system (GPS): a satellite navigation system operated by the US Department of Defense. The use of GPS for navigation (determining location, course and speed of a moving object) is well known. Earth scientists use the technology to determine the velocity of markers on the Earth's surface with millimetric precision. These measurements allow us to measure the rate at which the crust is accumulating the strain that, eventually, leads to earthquakes.

Hypocentre: The point in the earth where the rupture of the rocks begins during an earthquake. Its position, in practice, is determined from arrival times of the onsets of P and S waves. It is also called earthquake focus. The point on the earth's surface vertically above the hypocentre is called the epicentre.

Intensity: When capitalised, Intensity usually refers to the Modified Mercalli Intensity scale or one of the other common, non-instrumental measures of the strength of earthquake motion. A good website to explore is http://earthquake.usgs.gov/earthquakes/pager/, which has an archive of shake maps. Note that the Intensity is a measure of the intensity of shaking of the ground; it is not a measure of the size of the earthquake that causes the shaking (see *magnitude*).

Interseismic: The period between earthquakes. (See *coseismic*, *postseismic*.)

Isoseismal: A line bounding the area within which the intensity from a particular earthquake was predominantly equal to or higher than a given value.

Liquefaction: When sediments whose pores are filled with water are shaken by an earthquake, the grains may be separated from each other, essentially transforming the solid sediment into a fluid. Buildings and other structures can sink into the ground and steep slopes can become unstable.

Magnitude: The magnitude of an earthquake is what is usually reported in the media as being the size of the earthquake. The proper measure of an earthquake's size is its moment (see below). The idea of magnitude arose historically from a desire to produce a measure that was independent of the place of observation (contrast *Intensity*). There are many magnitude scales, including the famous Richter scale, but the proper scale to use now is the moment magnitude.

Moment: The fundamental measure of the size of an earthquake. It consists of the area of the fault plane that slipped, multiplied by the magnitude of the slip and by the shear modulus of the rock.

Moment magnitude (MW): Magnitude calculated from the seismic moment. This quantity has been routinely calculated, since it was defined in the late 1970s, for all earthquakes greater than a magnitude of about 5.5. The magnitude is commonly – but completely incorrectly – referred to as the 'Richter' magnitude.

Normal fault: A fault, usually dipping between 30° and 60°, on which the rock lying above the fault plane slips down the plane, relative to the rock below. Such movement results in horizontal extension of the crust.

Palæoseismology: The study of earthquakes decades, centuries or millennia after their occurrence.

Postseismic: The term refers to the interval immediately after an earthquake; this interval does not have a well-defined duration, but is characterised by aftershocks and ground movements that represent the crust making minor adjustments following the main earthquake. (See *coseismic*, *interseismic*.)

Seismic hazard: Any physical phenomenon associated with an earthquake (e.g. ground motion or ground failure) that has the potential to produce a loss. This term is also used without regard to a loss to indicate the probable level of ground shaking occurring at a given point within a certain period of time. Seismic hazard analysis (SHA) is the calculation of the seismic hazard for a site or group of sites, the result of which is often displayed as a seismic hazard map.

Seismic hazard (secondary): A natural hazard that results from the ground motion caused by an earthquake e.g. landslides or tsunamis.

Seismic risk: The risk to life and property from earthquakes. Probabilistic risk analyses are the probability that a specified loss will exceed some quantifiable level during a given exposure time.

Seismicity: Quantitative description of the distribution, in space, time and magnitude of earthquake occurrences.

Seismology: A branch of earth science dealing with vibrations of the Earth caused by natural sources (e.g. earthquakes, volcanic eruptions and glaciers) and man-made sources, such as underground explosions.

Strain (deformation): Change in shape and size of a body under applied stresses. Elastic deformation is reversible: if the stress is removed, the body returns to its original shape. Permanent deformation, or strain, remains after the stress has gone away. An example of elastic strain would be the bending of a ruler (short of the point of breaking it). Permanent strain can occur by breaking, bending or flow of the body. The elastic rebound model of earthquakes, which is correct to a good approximation, holds that during the interseismic period, elastic strain builds up over a large region around a fault. During the earthquake (coseismic period) this strain is converted into permanent strain (slip) on the fault, and the rest of the region returns to a state in which it is not deformed.

Strain rate: the rate at which strain builds up over time – strain per unit time.

The Yingxiu Emergency Response Team responding to a debris flow on 10 July 2013. Photo: Yingxui Town government

1. Introduction

John Young

The challenge

Between 2 million and 2.5 million people have died in earthquakes since 1900 – more than 500,000 in the last decade alone. Approximately two thirds of those deaths occurred in the continental interiors. In some parts of the world, advances in scientific understanding of earthquakes have led to increased resilience. However, comparable advances have not taken place in most parts within the continental interiors, where the earthquake hazard is still not well identified or understood.[1] Further research is needed, not only to enhance our understanding of the physical processes behind such natural hazards, but also to understand the social effects and implications for their prediction and mitigation.

Responding to the challenge

The Earthquakes without Frontiers (EwF) partnership brings together earth scientists specialising in integrated earthquake science; social scientists with extensive experience of exploring the vulnerability and resilience of communities in disaster-prone regions; and experienced practitioners in the communication of scientific knowledge to policy-makers. All are working towards three overarching objectives:

- To provide transformational increases in knowledge of the distribution of primary and secondary earthquake hazards in the continental interiors.
- To identify pathways to increased resilience in the populations exposed to these hazards.
- To secure these gains over the long term by establishing a well-networked, transdisciplinary partnership for increasing resilience to earthquakes.

1 Devastating earthquakes mainly take place in two settings – on plate boundaries and on diffuse networks of faults within continental interiors. The distinguishing characteristic of a plate boundary is that it is a narrow fault zone, wWWhose location is precisely known, and across which potential slip accumulates relatively quickly, at rates of 10–100 mm per year. In contrast, the networks of faults within the continents are far less well defined. They are commonly hundreds or thousands of kilometres in width and contain many separate faults, each accumulating slip at only a few tenths to a few millimetres per year (England and Jackson (2011) 'Unchartered seismic risk', *Nature Geoscience*).

What do we mean by resilience?

There are many definitions of resilience. The EwF partnership's work is based on a definition that measures the resilience of a community in terms of: (i) its capacity to resist, accommodate or adapt to the effects of earthquakes and their secondary hazards; (ii) its capacity to manage, or maintain certain basic functions and structures during earthquakes and their aftermaths; (iii) its capacity to recover after such events.

To increase resilience, therefore, requires a better understanding of the underlying risk and hazard (where earthquakes are likely to occur and how much damage they are likely to cause). There also needs to be a deeper understanding of the social, economic, political and cultural factors that affect how people, communities, local authorities and national governments can respond to this hazard. Finally, all the relevant stakeholders need to be brought together to decide what can be done to reduce the impact of earthquakes.

The global picture

The importance of bringing together different stakeholders was recognised in the 2015 World Conference of Disaster Risk Reduction, held in Sendai, Japan. More than 5,000 world leaders, scientists and civil society organisations gathered in Sendai to negotiate a new international framework for disaster risk reduction and resilience.

Since the Hyogo Framework for Action, adopted by world leaders in 2005, disasters have killed another 700,000 people, injured another 1.4 million and made more than 23 million people homeless. The new Sendai Framework for Disaster Risk Reduction 2015–2030 emphasises the need to address underlying disaster risk drivers, including poverty and inequality, rapid urbanisation, demographic change, non-risk informed policies and weak incentives for private and non-private-sector investment in disaster risk reduction. It calls for 'a broader and a more people-centred preventive approach to disaster risk' and, while recognising the leading role of governments, it promotes engagement with other stakeholders, 'including women, children and youth, persons with disabilities, poor people, migrants, indigenous peoples, volunteers, the community of practitioners and older persons in the design and implementation of policies, plans and standards' (UN, 2015: 4).

The EwF partnership

Globally, the EwF partnership is drawing on existing scientific knowledge about intra-continental earthquakes and approaches to increase resilience in Italy, Greece and Iran. It is undertaking new natural and social science research and collaborating with local scientists, policy-makers, operational agencies and local communities in three regions: Nepal and Northern India; Kazakhstan; and China.

In China, EwF is working with the National China Earthquake Administration (CEA), China's National Commission for Disaster Reduction (NCDR) and Beijing Normal University. The CEA, which has overall responsibility for informing China's earthquake disaster risk reduction policies, requested that EwF focus its work on the Ordos Plateau and Weihe Basin in Shaanxi Province. Local partners include the Shaanxi Seismological Bureau, the Western Institute of Seismic and Building Design, the Shaanxi Academy of Social Sciences, Tong-Li International College, Shaanxi Gender Development Solutions (GDS) and World Vision. Since the project began in 2013, EwF has worked with local partners to conduct geological mapping and remote sensing work on major faults in the region and to conduct research into what community-based disaster risk reduction work is currently taking place. The EwF project team has held a number of workshops and meetings with key stakeholders in Beijing and Xi'an, including the NCDR, the Ministry of Civil Affairs, the CEA, GDS, World Vision and a number of other NGOs.

The purpose of this book

This work has revealed a wealth of existing knowledge and much practical experience to increase resilience at the community level. However, knowledge is held by different stakeholders and little of it is easily available to other stakeholders. Furthermore, local stakeholders had limited access to the wealth of international experience on earthquake disaster risk reduction. This book brings together current local and international experience in order to strengthen earthquake resilience in Shaanxi Province, China.

It is based on the outcome of a three-day writeshop held in April 2015, hosted at Tongli International College in Xi'an, Shaanxi Province. The writeshop brought together different stakeholders to share knowledge and work together to identify approaches to increase resilience, especially at community level in rural areas and small towns in Shaanxi Province.

The chapters of this book were identified in advance and local and international experts prepared their draft chapters before the writeshop. The first two days of the writeshop focused on reviewing each chapter to identify any errors and omissions, and on shaping the chapters to provide greater coherence to the whole book. The third day was spent discussing the results, and working with the local NGOs to explore how some of the lessons from local and international experience could be incorporated into their ongoing work on community-based disaster risk reduction.

Chapter outlines

Chapter 1 outlines the purpose of this book. It offers an introduction to earthquake risk, the global emphasis on disaster risk reduction, the EwF partnership and ongoing work in China, which has led to this book.

Chapter 2 looks at earthquake disaster risk reduction policies and programmes in China. It provides an overview of the knowledge, policy and power analysis for strengthening earthquake resilience in China. It covers the political context; the actors involved in knowledge production and policy-making; different types of knowledge and knowledge interaction processes; China's earthquake disaster risk reduction guidelines at the local, provincial and national level; and the strengths and weaknesses of this strategy for local-level action.

Chapter 3 describes the distribution of seismic hazard in Shaanxi Province. It synthesises the current state of knowledge on the distribution of seismic hazard, drawing from studies of active faulting, instrumental and historical seismicity, palaeoseismology and the analysis of satellite imagery.

Chapter 4 considers current approaches to earthquake disaster risk reduction in Shaanxi Province. It provides an overview of current approaches, based on a literature review and a survey of NGOs working in south-western China. It concludes by identifying areas for future research, particularly in exploring the differentiated experiences of vulnerability within different segments of the population, capacity-building among civil society organisations delivering disaster risk reduction programmes, and the mechanisms whereby community resilience is fostered.

Chapters 5 and 6 discuss two examples of current community-based NGO disaster risk reduction projects in Shaanxi Province. Chapter 5 is a case study of World Vision's community disaster response plan in Ranjia Village, with an emphasis on work with children and families in schools. Chapter 6 is a case study on the GDS children disaster safety class, working on community-level disaster risk reduction training.

Chapter 7 looks at recent earthquakes in China, drawing lessons on resilience. It includes a description of work to improve earthquake resilience in Sichuan Province following the 2008 Wenchuan earthquake, which killed 70,000 people.

Chapter 8 considers global experiences and lessons for NGOs to promote earthquake disaster risk reduction. It provides a summary of global experience of approaches to improve earthquake resilience and lessons that may be relevant to improving resilience in Shaanxi Province. It provides a holistic overview of measures to be taken to maximise resilience, including resilient buildings, infrastructure, local government and non-government policies and procedures.

Chapter 9 identifies overall conclusions from the book and draws lessons about how to increase resilience at community level in Shaanxi Province.

Chapter 10 focuses on community-level approaches to increase resilience. It includes two examples of how lessons from the writeshop could be incorporated into disaster risk reduction projects at the community level in Shaanxi Province. Part one is written by GDS and explores possible approaches for establishing town-based disaster risk reduction mechanisms in Heyang and Houcheng County, using a systems approach with the government, civil society organisations, communities, women and children. In part two, World Vision explore opportunities for an integrated approach to improving earthquake disaster risk reduction activities through community schools, involving schools, local government and NGOs to establish earthquake-resilient physical infrastructure and improve earthquake response in Yaozhou District, Tongchuan City.

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2. Earthquake disaster risk reduction policies and programmes in China

Cui Ke, Timothy Sim and Lena Dominelli

Introduction

Since the founding of the People's Republic of China (China) in 1949, disaster management has been a high priority for the government. It recognises that measures to reduce disaster risk are core conditions for a safer society and a stronger economy. In 1989, the Chinese government responded to the United Nations (UN) International Decade for Natural Disaster Reduction (1989–1998) by setting up an International Decade for Natural Disaster Reduction Committee. This was renamed the National Committee on International Disaster Reduction in 2000, and then the National Commission for Disaster Reduction (NCDR) in 2005. Since then, China has been committed to using the International Hyogo Framework for Action. This commitment has been translated into actions that have reduced casualty rates, particularly during recent earthquakes such as the 2014 Ludian earthquake in Sichuan Province (see Chapter 7). Since 1989, China has become one of the leading countries in disaster risk reduction (International Strategy for Disaster Reduction (ISDR) and China's NCDR, 2015.

This chapter provides an overview of the political context, knowledge and policies relating to disaster risk reduction (DRR) in China. It addresses China's earthquake disaster risk reduction (EDRR) policies, programmes and guidelines at the national, provincial and local levels. Future challenges for China's disaster prevention and reduction are highlighted in concluding remarks.

Overview of disaster risk reduction in China

A comprehensive approach (综合减灾)

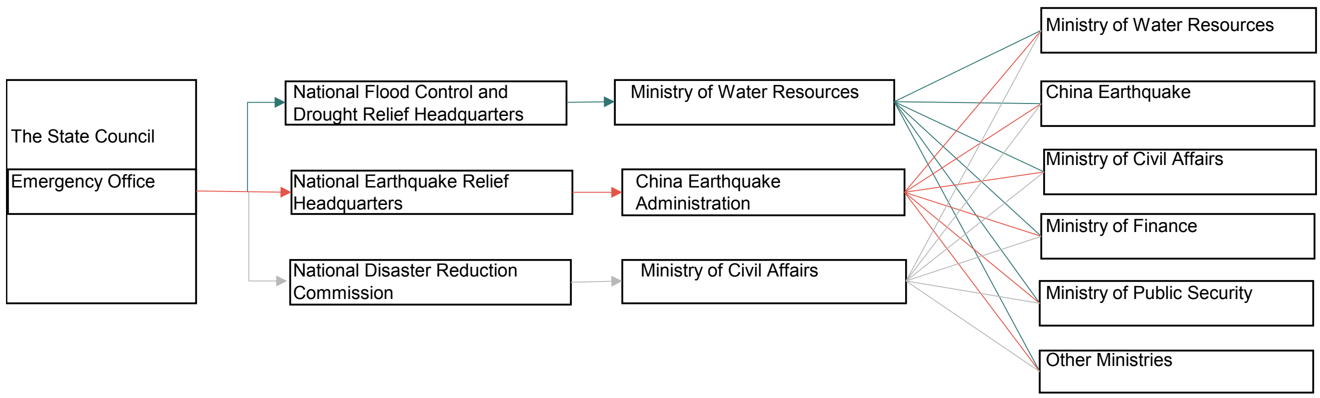
Over the past 25 years, China has developed a comprehensive approach to DRR, creating relevant legislation, regulations and mechanisms. Its key idea is to strengthen capacity for disaster prevention and reduction, and to promote coordination and cooperation among departments and regions (ISDR and NCDR, 2015). Gradually, China has moved through three transitional phases: (i) from single disaster reduction to comprehensive disaster reduction; (ii) from rescue-oriented to combined rescue and risk reduction; and (iii) from disaster mitigation to disaster prevention.

Organisational structure of China's disaster risk reduction system

China's DRR system is structured by disaster type. Government departments are assigned oversight of different disasters, or groups of related disasters. For example, the National Earthquake Relief Headquarters deals with all matters relating to earthquakes, such as hazard monitoring, warning systems, rescue and recovery. The National Flood Control Drought Relief Headquarters deals will all flood and drought-related disasters. The NCDR coordinates disaster relief work across the different headquarters.[2] The NCDR and the different disaster headquarters are supported by three government ministries: China Earthquake Administration (CEA), the Ministry of Water Resources and the Ministry of Civil Affairs. The Ministry of Finance and the Ministry of Public Security also support disaster relief work. The NCDR plays a leading role in China's DRR efforts. Its major tasks include:

2 A diagram of the different components of the China National Commission for Disaster Reduction is available at: www.jianzai.gov.cn//DRpublish/jggl/00010008-1.html

Figure 1: Organisational structure of China's disaster prevention and reduction system



Source: Zhang et al., 2014.

- to draw up guiding principles, policies and programmes for disaster reduction
- to coordinate national disaster reduction activities
- to guide local disaster reduction efforts
- to promote international disaster reduction communication and cooperation.

disaster reduction; and to establish a sophisticated working mechanism for disaster reduction.

Through the implementation of this plan, a large number of national disaster prevention projects have been developed. As a result, for example, monitoring and warning systems have been strengthened for meteorological, oceanographic, hydrological, geological and seismic disasters, for crop pests and diseases, and for forest fires.

National disaster risk reduction planning

China's 21st Century Agenda

In March 1994, the State Council promulgated China's '21st Century Agenda', emphasising the importance of disaster mitigation for sustainable development. The thinking behind this was that disaster mitigation forms the basis for sustainable national growth and for improvements in citizens' quality of life. The agenda included plans to improve natural disaster management and prevention systems, and to reduce the human factors that induced or exacerbated natural disasters.

Disaster Reduction Plan of the People's Republic of China (1998–2010)

In April 1998, the State Council enacted the Disaster Reduction Plan of the People's Republic of China (1998–2010). It was China's first dedicated plan on disaster reduction. It offered guidelines, objectives and action points for national disaster mitigation, emphasising the importance of disaster mitigation for economic development and the importance of engineering in disaster prevention. The plan identified the country's major goals for the work of national disaster reduction: to reduce significantly the economic loss and casualties caused by disasters; to increase people's awareness and knowledge of disaster reduction; and to establish a sophisticated working mechanism for disaster reduction.

National Plan on Comprehensive Disaster Reduction for the 11th Five-Year Period (2006–2010)

In August 2007, the State Council issued the National Plan on Comprehensive Disaster Reduction for the 11th Five-Year Economic and Social Development Period.[3] It set four basic principles for the national comprehensive disaster reduction plan.

1. It should be government-led: top-down administration and public participation.
2. Prevention should come first: integrated approach to prevention, resistance and rescue.
3. There should be a careful division of duties: regions and departments cooperating to reduce disaster risk.
4. Sustainable socioeconomic development should incorporate DRR.

This new plan outlined eight objectives.

1. To enhance the management of disaster risk and information.
2. To improve the monitoring and forecasting of natural hazards.
3. To strengthen comprehensive precautions and defence capacity against natural disasters.
4. To enhance national natural disaster emergency relief ability.
5. To intensify the comprehensive response ability against catastrophe.

3 The 'Eleventh Five-Year-Period' refers to China's National Five-Year Economic and Social Development Period. The National Plan for Comprehensive Disaster Reduction is a five-year-plan, corresponding to the Eleventh Five-Year-Period.

6. To promote disaster risk reduction in both urban and rural areas.
7. To enhance scientific and technological support for disaster reduction.
8. To promote education on disaster reduction.

National Plan on Comprehensive Disaster Prevention and Reduction (2011–2015)

In 2011, the State Council issued the National Plan on Comprehensive Disaster Prevention and Reduction (2011–2015). This plan put forward eight new objectives.

1. To map natural disaster risks in key regions.
2. To achieve a significant drop in the number of casualties from the 11th Five-Year Plan period.
3. To integrate disaster risk reduction into national economy and social development programmes at different levels.
4. To ensure the provision of basic disaster relief within 12 hours after a disaster occurs.
5. To limit the proportion of direct economic loss caused by disasters to less than 1.5% of GDP.
6. To enhance public awareness and increase the number of qualified persons for disaster prevention and reduction.
7. To create 5,000 national disaster reduction demonstration communities.
8. To further develop the national disaster prevention and reduction system.

Community-based disaster risk reduction in China

DRR work is usually top-down; plans are delivered by the government officials. Community-based disaster risk reduction involves grass-roots organisations and residents in development of DRR plans.

Historically, community-based disaster management (CBDM) in China focused strongly on relief, but it has been developed with continuous research and practice to cover risk mitigation, emergency preparedness, response and recovery (Zhang et al., 2013).

To improve China's CBDM capacity, relevant government departments and organisations promoted a series of programmes such as: the construction of a comprehensive disaster reduction demonstration community; construction of safe community-built infrastructures; construction of civil communities, and green communities; and the development of harmonious communities (National Disaster Reduction Centre of China, Ministry of Civil Affairs, 2009). Along with the implementation of these programmes, different stakeholders, such as government officials, academics and particularly community members recognised the concepts of vulnerability assessment, community disaster resilience and the theory of comprehensive disaster reduction (Yi et al., 2012; Shi et al., 2007).

In September 2007, the Ministry of Civil Affairs promulgated the Standards on National Comprehensive Disaster Demonstration Communities (2007) (hereafter referred to as National Standards). This document was revised in 2010 by the NCDR. The National Standards indicate that a model community should meet three basic requirements: 1) no major disaster-induced accident to have occurred in the community during the past three years; 2) it should have an emergency response plan consistent with the community's characteristics; 3) there is a satisfaction rate of above 70% among community members regarding the state of the community's integrated disaster reduction preparedness.

Provincial-level local governments also promulgated integrated disaster mitigation model community standards. In 2014, for example, Shaanxi Province announced the introduction of the Shaanxi Province Integrated Disaster Mitigation Model Community Standards (hereafter referred as Shaanxi Standards). These standards indicate that a model community in Shaanxi Province should meet six basic requirements.

1. The community has a fixed place for publicity and education for disaster risk reduction.
2. Community members' participation rate in community-based integrated disaster mitigation activities is higher than 50% (and there is a satisfaction rate of above 70% among community members regarding its integrated disaster reduction preparedness).
3. There has been no occurrence of major accidents in relation to natural disaster emergency relief, life assistance and reconstruction and recovery.
4. There is a disaster rescue and emergency response plan consistent with the community's characteristics.
5. The standards for a national earthquake safety model community are met (that is, the community has made significant achievements in conducting earthquake disaster prevention and reduction education, in anti-seismic fortification, in earthquake emergency preparedness, and in mass observation and preparedness for earthquakes).
6. The standards for a 'harmonious community' are met (i.e., a socialist community that is democratic and law-based, fair and just, trustworthy and friendly, full of vigour and vitality, secure and orderly, and in which humans live in harmony with nature).

Comprehensive disaster mitigation demonstration communities are implemented and led by province-level governments. In Shaanxi Province, for example, the departments of civil affairs, land resources, earthquakes and meteorology are responsible for guiding the screening work for various disasters, mapping all the disaster risks for a community and developing measures for risk prevention and management. The civil affairs department is responsible for creating a list of vulnerable groups within the community (people aged 70 and above, children under 14, disabled persons, pregnant women and patients with long-term or serious illness). According to the Shaanxi Standards, civil society organisations are strongly encouraged to participate in community-based disaster reduction activities. For example, communities are encouraged to build up a disaster social work service platform and to establish a disaster risk reduction social work service team to undertake community-based integrated disaster mitigation work, such as publicity and education, compulsory training and psychological counselling. However, social work service teams should be classified according to their expertise, registered and administrated by local government.

As a result of all this, communities are more prepared and engaged in DRR, and equipped with effective early warning systems. There are now safer schools and hospitals. China has invested significantly in critical infrastructure that is more resilient to earthquakes and has improved waterway management to reduce flooding. During the period of the 11th Five-Year Plan for National Economic and Social Development (2006–2010), the Ministry of Civil Affairs named 1,562 comprehensive disaster reduction demonstration communities (Zhang et al., 2013). By the end of 2013, a total of 5,408 demonstration communities had been established (ISDR and NCDR, 2015). These are deemed to have increased disaster prevention and reduction capacities at the local community level in both urban and rural areas.

However, despite rapid increase in the number of demonstration communities, public awareness of disaster prevention and mitigation is still weak (Yi et al., 2012). In recent years, disaster prevention and mitigation courses have been added to primary and secondary school curricula, however, insufficient attention is given to putting these into practice, for instance, through doing drills. The dissemination of information on hazards and risks is still inadequate. It is therefore common for residents to have little knowledge about local disasters and disaster risks.

Earthquake disaster risk reduction (EDRR) in China

Earthquakes are one of the most destructive natural disasters – and China has some of the most volatile earthquake movements and most serious earthquake damage. Its territory covers 7% of the land on earth, but in the 20th century, 35% of continental earthquakes with a magnitude of more than 7 took place in China. Among these were the 1975 Haicheng earthquake (magnitude 7.3), the 1976 Tangshan earthquake (magnitude 7.8), and the 1976 Songpan earthquake (magnitude 7.2).

These catastrophes also led to more earthquake prediction, through government laws. However, the 1976 Tangshan earthquake prompted greater emphasis on seismic risk mitigation with a much lower emphasis on prediction (Chen and Wang, 2010). This was mainly because, scientists failed to predict the 1976 earthquake, lowering people's confidence in prediction (Mei et al., 1993; Zhang et al., 2001).

The early part of the 21st century has seen several catastrophic earthquakes in mainland China. These include: the 2008 Wenchuan earthquake (magnitude 8.0), the 2010 Yushu earthquake (magnitude 7.1), the 2014 Lushan earthquake (magnitude 7.0), and the 2014 Ludian earthquake (magnitude 6.5). Among these, the Wenchuan disaster has been identified as the most destructive earthquake since the founding of the People's Republic of China in 1949. Confidence in earthquake prediction dropped to a historical low after that, due to the failure to predict such a catastrophic disaster and the ensuing large number of fatalities; the bias swung firmly towards disaster mitigation instead (Chen and Wang, 2010). This spurred the Chinese government to improve earthquake prevention and mitigation (ISDR and NCDR, 2015).

In 1956, the State Council held the National Science and Technology Plan Conference. The People's Republic of China Science and Technology Long-Term Plan was formulated in June that year. Within the plan, the 'study of China's earthquake activity and prevention' was identified as a core research topic. This was the first time that earthquake prevention was included in a national-level plan. The 1966 Xingtai earthquake prompted more government support for earthquake prevention and reduction.

In 1969, right after a magnitude 7.4 earthquake in Bohai Sea, the then Premier Zhou Enlai led the establishment of the Central Earthquake Work Team, responsible for the organisation and coordination of national seismological work. In 1971, the Central Earthquake Work Team was withdrawn, and the China Earthquake Administration (CEA) was founded to administrate national seismological work. In March 1972, through the CEA, 24 provinces established institutions for seismological work and earthquake teams with professional groups including more than 9,000 individuals. These achievements marked the beginning of the gradual systemisation of earthquake management agencies in China.

More than two decades later, in 1996, the then leader of the CEA, Chen Zhangli, noted that the objective of earthquake management was to reduce damage as much as possible. Simply relying on earthquake prediction was not enough to meet this objective. The principles of earthquake prevention and reduction in China were introduced and clarified to put prevention first: strengthen emergency response and reconstruction based on earthquake monitoring, and reduce earthquake damage through comprehensive prevention.

Between the Fifth and Ninth National Economic Development Five-Year Plan period (1976–2000), the CEA drew up various long-term plans on prevention and reduction.

The guiding principles of the China Earthquake Prevention and Reduction Plan of the Ninth Five-Year Economic and Social Development Period and the 2010

Long-Term Objective Outline clearly stated the policy of ‘prevention first, combining prevention and relief, and promoting comprehensive disaster reduction’.

Law on Protecting Against and Mitigating Earthquake Disasters (2008)

This law was adopted at the 29th meeting of the Standing Committee of the Eighth National People’s Congress on 29 December 1997, and was amended at the sixth meeting of the Standing Committee of the 11th National People’s Congress on 27 December 2008. The law aimed to protect against and mitigate the risk of earthquake disaster; ensure the safety of people and their property; and promote sustainable economic and social development. It states that in order to protect against and mitigate earthquake disasters, the principle of combining protective measures and rescue efforts shall be applied (article 3), with an emphasis on the former, and that it be incorporated into all plans for national economic and social development.

The law reaffirms the absolute leadership of the central government (that is, the State Council) in disaster management. Under the leadership of the State Council, the relevant administrative departments are responsible respectively for seismic work. Relevant government ministries shall cooperate with each other, while acting in accordance with the division of their functions and duties, to protect against and mitigate earthquake disasters (article 7). The law encourages social organisations and volunteers to participate in monitoring and prevention activities, but clarifies that the government (at all levels) should play a leading role in promoting education and citizen awareness around earthquake risk reduction and prevention.

Yi et al. (2012) criticised the ‘single (disaster)-style’ disaster prevention system, arguing that, although there are a series of laws and regulations regarding the prevention and mitigation of disasters, they cannot replace the fundamental role of a basic law which guarantees national disaster prevention and mitigation. Nor is there a corresponding legal mechanism to ensure the validity of NGOs and volunteers participating in disaster prevention and mitigation, despite the fact that the Chinese government encourages them to take active roles.

The law has nine chapters:

1. General provisions
2. Blueprint for protecting against and mitigating earthquake disaster
3. Earthquake monitoring and forecasting
4. Protection against earthquake disasters
5. Earthquake emergency rescue
6. Post-earthquake transitional resettlement, rehabilitation and reconstruction
7. Supervision and administration
8. Legal liabilities
9. Supplementary provisions

Guidelines for earthquake disaster prevention and mitigation plans

The law can serve as guidelines for the preparation of an earthquake disaster prevention and mitigation plan at all levels. It stipulates that EDRR plans be prepared jointly by the central administrative department for seismic work and relevant departments (article 12). Approval from the State Council is required before implementation. Secondly, EDRR work should fully consider the safety of people’s lives and property and the needs of economic and social development, resources and environmental protection. Thirdly, EDRR work should cover: the situation of an earthquake, the overall objectives of protection against and mitigation of earthquake disasters, the construction and layout of earthquake monitoring stations and networks, measures for protecting against earthquake disasters, measures for earthquake emergency rescue, and safeguarding measures for technology, information, funds, and materials for protecting against and mitigating earthquake disasters. Finally, once an earthquake disaster prevention and mitigation plan is approved, it shall be strictly implemented; where any amendment is necessary due to changes in the earthquake situation and economic and social development, the amended plan shall be submitted for examination and approval in accordance with the relevant original procedures (article 16).

National Earthquake Disaster Mitigation and Reduction Plan (2006–2020)

This plan is based on the law on Protecting Against and Mitigating Earthquake Disasters in connection to the Disaster Reduction Plan of the People’s Republic of China (1998–2010). The plan period spans from 2006 to 2020.

The plan emerged from the national earthquake prevention and reduction system, which began to take shape in the late 1990s. It grew to encompass many provincial and city/county governments throughout the early 2000s. This culminated in late 2006 with the publication of the National Earthquake Disaster Mitigation and Reduction Plan 2006–2020.

Guiding principles

The plan prioritises people’s safety, emphasises a parallel focus on earthquake prevention and reduction and economic development, and adopts the policy of putting prevention first and combining prevention and relief. There is emphasis on building working systems for: (i) earthquake monitoring and pre-warning; (ii) earthquake prevention; and (iii) emergency rescue. The comprehensive capacities of earthquake prevention and reduction will be constantly improved through government leadership, supported by technology, the system of law and civilian power, in order to provide reliable protection for maintaining national public safety, building a harmonious society and ensuring sustainable development.

Main tasks

The main tasks for earthquake prevention and reduction in China between 2006 and 2020 are: improving the construction of basic monitoring infrastructure to increase the level of earthquake prediction; increasing basic earthquake information and knowledge; improving earthquake prevention capacities of major cities, lifeline projects and rural monitoring and prevention areas; perfecting coping mechanisms for sudden earthquake incidents; enhancing the emergency response capacities of governments at all levels; and comprehensively raising the general public's disaster prevention and reduction abilities.

On 30 July 2008, the Ministry of Housing and Urban-Rural Development (MOHURD) approved and implemented the Standard for Classification of Seismic Protection of Building Construction. This national standard aims clearly to define the seismic fortification category and corresponding criterion for earthquake-resistant design when building, thereby reducing earthquake disaster risk effectively. Based on an investigation into the 2008 Wenchuan earthquake experience, this standard particularly strengthened the protection for juveniles in an emergent earthquake event; enlarged the scope of high-occupancy buildings, thus enhancing the resistance capacity of public buildings such as hospitals, gymnasiums, stadiums, museums, libraries, theatres, shopping malls and transportation hubs; and set a higher requirement for buildings in seismic refuges.

To better implement the National Earthquake Prevention and Reduction Plan (2006–2020), the CEA published and distributed the China Earthquake Administration 11th Five-Year Development Plan Outline. This emphasised social management and public service in national earthquake prevention and reduction.

During the 11th Five-Year Plan (2006–2010), under the leadership of governments at all levels, 28 provinces (districts, municipalities) and 253 cities (counties) issued earthquake prevention and reduction plans for their own jurisdictions. The three-level (national, provincial, municipal) earthquake prevention and reduction plan system was established.

In 2012, the CEA promulgated the Planning System of National Earthquake Disaster Risk Reduction for the 12th Five-Year Period (2011–2015), followed by the National Earthquake Prevention and Reduction Plan for the 13th Five-Year Period – the latest national earthquake disaster risk reduction programme so far, although it has not been officially released yet.

National Planning System for Earthquake Disaster Risk Reduction for the 12th Five-Year Period

This planning system comprises nine specific programmes on different subjects related to earthquake disaster mitigation and reduction.

1. Information plan
2. Publicity plan
3. Social administration and public services plan
4. Standardisation and econometric plan
5. Emergency response plan
6. International cooperation and communication plan
7. Legal construction plan
8. Disaster prevention plan
9. Earthquake monitoring

Local regulations on EDRR

In accordance with the law on Protection Against and Mitigation of Earthquake Disasters, EDRR regulations are compiled and implemented at provincial level in China. The structure of the provincial-level regulations in Shaanxi Province, for example, follows the national law and includes these nine chapters:

1. General principles
2. Plan of earthquake disaster prevention and mitigation
3. Earthquake monitoring and forecasting
4. Protection against earthquake disasters
5. Earthquake emergency rescue
6. Post-earthquake transitional resettlement
7. Rehabilitation and reconstruction
8. Supervision and administration
9. Legal liabilities and supplementary provisions.

This strengthens the leadership of the central government and the top-down disaster management mechanism in mainland China. The ordinance clarifies the responsibilities and working guidance for county-level governments. There is no clear statement regarding responsibilities in earthquake disaster prevention and mitigation for governments below county level.

Concluding remarks

Since the founding of China in 1949, the country has made remarkable achievements in disaster risk reduction. In strengthening the development of its national comprehensive disaster prevention and reduction systems, mechanisms and legal systems, China has actively engaged communities, enterprises and various civil society groups.

However, there are still areas that require strengthening and improvement to reduce disaster risk further. For example, work is needed to strengthen and improve the synergy between central and local government and the synergy between urban and rural areas; to secure an institutional guarantee for the cooperation between the government and civil society; and the disaster risk governance still needs to be integrated (ISDR and NCDR, 2015). Additionally, greater environmental risks induced by climate change and new risks emerging from efforts to achieve sustainable development will see China, along with many other countries, facing new challenges for effective disaster prevention and reduction.

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3. Current knowledge on seismic hazards in Shaanxi Province

Feng Xijie, Richard Walker and Philip England

Introduction

This chapter discusses *seismic hazard* in Shaanxi Province, with particular reference to the Weihe Basin. Technical terms explained in the glossary of terms are printed in italics on their first appearance in the text. This chapter presents:

- background information on *faults* and earthquakes
- information on the relationship between faults and earthquake hazards
- maps of the distribution of *active faults* in the region of the Weihe Basin
- maps of ground shaking recorded in historical earthquakes of the region
- suggestions as to how to interpret the geological and seismological data during the development of earthquake disaster risk reduction (EDRR) projects in the region.

The Weihe Basin (Figure 2) is a region of flat-lying and relatively low ground about 250 km east-west and up to 150 km north-south, between the Ordos plateau to the north and the Qinling mountains to the south. The basin is bounded, to north and south, by a system of *normal faults*. Movement on these faults causes the land between them to sink, and sediments carried by rivers flowing from the surrounding mountains accumulate in the basin, giving it its smooth, and approximately horizontal, land surface.

Background information on faults and earthquakes

Causes of earthquakes

The modern understanding of earthquakes is due to H.F. Reid, who investigated the earthquake that devastated San Francisco in 1906. Reid recognised that earthquakes are a consequence of elastic *strain*. In the time between earthquakes, the earth's *crust* deforms slowly (Figure 4a, b) until an earthquake releases, in a few seconds or minutes, the strain that has built up over decades or centuries. As the earthquake occurs, the rocks on either side of the fault slip rapidly past each other (Figure 4c). The end result, immediately after the earthquake, is that the crust either side of the fault has returned to its original shape. The rapid change of shape of the crust during the earthquake causes vibrations that, near the earthquake, can be large enough to cause damage or destruction of buildings. These vibrations may also cause landslides, particularly in mountainousregions.

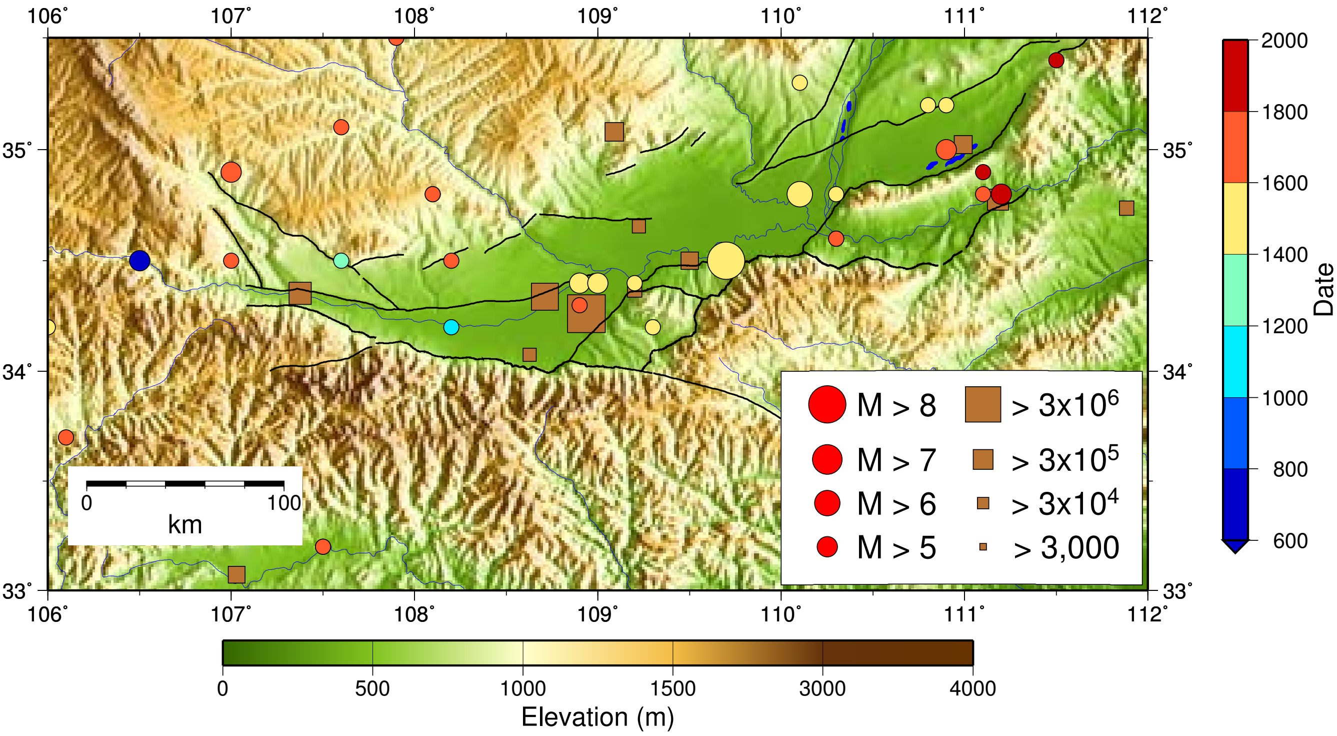
Sizes of earthquakes

The size of an earthquake is most commonly reported as its *magnitude*, and we shall use this term. (The correct measure of an earthquake's size is its *moment*. This term, which is often used in the seismological literature, is discussed briefly in the glossary of terms.

Observations of almost 200 earthquakes in continental regions show a relationship between the magnitude of an earthquake and the length of the fault that slipped during the earthquake (Wells and Coppersmith, 1994, Figure 5). For example, earthquakes of about magnitude 6 take place on faults that range from a few kilometres to 10 km long. Magnitude 7 earthquakes take place on faults that are a few tens of kilometres long, while a magnitude 8 earthquake may cause a fault break of more than 100 km. This relationship is central to attempts to understand the earthquake hazard in the region of the Weihe Basin.

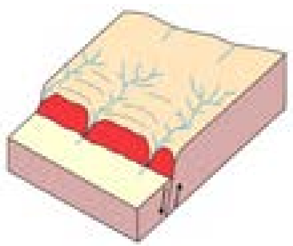
Earthquakes usually break along one (sometimes two or more) segments of a fault. The term 'segment', in this context, refers to a portion of fault that shows an approximately straight trace on the land surface. One segment is distinguished from another by a change in direction of the fault, or by an offset in fault location. If one knows the length of a segment of fault, then one may make a reasonable estimate of the size of earthquake

Figure 2. Faults, historical earthquakes and population centres of the Weihe Basin region, Shaanxi Province



Black lines show the locations of faults mapped by the Shaanxi Seismological Bureau. Coloured circles show the locations of historical earthquakes (Liu et al., 2011; Song et al., 2011); the size of the symbol is related to the earthquake's magnitude (see inset scale) and the colour relates to its date (scale to right). Squares show the location of towns and cities with populations greater than 3,000; the size of the symbol is related to the population (see inset scale).

Figure 3. A sketch to illustrate the formation of a basin and its bordering mountains as a result of repeated slip on a normal fault



Arrows show the sense of slip on the fault. Repeated earthquakes raise the mountains (behind the fault, as we look at it) and lower the basin in front of it. (Image courtesy of Steven Wesnousky.)

that it is capable of generating. Unfortunately, it is easier to identify fault segmentation after an earthquake than beforehand. Extensive *palaeoseismological* work is required to estimate what sizes of earthquake took place on a given fault in the past and, even then, the results are often ambiguous. Nevertheless, two important conclusions apply: short faults cannot generate large earthquakes; and it is unwise to assume that a long active fault will not generate a large earthquake at some time in the future (see also Jiang et al., 2000).

Earthquake locations

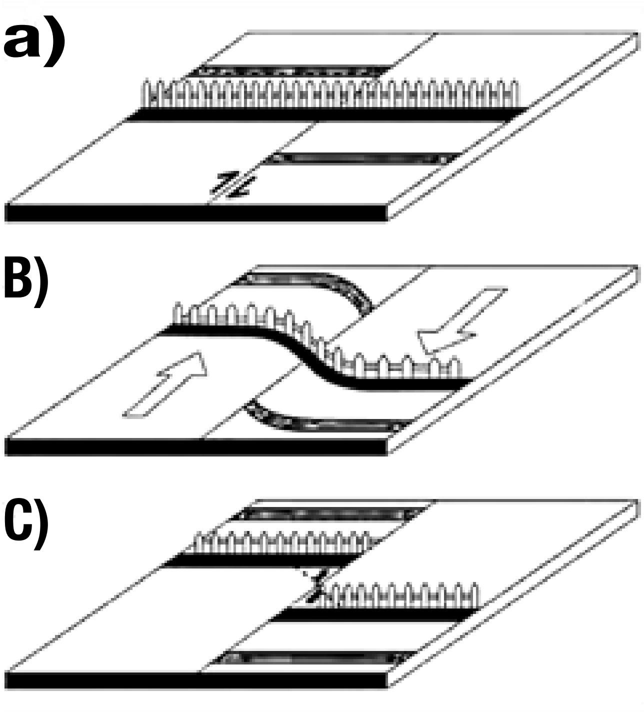
The location of an earthquake is given by its *hypocentre*, which specifies longitude, latitude, and depth of the first motion to occur during the earthquake. Since about 1960, the locations of earthquakes of magnitude 5 or more have been routinely determined by international and national seismological organisations. Even with modern seismic networks, such locations have errors of 10 km or more. Before 1960, errors could easily be up to 100 km.

For most damaging earthquakes, the fault breaks over several tens of kilometres, so it is more important to identify the location of the fault than it is to know the location of epicentre. The China Earthquake Administration (CEA) has assembled historical catalogues (pre-1900) of earthquakes in China (Institute of Geophysics State Seismology Bureau, 1983). The locations of earthquakes are based on records of destruction, interpreted in terms of shaking intensity (see, for example, Figure 7).

Earthquake prediction

In common usage, the term 'earthquake prediction' refers to the idea that it is possible to state with precision, before an earthquake occurs, its location, its magnitude, and the time of its occurrence. For such a prediction to be useful, all three of these conditions must be met. Precise statements of any two of those factors, without the third, are useless.

Figure 4. Distortion of the crust (and a fence built on top of it) during a cycle of build-up of strain, and its release in an earthquake on a strike-slip fault.



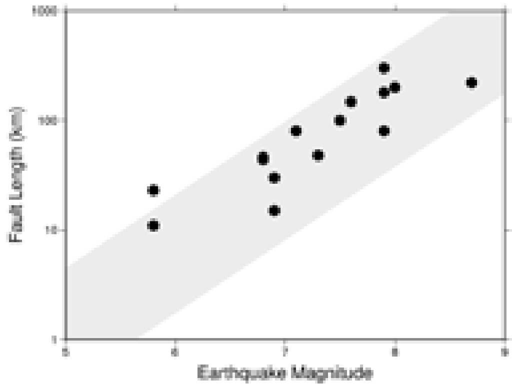
a) A fence is built in a straight line, immediately after the last earthquake.
b) Under the action of distant forces, the crust slowly deforms; this is known as the interseismic period.
c) The strain of the crust is released by slip on the fault, leaving the fence and perhaps other nearby structures in a state of disrepair. (From Stein and Wysession, 2003).

The location of an earthquake is obviously important, because the destruction caused by large earthquakes dies out with distance from the causative fault.

The size of an earthquake controls the intensity of shaking that it generates, so it is of great significance whether an earthquake has magnitude 6, 7, 8 or greater. Large earthquakes are rare, small earthquakes are frequent, so a famous example of a correct but useless prediction is: 'There will be an earthquake in Shaanxi Province tomorrow'. This prediction is likely to be correct on any day that it is read, but the 'predicted' earthquake may have a vanishingly small magnitude – and hazard.

It is usually assumed that, if earthquake prediction is to save lives, the earthquake must be predicted long enough before it happens so that people are able to vacate vulnerable areas and move to places of greater safety. Such a prediction must also be accurate, and over a time span that is short enough that the population does not lose faith in it and move back into vulnerable areas: perhaps a few hours or days; not a few months.

Figure 5. Relationship between earthquake magnitude and length of the fault break.



The shaded region shows the relation between fault length and earthquake moment magnitude determined by Wells and Coppersmith (1994); black dots show the earthquakes in China, from the same study.

Predictions of earthquakes that state, with the precision discussed above, all three of the conditions: time, location and magnitude are not possible in our current state of knowledge.

With our present state of knowledge it is, however, possible to take decisions based on an understanding of the distribution of hazard.

Seismic hazard

The term seismic hazard is used to describe any physical phenomenon associated with an earthquake that has the potential to cause damage or loss of life. These phenomena are usually ground shaking, ground failure, or *liquefaction*, which can cause buildings and other structures to fail. An important *secondary seismic hazard* is landsliding triggered by ground shaking.

Around the world, about 75% of earthquake-related deaths are caused by building collapse, with most of the remaining being approximately equally split between tsunamis and landsliding (Daniell et al., 2011). Tsunamis are irrelevant to the hazard in the Weihe Basin, but the secondary hazard from landsliding may be higher than the global average for two reasons: (i) because the basin is surrounded by many steep mountain fronts (Figure 2); and (ii) because loess, which is a common local rock type, is particularly weak and therefore vulnerable to shaking.

Ground shaking

It is usual to measure the intensity of ground shaking using an *Intensity* scale, which relates the intensity of the shaking to its effects on people, buildings and the natural environment. Three intensity levels are important for the purposes of our discussion here.

- At intensity VII (7) there is considerable damage to poorly built structures. It is of particular relevance to historical earthquakes in the Shaanxi region. Instability of loess causes damage to dwellings cut into that rock type.
- At intensity VIII (8), poorly built structures are greatly damaged, and there is considerable damage to ordinary buildings.
- At intensity X (10), most masonry and frame structures are destroyed and there is landsliding in vulnerable areas.

The intensity of ground shaking caused by an earthquake at a particular site depends on a number of factors, of which the most important are the magnitude of the earthquake and the distance of the site from the earthquake. Another very significant set of factors, which may be grouped under the label of 'site effects', are connected with the details of the geological conditions at any point and the interaction of the waves generated by the earthquake with those geological features. Site effects include, but are not restricted to the following:

- Variations in rock type: for a given size of earthquake, weaker rocks will experience greater shaking.
- Liquefaction: differences in the water content of near-surface sediments, and in the physical properties of their grains, determine whether they will liquefy at a given level of shaking.
- Amplification of ground shaking by reflections caused by variations in the sub-surface geological structure.
- The slope of the land surface.

We illustrate these considerations with the map of ground shaking associated with the great 1556 Huaxian earthquake (Yuan and Feng, 2010 (Figure 6)). The magnitude of the earthquake was about 8, and the maximum shaking exceeded intensity XI (11) in the epicentral region. The zone of intensity X (10) shaking was more than 100 km long, and of the zone of intensity VIII (8), shaking covered most of the Weihe Basin. Note that the *isoseismals* are elongated in the direction parallel to the Weihe Basin; this effect is common in large basins filled with sediments, where both reverberations, and the intrinsic weakness of the sediments contribute to amplification of the seismic waves.

Landslides

Earthquake-induced landsliding represents a significant hazard in the mountainous regions that border the Weihe Basin. Landslides are likely where shaking is strong and the hill slope is steeper than about 20^{o}. The minimum intensity needed to trigger landslides is uncertain (and depends on surface slopes and on geology). In the 2008 Wenchuan earthquake landslides occurred within areas

Figure 6. Ground shaking in the 1556 Huaxian earthquake

Red lines show contours of equal intensity of shaking (isoseismals) (Yuan and Feng, 2010).

of intensity VII (7) and greater. The density of landsliding increases both with the steepness of the hill slope and with the intensity of shaking; near the epicentre of large earthquakes it is possible that landslides may affect more than 50% of the land surface.

Damming of rivers by landslides should be expected, especially in areas with narrow valleys and high relief (>1 km). Most dams fail within one week of filling, so this hazard is greatest in the days and weeks following an earthquake.

The hazards and economic disruption resulting from landsliding will last for decades or centuries after the earthquake that caused them. Landslides greatly increase the delivery of sediments to the river systems. Supply of fine sediment (silt and clay) will be elevated for decades to centuries; supply of coarse sediment will potentially be elevated for an unknown time interval, perhaps much longer.

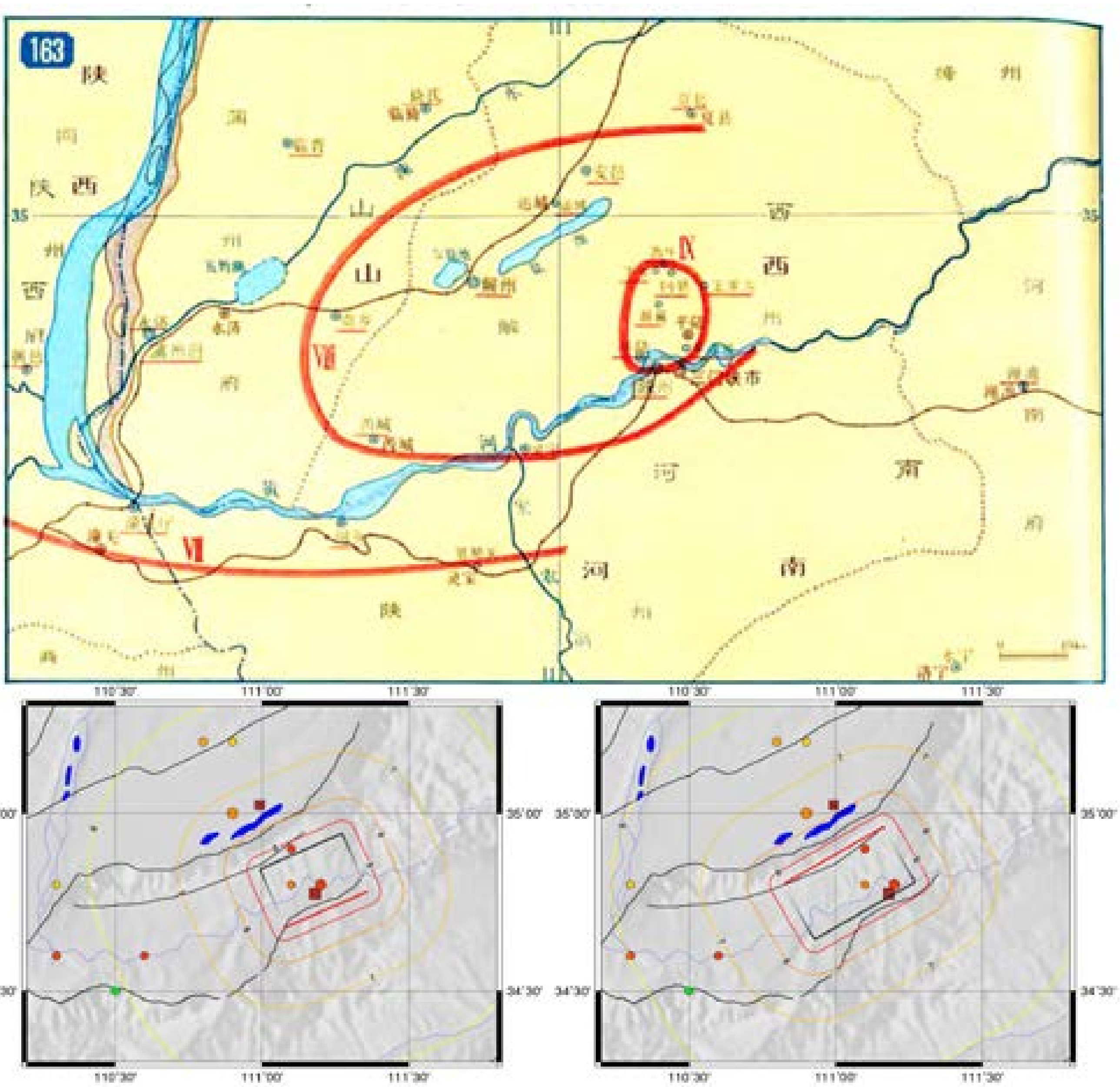
One should expect major effects on dams, canals and flood levels. Major (metre-scale) deposits of sediments will cover parts of the fan surfaces at the margins of the basin. This sedimentation should be expected to persist for decades to centuries, and will probably cause changes in river courses on the edges of the basin.[4]

Faults and seismic hazard in the Weihe Basin

The 1556 Huaxian earthquake was the most deadly earthquake in recorded history, but we should not allow our understanding of seismic hazard in the Weihe Basin to be dominated by the enormity of that death toll. Large earthquakes are much rarer than small earthquakes. For every magnitude 8 earthquake, in a given time interval, there will be about 10 magnitude 7 earthquakes, and 100 magnitude 6 earthquakes, and so on for smaller earthquakes. Because earthquakes of magnitude 6 and 7 are capable of causing considerable devastation,

4 We are grateful to Alex Densmore for providing notes upon which the preceeding remarks are based.

Figure 7. Map of intensity of shaking for the 23 October 1815 earthquake and two synthetic calculations of shaking



(Top:) Map of intensity of shaking for the 23 October 1815, M6.8 earthquake [Institute of Geophysics State Seismology Bureau, 1983]. (Bottom) Two synthetic calculations of shaking in the 1815 earthquake. The black lines show the locations of active faults mapped by the Shaanxi Seismological Bureau. (Left) Calculation assuming that the earthquake took place on a mapped fault that dips to the north and reaches the surface south of the river, with location shown by the red line. (Right) Calculation assuming that the earthquake took place on a fault that dips south and reaches the surface north of the river, with location shown by the red line. Either calculated distribution of shaking is consistent with the historical record. Calculations were performed using the OPEN SHA software (http://opensha.usc.edu). These calculations are for the purpose of illustration only, and take no account of the influence of site effects on the amplitude of shaking.

particularly in rural areas – and because they are much more frequent – we should be alert to the hazards that are posed by such smaller earthquakes.

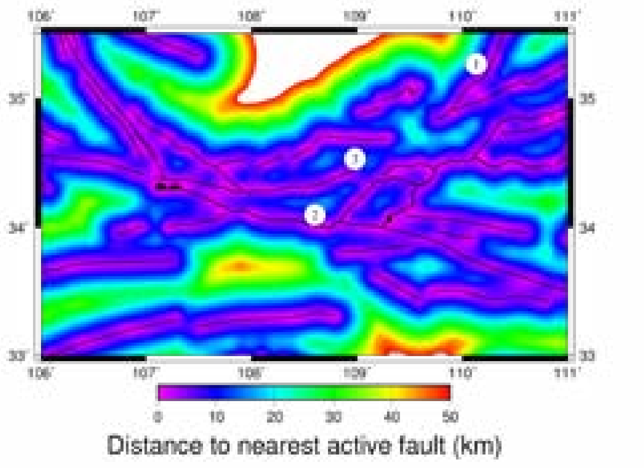
Figure 6 illustrates this point by comparing the extent of intensity VIII (8) shaking for the 1556 earthquake with the shaking caused by two other historical earthquakes. The records of damage caused by the 1704 Long Xian earthquake suggest that it had a magnitude of about 6, and the magnitude of the 1815 Pinglu earthquake was close to 7 (Institute of Geophysics State Seismology Bureau, 1983). Although these earthquakes were much smaller than the 1556 earthquake, intensity VIII (8) shaking caused by the 1704 earthquake affected places up to 10 km from the epicentre, while intensity VIII (8) shaking affected regions up to 100 km away from the 1815 earthquake (Figure 7).

Comparison between extent and intensity of ground shaking in the 1556, magnitude 8, Huaxian earthquake (after Yuan and Feng, 2010); the 1815, magnitude approximately 7, Pinglu earthquake; and the 1704, magnitude 6, Long Xian earthquake (Institute of Geophysics State Seismology Bureau, 1983).
Red lines show isoseismals of intensity VIII (8) shaking in each earthquake; yellow line shows the intensity X (10) isoseismal for the 1556 earthquake.

At least 20 damaging earthquakes are known, from historical records, to have affected the Weihe Basin (Figures 2 and 7). Although historical catalogues have been compiled with great care, they are unlikely to be a complete record of the damaging earthquakes of the region. Many earthquakes of magnitude 7 or lower could be missing from the catalogue because they caused damage over small areas, and/or were not recorded for other reasons. We should bear in mind that historical records of earthquakes rely on reports of destruction. If an historical earthquake occurred in a place that was uninhabited at the time, it is unlikely to have been reported; if that place is now inhabited, it would be subject to a seismic hazard for which there is no record. These points are important point to bear in mind when assessing hazard because most earthquake-related deaths in continental regions during the past 100 years have taken place in earthquakes of magnitudes 6.5 to 7.5 (England and Jackson, 2011). Earthquakes of such magnitude posed far greater risks now than they did in the past, because of increasing population densities and the rapid migration of people into vulnerable cities (Tucker, 2004; Bilham, 2009).

The reported epicentres of many historical earthquakes in the Weihe Basin lie close to the positions of faults that are known to be active. Given the uncertainties in earthquake location (see *Earthquake locations*), all the historical earthquakes illustrated in Figure 3 can be associated with a known fault. Figure 2 also shows that there are many faults in the region that are active, but have not experienced an earthquake that was recorded in historical time. This result is to be expected. The time interval between successive earthquakes on the same fault segment may be thousands, or tens of thousands, of years so that the historical record often provides little evidence of where the next earthquake in a region will take place. Indeed, devastating earthquakes in the continental interiors frequently take place on faults that either were previously unknown, or whose threat had not been recognised (England and Jackson, 2011).

Figure 8. Distances of places within the Weihe Basin from faults that are thought to be capable of producing damaging earthquakes



Numbers in white circles show the locations of demonstration projects discussed with GDS: (1) He Yang; (2) Hu Xian; (3) Gao Ling.

Conclusion: what can we learn from history and geology?

The historical record shows that in at least 20 cases over the past 2,000 years damaging earthquakes have occurred in the Weihe Basin (Figure 3); other similarly sized earthquakes may have occurred without being recorded (see *Faults and seismic hazard in the Weihe Basin*). The basin contains many faults that geological mapping shows have caused earthquakes in the past (Figures 3 and 9). Individual sections of fault are long enough to be capable of generating earthquakes of magnitude 6 or 7 (see *Faults and seismic hazard in the Weihe Basin*, and Figure 6). Most of the historical earthquakes can be attributed to a fault that has been identified. Many sections of those faults have not generated earthquakes in historical time, but may be expected to generate earthquakes in the future. We do not know enough about the rates at which these faults slip to say where, or when, such earthquakes will occur – nor what are their likely magnitudes.

The 1556 earthquake took place on one section of the large system of faults that bound the southern edge of the Weihe Basin. Other sections of that fault system are equally prominent, however, and most of the population centres within the Weihe Basin lie within 20 km of one or more of the active faults in the basin (Figure 9). A cautious approach to seismic hazard in the Weihe Basin is to recognise, given our present state of knowledge, that any of the active faults in the region is capable of generating a damaging earthquake, and to assume that the hazard is approximately the same in all parts of the basin.

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4. Community-based approaches to disaster risk reduction in China

Lena Dominelli, Timothy Sim and Cui Ke

Introduction

Disasters, whether natural or (hu)man-made are increasing in frequency and in terms of the deaths and damage they cause, with on average 232 million people affected yearly (IFRC, 2015). Climate change is exacerbating this situation (Oven et al., 2012). Attempts to mitigate disaster risk, especially in disaster-prone communities, have become a major issue in government policy agendas, and many civil society organisations (CSOs) are working in local communities to enhance community resilience as a result. Many are doing so within a framework of equality and engagement for all (Lovell and Masson, 2014).

Disaster risk reduction (DRR) is a major concern in China, which has a considerable number of 'natural' disasters associated with earthquakes and extreme weather events. It also has a growing preponderance of (hu)man-made disasters, linked to the pollution of its air, waters and soils, caused by rapid industrialisation and urbanisation (ISDR, 2015; Qin et al., 2015). Industrialisation and urbanisation have brought benefits, such as a rise in national living standards, the lifting of many people out of poverty, and the growth of China as a significant player in international affairs. But there has been a downside to this development and this is reflected in the depopulation of rural areas and the overcrowding of urban areas and the health problems associated with degraded environments. Addressing these issues contributes to DRR and infrastructural capacity-building, associated with mitigating (hu)man-made disasters and the human consequences of 'natural' ones such as earthquakes.

Research is needed to explore what is being done to remedy these situations, and to improve matters further. In this paper, we focus on the activities undertaken by CSOs to support communities in developing resilience in the face of disasters, and to highlight ways of promoting further development in this area. We do this in three parts:

- a discussion of national policy initiatives in China
- a discussion of differentiated experiences of disasters
- the responses to a questionnaire on civil society disaster risk reduction initiatives.

Disaster risk reduction policies in China

China has been committed to using the Hyogo Framework of Action (HFA) to reduce disaster risk in the country for some time, seeing this as the basis for developing a strong economy and safer communities. The strides made over the past 25 years have been remarkable, and in the course of making this progress, Chinese social policy in this field has shifted from disaster response to risk reduction and risk prevention (ISDR, 2015; Qin et al., 2015).

The emphasis on activities focused on strengthening the local level – particularly in improving early warning systems, schools, hospitals and other critical infrastructures – has brought significant rewards. For example, the low death toll during the magnitude 6.1 Ludian earthquake in Yunnan Province in 2014 has been attributed to this strategy, as has China's ability to keep losses attributed to disasters within 1.5% of GDP for the past three consecutive years (ISDR, 2015), a goal articulated in China's National Plan on Comprehensive Disaster Reduction.

China's National Commission for Disaster Risk Reduction (NCDR) leads these endeavours. It has built on lessons learnt from the 1998 floods involving the Yangtze, Songhua and Nen rivers; the 2008 Wenchuan earthquake; the 2010 mud-rock flow in Zhouqu; and the 2013 Lushan earthquake, among others. Additionally, China's geographical location at the meeting of the Eurasian, Pacific and Indian Ocean tectonic plates makes it one of the most earthquake-prone areas on earth, with one third of continental earthquakes occurring there. China, therefore, has a wealth of experience in dealing with high disaster risk that can be shared with other nations seeking to reduce disaster liabilities.

China's endeavours in reducing disaster risk began in earnest following the United Nation's (UN) declaration of the International Decade for Natural Disaster Risk Reduction in 1989. China's national government established what became known as the National Disaster Reduction Committee, an inter-ministerial body under the State Council, to coordinate national activities and draft comprehensive policies and action plans to guide local government in disaster prevention and preparedness.

China's approach included inter-sectoral collaboration and sustainable development as part of this strategy. Decentralisation of responsibilities and resources, and community participation both formed important components of this policy, which aims to prevent disasters as much as possible by having appropriate infrastructures and mechanisms, and strong emergency and rescue mechanisms in place.

This planning has paid dividends, and led to further developments. For example, in the Wenchuan earthquake, the principle of non-affected areas supporting those affected during and after a disaster was operationalised through a pairing arrangement involving 19 other provinces helping Sichuan, the devastated area. Consequently, Sichuan Province recovered quickly and within three years, its socioeconomic development surpassed that prior to the earthquake (ISDR, 2015: 13). This approach is being rolled out to cover other disasters and is being buttressed by an investment in scientific research through the National Basic Research Programme and the National Natural Science Foundation. These initiatives have been underpinned by a public campaign on disaster prevention and reduction to raise awareness of the issues and the steps that people can take to mitigate risk by protecting themselves and knowing what resources and responses are already available for them.

By 2013, the emphasis on community-based disaster risk reduction (CBDRR) and capacity building had resulted in 5,408 'national disaster reduction-prepared communities' in both urban and rural areas (ISDR, 2015: 18). CBDRR has resulted in communities becoming involved in assessing disaster risk, compiling community disaster risk maps, which identify vulnerable groups, and mobilising communities into participating in disaster reduction drills and educational exercises that emphasise prevention, evacuation and survival skills, especially in schools. These initiatives provide fertile ground for other countries to learn from by adapting the materials produced to local circumstances and cultures to produce what Dominelli (2012) has termed 'locality specific culturally relevant practice'.

Chinese policy now endorses a greater role for market mechanisms in disaster risk reduction and reconstruction and insurance provision for households. These moves foster stronger governance mechanisms between national and local government and business, and the wider sharing of scientific information and technology to 'build back better'. They also enable China to become a major player in global initiatives, particularly through the post-2015 Framework for Disaster Risk Reduction (HFA2 – the follow-up to the Hyogo Platform of Action) deliberations.

Differentiated vulnerabilities in disaster situations

Vulnerability to disasters is differentiated according to age, disability, gender, ethnicity and other social divisions, including class expressed through poverty. A review of the literature indicates that those who have been marginalised by disaster policies and initiatives have demanded their inclusion through advocacy, network-building, multi-stakeholder partnerships, lobbying and campaigning, and educational training (Brown and Westway, 2011).

They also provide locality-specific and culturally appropriate knowledge that strengthens their base in local communities. The interests of these marginalised groups should be included in all DRR thinking and doing, and the nostrum that 'one size fits all' discarded (Dominelli, 2012). However, the work of Qin et al. (2015) in the *China National Assessment Report on Risk Management and Adaptation of Climate Extremes and Disasters* has little to say about giving specific attention to differentiated vulnerabilities among vulnerable populations including women, children, older people and indigenous minorities. More research is needed to determine the extent to which these concerns have been or will be addressed in future policy initiatives, including through China's 13th National Five-Year Plan (2016–2020).

Age

Age constitutes an important dimension of social vulnerability that affects children, young people and older people, especially women. Hurricane Katrina in the United States (2015) highlighted older people as particularly vulnerable. The intersections between age, ethnicity and gender resulted in older African-origin American women being disproportionately affected (Pyles, 2007; Lovell and Masson, 2014). Older people also encompass other social divisions such as class, linguistics, religious affiliations, ability, or mental health status, which intersect and interact with one another to produce complicated differentiations in life status and wellbeing.

Responding to children's varied experiences of disasters is an agenda item for all governments. This includes having a child-friendly HFA2 to which CSOs subscribe – especially those involved in the Children in a Changing Climate Coalition and the Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector. Their goals include: child participation and empowerment; child protection legislation; safe schools; life skills; equal access to quality services; recognition of differentiated vulnerabilities; increased accountability from the national to the local levels; child-sensitive risk assessments; risk mitigation; action plans that promote sustainable livelihoods and safe environments; and education that develops children's resilience (World Vision, 2015). China has been emphasising child-preparedness by targeting schools as sites for raising awareness of disasters and performing drills (Qin et al., 2015).

Disability

Disability is another source of socially constructed vulnerability. The Japan Disability Forum (JDF, 2015) revealed that during the multiple-hazard Great East Japan Earthquake of 2011, disabled people were more than twice as likely to die as non-disabled people. The JDF research revealed that evacuation shelters, responses to disabled survivors living at home and post-disaster interventions did not take their specific needs into account. They recommended that disaster mitigation, preparedness, relief, recovery, reconstruction initiatives and long-term support address these and that work is undertaken to eliminate deep-rooted prejudices against people with disabilities (JDF, 2015: 116). Along with the global disability movement and their supporters, their efforts have ensured that the statement made by the United Nations Office for Disaster Risk Reduction (UNISDR) at the conclusion of the Third World Conference on Disaster Risk Reduction in Sendai, Japan included reference to disabled people as a priority group.

Gender

Women are under-represented in leadership and decision-making structures throughout the disaster cycle, in the receipt of aid, and as holders of knowledge crucial to sustaining life and the reconstruction of communities (Enarson and Morrow, 1998; Dominelli, 2012, 2013; JNWDRR, 2015). Despite the Convention for the Elimination of Forms of Discrimination Against Women (CEDAW), advocacy by organisations such as the Gender in Disaster Network, and the commitment of the Rio Convention of 1993 arguing for the equality of women throughout social life, the mainstreaming of women and their concerns remains marginalised. Additionally, the needs of men for psychosocial support and the retention of their breadwinning roles have been ignored by most humanitarian aid endeavours (Dominelli, 2012, 2014). Thus, mainstreaming gender perspectives means involving both men and women; and boys and girls in all aspects of DRR at all temporal and spatial scales.

Urban poor

Another group of vulnerable people are the urban poor, especially those living in peri-urban areas or those marginalised within them. For China, this group includes migrant workers leaving rural areas for jobs in the cities and often living at the margins (Chan and Zhang, 1999). Vulnerabilities among this group are often associated with poverty; overcrowding; inadequate infrastructures including housing, clean water supply, sanitation, power, transportation and communication systems; inequitable access to and distribution of resources including land, health and social care services and education; and social conflicts of various types (IFRC, 2015). Actions to reduce vulnerability rely on the development of adaptive capacities in the institutional, economic, social and eco-environmental systems (Wang et al., 2015). They can be government-led or grassroots-based approaches. Adaptive capacities seek to address the 'risk = exposure to hazards x vulnerability' equation, by enhancing resilience in individuals and communities.

The questionnaire: findings and analysis

Methodology

The Earthquakes without Frontiers (EwF) Social Sciences China Team (Dominelli, Oven and Sim) designed the questionnaire in consultation with Gender Development Solutions (GDS), a local non-government organisation (NGO) in Shaanxi, and World Vision (WV), an international NGO with local offices in Shaanxi.

In September 2014, GDS helped to distribute the questionnaire to 39 organisations in south-west China. Twenty-seven organisations replied with 33 completed questionnaires. This is a response rate of 69.2% of organisations, and 84.6% of questionnaires. The other 12 organisations did not reply. This could be because they forgot to distribute the questionnaire, possibly because they were busy supporting victim-survivors in Yunnan Province following the Ludian earthquake on 3 August 2014. In the chapter, the findings of the two CSOs surveyed are amalgamated in all the tables below to retain anonymity and they will not be mentioned by name, but referred to as CSOs where appropriate.

As there is limited information available on how CBDRR is carried out on the ground, this survey becomes useful in providing insights into practices in the field. However, the survey was small-scale and the results should be treated with caution. We suggest that this endeavour is considered an indicative survey that identifies trends that merit further investigation. For example, the issue of differentiated experiences of disasters and responses that are targeted at meeting specific needs within vulnerable populations were not explicitly explored in this questionnaire. Additionally, the questions did not cover issues of post-disaster reconstruction. Nor did the questionnaire ask whether following DRR training, the residents felt more able to deal with disasters of whatever nature that might arise. The issue of community engagement was another that requires examination in future research.

Table 1: Funding sources for DRR projects

	Central government	Local government	Local Charitable funds	International Charitable fund	International NGO	Aid from Hong Kong/ Taiwan/ Macau	Assistance from other countries	Assistance from international organisation	Philanthropist	Other
Frequency	0	3	23	1	10	5	0	0	4	3
Percentage	0	9.1	69.7	3.0	30.3	15.2	0	0	12.1	9.1

N=33

Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

Results

Funding

The 27 CSOs that responded to the survey questionnaires all involved collaboration with overseas funders, had diverse linkages with local organisations and projects in Shaanxi Province, and acquired funds from more than one source.

Overseas donors provided funds that were significant in enabling these organisations to carry out DRR initiatives. Funding from local charitable sources accounted for nearly 70% of funds, compared to 30% that emanated from international NGOs. International charitable donations comprised 3% of funds, while those from Hong Kong/ Taiwan/Macau totalled 15.2%, and philanthropic sources 12.1%. While central government provided no funds to any of these organisations, local government provided 9.1%.

Budgets

The data showed that the mean budget for a DRR project was 74,136.56 Chinese yuan, with the minimum budget being 10,000 Chinese yuan and the maximum 600,000 Chinese yuan. Nearly half (45.5%) of DRR project budgets were equal to or less than 15,000 Chinese yuan.

Professional staff

These DRR projects comprised professionals drawn from a wide spectrum of disciplines that included physical and social scientists, as well as those from the arts and humanities. The social scientists outnumbered the physical scientists, and arts and humanities by nearly two to one. The organisations revealed that they used interdisciplinary approaches that enabled a wide range of expertise to be available to the projects. The experts included seismologists, geologists, engineers, geographers, psychiatrists, psychologists, community development workers and social workers. However, the data did not distinguish whether these professionals were drawn from a range of disciplines and were working as individuals within their own specific discipline or whether there was an interdisciplinary team operating as one team following a common framework to solve problems together.

The co-production of knowledge and the engagement of local communities in data collection and knowledge-sharing endeavours were also not covered in any of the responses. Interestingly, on the social sciences side, social workers composed the largest group and psychiatrists the smallest.

The numbers were more evenly spread across different types of expertise on the physical sciences side, although seismologists and geographers formed the largest two groups (Table 3). Having access to this array of expertise meant that it was relatively easy for projects to refer individuals and groups onwards to those having appropriate expertise if necessary. According to the survey, 10 of the 29 organisations would refer their service recipients onwards to other professionals. Of these referrals, 12.5% involved psychiatrists; 18.8% health

Table 2: Involvement of professionals

	Physical sciences	Social sciences	Arts & humanities	Others
Frequency	12	21	11	12*
Percentage	36.4	63.6	33.3	35.5

N=33

** Nine organisations mentioned doctor, nurse or staff with medical background; three organisations mentioned teacher.*

Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

Table 3: Interdisciplinary collaboration

	Seism-ologists	Eng-ineers	Geog-raphers	Geol-ogists	Psych-iatrists	Psychol-ogists	Sociol-ogists	Community Development staff	Social worker	Other
Frequency	6	5	5	6	2	6	6	9	17	1*
Percentage	18.2	15.2	15.2	18.2	6.1	18.2	18.2	27.3	51.5	3

N=33
** Respondents mentioned teacher and staff from the civil affairs department.*
Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

Table 4: Referral to other professionals

	Psychiatrist	Health care service	Mental health service	Other
Frequency	4	6	3	5*
Percentage	40	60	30	50

N=10
** Three DRR projects mentioned teacher.*

care service providers; 9.4% mental health services; 9.4% teachers; and 15.6% other professionals.

Project organisation and collaboration

The projects were organised according to a hierarchical structure headed by a project manager. The fact that managers formed the largest category of those completing the questionnaire may be attributed to this hierarchical structure. Operational decisions are delegated downwards. The mean number of paid employees in a DRR project was 2.58, where the minimum number was one and maximum number was seven. The mean number of voluntary workers in a DRR project was 13.58, with the minimum being zero and the maximum being 83.

Overall, the projects cooperated with a range of NGOs other than the participating CSOs across a range of activities associated with DRR. Such cooperation was widespread (nearly 86%) and enabled them to utilise social capital embedded in their networks to acquire additional resources, information about DRR, exchange experiences and knowledge to learn from and support each another in various ways, including the comfort that came from knowing that other people shared their concerns and approaches. This latter element could be explored in greater detail in future studies.

The data showed that 57.7% of DRR projects cooperated with agencies other than one of the CSOs involved in the survey. In addition to this, 13.3% reported plans to cooperate with other agencies; 80% claimed to cooperate with other local charitable organisations; 40% said they cooperated with local government departments;

Table 5: Post held by respondents

	Agency	Project manager/leader	Project officer	Project assistant	Project members	Missing data
Frequency	9	11	5	1	4	3
Percentage	27.3	33.3	15.2	3.0	12.1	9.1

N=33

Table 6: Cooperation with other NGOs

	Yes	No
Frequency	24	4
Percentage	85.7	14.3

N=28
Note: Five organisations did not respond to this question.

Table 7: Project involvement in the disaster phases

	Disaster prevention	Immediate disaster recovery	Short-term recovery (up to 3 months)	Medium-term recovery (3 months to 12 months)	Reconstruction (12 months or more)
Frequency	31	14	7	9	12
Percentage	93.9	42.4	21.2	27.3	36.4

N=33
Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

Table 8: Disaster addressed

	Earthquake	Flood	Fire	Cold	Landslide	Hail	Drought	High temperature	Other
Frequency	**25**	**25**	**26**	**7**	**18**	**10**	**9**	**4**	**3***
Percentage	**75.8**	**75.8**	**78.8**	**21.2**	**54.5**	**30.3**	**27.3**	**12.1**	**9.1**

N=33
* The three DRR projects mentioned mudflow.
Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

20% claimed that cooperation would enable them to integrate resources and maximise efficiency; 6% said that they wanted to cooperate to obtain technical support or effective evaluation. Of those who did not cooperate with other agencies, 22.2% reported difficulties in finding appropriate partners; 11.1% had problems arising from resource shortages. However, a significant proportion (27.7%) claimed that existing links with other organisations enabled them to obtain sufficient support for their activities.

Disasters covered

The organisations covered by the survey revealed that they had projects engaged with most phases of a disaster cycle. However, most of these projects involved disaster prevention, although immediate disaster recovery and longer-term reconstruction were also significant (see Table 7.)
A number of different disaster types were covered by the projects surveyed. The majority (75%) of DRR projects concentrated on earthquakes, floods or fires; 54.5% concentrated on landslides; 20% on hail, cold and drought; and 9.1% on mudflows.

Sources of information

Most projects (51.5%) revealed that the major providers of the information they obtained about disasters were government sources or local NGOs. Other institutions were also significant. Around 42.4% were derived from international NGOs. A significant 30.3% was retrieved from the internet. A smaller proportion – 15.2% – was provided by a university or institute. A very small amount, or 6.1%, relied on the project's own internal arrangements for the information they used. That is, they did not receive any disaster information from external sources.

Table 9: Source of information about disasters

	Government	INGO	NGO	University /Institute	Internet resources	Other	None
Frequency	**17**	**14**	**17**	**5**	**10**	**6**	**2**
Percentage	**51.5**	**42.4**	**51.5**	**15.2**	**30.3**	**18.2**	**6.1**

N=33
Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

Table 10: Work area of the project

	Climate change	Livelihoods	Health	Education	Housing	Hospitals, schools & clinics	Infrastructure	Environmental damage	Others
Frequency	**6**	**6**	**8**	**23**	**9**	**20**	**9**	**13**	**1***
Percentage	**19.4**	**19.4**	**25.8**	**74.2**	**29.0**	**64.5**	**29.0**	**41.9**	**3.2**

N=33
** Culture*
Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

Activities

The DRR projects had 74.2% focusing on education in schools; 64.5% on hospitals, schools and clinics; 41.9% on environmental damage; 25% on health, housing or infrastructure; and 20% on climate change and livelihoods.

The data collected indicated that 22 DRR projects offered courses that increased children's understanding, awareness and skills in response to disaster (66.6%). Most DRR education programmes for children emanate from the *Mini Lessons of Disasters* (One Foundation, n.d.). This approach has the following five aims:

- equipping children with knowledge of disasters, disaster prevention and helping oneself/each other during a disaster
- raising awareness of schools on the necessity of disaster prevention and DRR education
- reducing the negative impact of disasters on children
- raising social awareness among government, NGOs and community residents about the importance of educating children in how to cope with disasters
- promoting the acquisition of knowledge and skills for coping with disasters among families and communities via the children.

The common activities covered by these programmes include participatory classroom instruction, finding optimal escape routes on maps, safety drills, getting to know hidden resources or dangers in the surroundings, distributing DRR education materials and providing psychological assistance to children.

A further three projects sought to secure material supplies (9.0%); three other projects aimed to build disaster prevention facilities or systems (9.0%); another two projects aimed to reconstruct facilities (6.0%); another project aimed to ensure culture conservation (3%).

These community-based programmes sought to facilitate post-disaster recovery and reconstruction, increase the DRR capacity of communities, fix and upgrade disaster-related infrastructure, train DRR personnel and establish disaster pre-warning systems. Relevant activities or services included DRR education in the community, organising DRR volunteer teams, training DRR professional teams, distributing disaster relief materials, helping to reconstruct local infrastructure or residential houses, building disaster pre-warning stations in cooperation with local government representatives, developing emergency response plans and carrying out drills.

Moreover, the majority of DRR projects, 24 of the total, focused mainly on providing education on disaster risk reduction. Of these, 22 had targeted mainly children and schools, while only two had reached out to the entire community. Of the projects providing DRR education, 66.6% included sessions in class such as drawing safety and resource maps. Most projects (78.7%) engaged in escape drills, 6% included the delivery of goods and resources, and 3% addressed building infrastructure or the rescuing of non-material culture. A further five projects were carrying out either reconstruction work or developing DRR-related facilities, while another project focused on heritage and culture conservation efforts. Additionally, projects were of short durations, with the mean period being 7.47 months. The shortest time was one month, and the longest was 52 months.

Locations

Although the survey was administered only in one part of China, it was clear that the organisations involved had programmes that operated within different parts of the mainland. These programmes were located primarily within the western provinces and encompassed other provinces as follows: seven were in Shaanxi Province, four in Yunnan Province, four in Sichuan Province, three in Gansu Province, and two in Chongqing. There were also programmes in eastern provinces such as Anhui, Liaoning and Jiangxi. Moreover, most of the DRR project work (78.8%) was conducted in rural areas. However, 18.2% of the work of the projects questioned was being conducted

Table 11: The duration of DRR projects

	Mean	Minimum	Maximum
Months	7.47	1	52

N=33

Table 12: DRR project outputs

	Mean	Minimum	Maximum
The number of persons receiving services	1199.28	0	10000
Buildings/facilities	1.17	0	20
Result report	.39	0	4
Conference	2.33	0	20
Symposium	2.37	0	20
Seminar	.37	0	3
Training course	24.7	0	360
Television programme	.40	0	5
Radio programme	.73	0	20
Newspaper report	.57	0	8
Scholarly articles	0	0	0
Other	0	0	0

N=29

Note: Four organisations did not respond to this question

in both urban and rural areas. None of those responding to this survey operated only in the cities, at the time when the survey was undertaken. This has highlighted an area for future development and research.

Beneficiaries

The mean number of persons receiving services from these DRR projects was 1,199.28, while the minimum was zero and the maximum was 10,000 people. The outputs of these projects included the following items: buildings, facilities, reports, conferences, symposiums, seminars, television programmes, radio programmes and newspaper reports which varied in mean quantity from 0.37 to 2.37. The mean number of training courses was 24.7, with a minimum number of zero and a maximum number of 360.

The data demonstrated that 93.9% of the DRR projects benefited schools; 72.7% benefited children and young people; 54.5% benefited the entire community. Interestingly, 20% of DRR projects claimed to benefit women, racial minorities, local government and NGOs; 18.2% focused on individuals in need; 9.1% identified disabled people; and 6.1% highlighted migrant workers. In this regard, the survey indicated that there were activities on the ground that addressed the differentiated needs of diverse groups within particular populations or locales. In that sense, the lack of specific policies targeting these groups did not act as an obstacle to their receiving the necessary information and/or resources through which to develop their own capacities for resilience in the face of disasters that might come their way.

Evaluations of project effectiveness

The majority of DRR project respondents (55.2%) said that they had a baseline from which to assess the effectiveness of their programmes. These respondents mainly favoured verbal feedback (86.7%). However, nearly

Table 13: The main location of DRR projects

	City	Rural	County	Both urban and rural area	To be confirmed
Frequency	0	26	1	6	0
Percentage	0	78.8	3	18.2	0

N=33

Table 14: Beneficiaries of the project

	Entire community	School	Children and young people	Women	Disabled	Racial Minority	Migrant worker	Persons in need	Local government	NGO	Other
Frequency	18	31	24	7	3	11	2	6	12	8	1
Percentage	54.5	93.9	72.7	21.2	9.1	33.3	6.1	18.2	36.4	24.2	3

N=33

Note: The total percentage is greater than 100 because this question allows participants to choose more than one item.

two thirds (65.6%) asserted that they had conducted formal evaluations. Baselines are useful in providing a benchmark from which to assess future progress or provide the foundation for a longitudinal study in the future.

Who was involved in conducting the evaluation of the project is relevant in terms of determining the robustness of the data collected. Those researchers who have formal project evaluation expertise tend to be favoured for institutional resource allocation purposes. However, including the voice of service users in project evaluations is becoming increasingly valued as a means of assessing the usefulness of resource usage to those receiving services. Of those involved in DRR project evaluations in this survey, the largest group, or 92.3%, were clients; 80.8% were institutional members; 65.5% were volunteers; 61.5% were staff of other NGOs; 15.2% were government officials; 11.5% were external consultants. Thus, service user voices were well represented.

Table 15: Evaluating project effectiveness

	Frequency (Yes)	Percentage
Does the project establish a baseline to assess the effectiveness? N=29	16	55.2
Does the project have verbal feedback? N=30	26	86.7
Does the project conduct a formal evaluation?	21	65.6

N=32
Note: Not all members provided replies to this point.

Research capacities

A small but significant minority (27.3%) of DRR projects were involved in basic research. The research aims included programme evaluation, community disaster management, improving and promoting DRR education for children, a post-disaster reconstruction plan based on loss statistics, and the history of local natural disasters. However, the 40.9% of DRR projects that lacked basic research facilities were interested in developing basic research capacity; 77.7% mentioned a desire to establish a theoretical foundation to their work, draw community attention to disaster situations and enable them to obtain further understanding of disaster management; and 22.2% were concerned about a lack of resources in their organisation for the purposes of conducting research. The data also showed that 88.8% of these projects wished to explore methods, plan strategies for reducing disaster risk and 11.2% aimed to evaluate the effectiveness of the project itself.

Much of this research (71.4%) was carried out by research staff within the organisation, compared to 14.3% that was conducted through a local research institution, university, the UN or other organisation. Government bodies undertook 7.1% of this research.

Table 16: Participants in project evaluations

	Client	Institution member	Staff of other NGO	Government official	Volunteer	External consultant	Other
Frequency	24	21	16	5	17	3	0
Percentage	92.3	80.8	61.5	15.2	65.5	11.5	0

N=26

Table 17: Person in charge of DRR project research

	Research staff within the organisation	Local research institution and university	Government	United Nations and other organisation	Other
Frequency	10	2	1	1	1
Percentage	71.4	14.3	7.1	7.1	7.1

N=14

Main challenges facing DRR projects

The challenges reported by the DRR projects were mainly organisational in nature. Nearly two thirds of DRR projects (62%) had insufficient funding; 50% lacked technical and professional skills; 39.4% felt understaffed; 34.4% had difficulties engaging community participants; and 18.8% claimed to have inadequate government support.

Addressing these challenges will require energy and commitment as well as financial resources and skilled personnel.

Discussion

The DRR projects surveyed in Shaanxi Province, China follow government policies in targeting schools and community-based initiatives, particularly activities focusing on education and disaster awareness-raising. However, the results of this survey also revealed a lack of capacity in a number of crucial areas, notably: funding, research, organisational capabilities and government support.

Although these DRR projects were keen to carry out basic research, this enthusiasm needs channelling into appropriate actions aimed at developing capacity. To do this, the organisations need funds to employ and train staff and to secure academic support for such research. However, this challenge might prove an insurmountable problem.

Despite this, the CSOs involved in the survey show that they are conducting important DRR projects. Their primary focus is sessions that equip students with knowledge of certain natural disasters. They relied heavily on voluntary workers and charitable funding to do this. Thus, there is considerable scope for government involvement in supporting and extending their activities, particularly through funding initiatives linked to building research capacities and fully engaging local communities.

Conclusions and recommendations

The DRR projects involved in this survey focus the bulk of their efforts on schools, as has occurred in many parts of Asia (UNCRD, 2006; Action Aid, 2011). However, it is important that these are expanded to the entire community, especially to groups that are particularly vulnerable (Action Aid, 2015; GAR, 2015). Moreover, they should engage the public more fully in geographically based scientific knowledge that national and local government agencies already have. They should also advocate for an equitable distribution of resources, and the involvement of all in decision-making processes and governance structures.

There was a lack of explicit emphasis on developing resilience (resilience practice) within these DRR projects, indicating that this is an important area for future development. For resilience-building to make a difference, it needs to be transformative and inclusive. This means, engaging grassroots movements and groups, and drawing on existing strengths to create new bonds of solidarity and recognition of differentiated needs and contributions among community residents. Linked to this is the co-production of solutions to common problems. This is achieved through dialogues between people with scientific and local knowledge yielding responses that build strong, safe and healthy communities and ecosystems.

Strengthening the capacities of the CSO sector is an important DRR priority (ISDR, 2015), and is one in which the national government could usefully invest resources. This will reap dividends that are consistent with the current

Table 18: The main challenges facing DRR projects

	Insufficient funding	Understaffed	Insufficient government support	Lack of technical and professional skills	Difficulty engaging community participation	Other
Frequency	20	13	6	16	11	4
Percentage	62.5	39.4	18.8	50.0	34.4	12.5

N=32

Five-Year Plan being deliberated by national government, and carry the potential to make China's communities stronger and safer in the face of disaster challenges.

The experiences of Chinese organisations can also provide useful lessons for NGOs engaging in CBDRR initiatives in other parts of the world. The survey highlighted areas for future research. These included:

- effective community engagement, especially in dialogue with expert-driven scientific knowledge and their own experiential knowledge
- identifying the nature of differentiated experiences and responses to locality-specific and culturally relevant experiences
- reaching out to become more inclusive and encompass wider segments of the community
- highlighting which DRR approaches are relevant for different types of disaster
- learning from CBDRR experiences elsewhere, as well as contributing to the global cache of knowledge in this arena.

(We thank Gender Development Solutions and World Vision for their assistance in the administration of the survey questionnaires, Katie Oven for her contributions to the design of the questionnaire, and Ben Chan for his endeavours in analysing the data collected.)

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5. Case study: World Vision's community disaster response plan in Ranjia village

William Weizhong Chen, Ning Li and Ling Zhang

World Vision and disaster risk reduction in China

World Vision is a Christian humanitarian organisation dedicated to working with children, families and their communities worldwide to reach their full potential by tackling the causes of poverty and injustice.

In 1982 the World Vision Hong Kong Office contributed to the Qinghai Province flood relief work, and with support from the central government of the People's Republic of China, the organisation became established in the mainland soon after. Today, it has offices in 17 provinces across China.

When disaster strikes, World Vision adopts a 'first-in, last-out' approach, responding with life-saving emergency aid and long-term support to help families recover and rebuild. Relief teams reach affected areas quickly, conducting vital needs assessments that enable the swift distribution of appropriate relief materials and reconstruction planning. Between 1998 and 2012, World Vision engaged in relief and reconstruction activities across 20 Chinese provinces. It has invested $77.8 million (0.48 billion Chinese yuan) in relief and reconstruction work across China, benefiting more than 8.1 million people.

There are five World Vision programme offices and one regional office in Shaanxi Province. The Yangxian County programme office was established on 29 April 2008 to carry out a comprehensive regional children's development programme. Just 12 days later on 12 May 2008, the Wenchuan earthquake struck in Sichuan Province. Several counties in Shaanxi were affected, including Ningqiang, Lueyang and Yangxian. World Vision staff had to evacuate their office but continued working in temporary outdoor tents. Before long, the organisation was involved in the initial disaster assessment and post-disaster reconstruction work.

The 2008 Wenchuan earthquake killed 87,449 people according to the International Federation of Red Cross and Red Crescent Societies (IFRC), and displaced 15 million. In 2009, World Vision made the commitment to include disaster risk reduction (DRR) work in all its community development programmes, considering DRR investment crucial to achieving its sustainable development goals. Projects are designed to play a positive role in lowering local disaster risk and vulnerability and they strive to identify and use local resources and techniques to increase community resilience.

The need for action

Yangxian County is subject to frequent natural disasters, especially droughts and floods. There are 80 potential geological disaster risk points in the county, including 77 landslide (unstable slope) points, one collapse point and two debris flow ditches. This threatens the safety of 1,010 households, 4,132 people, 3,739 houses, six schools and a number of important constructions and facilities, with a potential economic loss of up to 30 million Chinese yuan.

In 2010, the Yangxian County programme office went into villages and towns to speak with local residents on a number of community development issues. They conducted surveys and interviews with children, adults, local government officials and the county civil affairs bureau. The results found consecutive torrential rainfall in the months July to September to be the most likely disaster in Yangxian County. Secondary disasters caused by rainstorms included debris flows and landslides.

Box 1. The World Vision DRR framework

The World Vision DRR framework aims to:

- provide communities, families and children with a safe environment
- increase community DRR knowledge, skills and practical capacities
- increase regional DRR capacity and formulate local effective policy
- advocate for national policies that support DRR efforts.

Based on this outreach work, the Yangxian programme office developed a county-wide 'Child-Centred Emergency Disaster Response Plan', consisting of a relief response system to organise personnel, funding, responsibilities, logistics, donations and communications. It also began planning a series of community-based DRR projects to be incorporated into its wider community development programmes.

The community DRR projects officially began in 2010. The Ranjia Village case study is an exemplary World Vision DRR community project in Shaanxi Province.

Ranjia Village sits in Silang Town, located in northern Yangxian County, Shaanxi Province. There are approximately 2,150 residents in the village, with 560 households across 11 village 'groups'. The village land comprises more than 27,000 acres of arable land, with 552 acres of paddy fields. The main source of village income is money sent from family migrant workers who have moved to the cities. This widespread migration to the cities has left many children in villages such as Ranjia without parents. These children are known as 'the left-behinds'. Grandparents and other relatives take on responsibility for caring for these children, as well as working the land. World Vision undertakes a variety of activities in the village to support the education, physical and mental health development of these children.

A series of focus group meetings in the village showed that, while natural disasters were well known to the area, villagers had not previously been given the space to reflect on how the community could better protect itself from the potentially devastating impact of such disasters. It showed that participants were keen to contribute to discussions.

Activities and implementation

World Vision's Yangxian office has 14 staff members working across four community development projects. A number of volunteers from the village and the nearby town support its community work. The Ranjia Village project mainly includes the following four areas of activity relating to DRR:

1. Developing a community emergency response plan
2. Promoting DRR knowledge within the community
3. Undertaking regular emergency response drills
4. Equipping residents with tools to respond to disasters.

Beiliang village residents take part in disaster emergency drill, Photo: World Vision/Yujiang Chen.

The Ranjia Village community emergency response plan

Preparing the community to respond quickly and effectively to an emergency requires a comprehensive plan. World Vision worked with the local government to gather accurate and up-to-date information on the population and geographical composition of the village. This was followed by disaster risk analysis, looking at trends and current land formation to assess the potential risks, the most likely disasters, as well as the 'worst case scenario'. The plan itself was developed to include both short- and long-term response mechanisms, including evacuation and relocation, first aid, damage assessment, property salvation, communication, transportation and application for materials to rebuild. As part of the plan, the community developed a 'disaster liaison mechanism' for reporting to higher-level government officials and surrounding villagers, in order to seek emergency assistance.

Promoting DRR knowledge in Ranjia Village

Raising awareness for DRR within the village was crucial for the effective implementation of the emergency response plan. Activities needed to be both educational and engaging. World Vision designed a series of events to involve community members through social activities. Games for children, such as 'safety chess', were introduced. Reading materials for children and young adults, including cartoon handbooks on what to do in the case of a natural disaster, were distributed to schools. A prize quiz strengthened community understanding and also demonstrated knowledge learned. The village committee invited villagers to put on art performances incorporating DRR knowledge into performances.

Disaster emergency drills

There have been two drills since the project began, the most recent in March 2015. While World Vision has done school drills before, the Ranjia Village drills in 2012 were the first in the community. Drills focused on the three most likely disasters: earthquake, flood and fire, and involved reporting disaster information, communication between the village DRR response team members, relocation, resettlement, risk avoidance and first aid skills. This year the local fire service continued to participate in the drill, delivering a speech and demonstrating how to use the fire extinguisher.

Equipping the community with DRR facilities and equipment

The project has built a number of disaster facilities and equipment, such as a village evacuation site, equipped with first aid materials and relief supplies. Evacuation route signs have been added around the village. In addition, flood channels have been built to direct flood water away from houses and schools.

What has been achieved

The community emergency response plan has developed a system within the community to respond quickly to natural disasters, reducing their potential impact. Community leaders and volunteer members have specific responsibilities to ensure the protection of the community and to communicate outside the village to access additional support and relief.

These processes complement local government activities, making sure that DRR knowledge and skills reach the villages, shifting focus from external relief and assistance response to community protection against and in the immediate aftermath of a disaster.

In July and August 2010, not long after the implementation of the emergency response plan, the south of Shaanxi Province experienced the worst rainstorm for more than a century. The water level in the Jinjiahe Reservoir (which sits at the upper reaches of Ranjia Village) rose considerably and the dam was at risk of bursting, posing a threat to lives and livelihoods; if burst, the reservoir would destroy many residential houses and farmland in Ranjia Village and neighbouring Qingliang Village.

The village launched its disaster plan. The community DRR team members organised themselves and assigned key tasks. The reservoir was under 24-hour community surveillance with updates regularly reported to the government. Villagers living downstream were evacuated and resettled away from the danger zone. The community DRR team cleared the flood channel to divert water away from the village, hence lowering the risk of flood and ensuring the safety of the community and villagers.

The Ranjia DRR project has also achieved recognition from the local government. In its third year, the Silang Town government made it a requirement for all village-level cadres to participate in the emergency response drill. In addition, the Yangxian County civil affairs bureau has expressed interest in turning Ranjia Village into a provincial-level comprehensive 'DRR model community' (formal recognition from the government of the village's achievements with regards to DRR planning). In 2015, the Yangxian programme office will work with the county civil affairs bureau, the Silang Town government and Ranjia Village to build the village into a provincial-level DRR model community. It is hoped that government recognition of the standards in the district may lead to government investment in similar projects across the region.

Challenges

Despite the successes in Ranjia Village, there are still many challenges. With many of the young adults in the village migrating to cities, those remaining are particularly vulnerable (children and elderly people). Those remaining are also responsible for working the land, leaving limited energy or ability to participate in active work. Not only is there a limited number of active adults in the community, but this also poses challenges for engaging residents in DRR work. World Vision tries to integrate DRR knowledge-building into community social activities and programmes to increase participation, but nonetheless there are still obstacles to complete engagement.

While the Chinese national- and provincial-level governments are increasingly recognising the importance of DRR planning, there is still a relatively limited understanding at the local government level of the urgency of DRR work. World Vision is working to build relations and engage the local government in taking the initiative in designing, implementing and investing in DRR projects and ensuring that these initiatives reach rural communities.

Resources also remain a challenge for World Vision. The Yangxian programme office covers a wide range of community development areas and this affects the depth and quality of its DRR projects. To address this, World Vision is seeking someone to take sole charge of DRR projects, but funding is a constant challenge.

World Vision has an international handbook on DRR. This was translated into Chinese in 2014. However, there is an absence of content relating to the Chinese context. There is a lack of localised theories and knowledge to guide the organisation's DRR efforts. Similarly, DRR remains a new area of work for World Vision and staff are learning as they go. There is a need to develop and enrich knowledge and capacities among natural scientists, teachers and social or community workers.

What next?

World Vision believes that DRR efforts are an important investment in protecting all development achievements. A comprehensive DRR approach not only reduces the damage that natural and unnatural disasters have on communities, but it also helps communities to recover quickly. In 2015, the Yangxian County programme office will work to transform Ranjia Village into a provincial-level model community, working in continuous cooperation with the Yangxian civil affairs bureau, Silang Town government and the Ranjia Village committee. To achieve recognition as a model DRR community the village will need to undertake more detailed investigation into local disaster risk; improve the disaster monitoring and information reporting systems; strengthen emergency response planning; and continue efforts to promote DRR community-based knowledge. It is hoped that achieving model-DRR status will have impact on three levels: at the community level, the recognition will encourage the village committee and members to do more. At the county level, the village is an example of best practice that other communities can follow. At the provincial level, the village will be able to demonstrate the positive impact and benefits of such work, leading to greater investment across the province in similar projects.

6. Case study: Gender Development Solution's disaster risk reduction in primary education

Zhao Bin

The need for action

Natural disasters affect up to 370 million people in China each year. This results in a direct economic loss of nearly 100 billion Chinese yuan annually, and this loss is increasing. Compared with some countries in the world, the number of people injured or killed by natural disasters annually in China is high.

In a survey conducted after the 2008 Wenchuan earthquake, most respondents reported having never received education on disaster risk reduction (DRR). This suggests that the high number of casualties after the 2008 earthquake may be related to people's lack of knowledge and capacity to respond to emergencies.

Gender Development Solution (GDS) proposes that DRR education should be started as early as possible. However, many problems exist in current child-oriented DRR and safety education programmes. This includes a lack of active participation among children and a dissociation of knowledge from practice. Theoretically, DRR education aims not only to equip children with knowledge, but also to cultivate in people a good attitude towards disaster preparation and scientific disaster mitigation skills, so that they are well-grounded in dealing with natural disasters in the future. To do this, an appropriate education system on DRR is needed, in which people have access to DRR knowledge and skills, in turn enabling the community to minimise the negative impact caused by natural disasters.

GDS and disaster risk reduction

GDS is a local NGO, founded by the Shaanxi Women Theory Marriage and Family Research Centre – a well-known institution dedicated to women's development in China. Since the mid-1990s, GDS has worked on rural community development, incorporating disaster management into its projects. GDS promotes community development through public welfare programmes, using a combined approach of research and action. Its experience in boosting community development over a period of nearly 20 years has garnered recognition from its peers.

Initiating the project

The 'Children's Safety and Disaster Risk Reduction Class' was initiated in 2013. GDS collaborated with Ping An Insurance and One Foundation to design, launch and implement the project. GDS was responsible for overall project management and supporting project partners in China. Drawing on its experience in disaster management, this project brought GDS's expertise from the rural community to the classroom. The project adopted a participatory approach, allocating resources to vulnerable groups and promoting community sustainable development into disaster reduction work in schools.

Long-term DRR educational activities are carried out in the mid-west regions of China, where disasters frequently occur. The plan is to provide 90,000 children with DRR education in three years (2013 to 2015), as well as train teachers, parents and education officers to gradually build up a demonstration area of children's DRR education, and drive forward completion of relevant policies and funds for children's DRR education.

Children in school, discovering contents of the emergency backpacks. Photo : GDS

Project outcomes

Phase II of the project was completed in early 2015. GDS developed a class package, comprising a children's DRR education bag and a DRR education box for teaching staff. A participative teaching approach was adopted in order to raise children's awareness of natural disasters, the environment and of practical skills of what to do in a disaster.

GDS supported 56 implementing NGOs working across 25 Chinese provinces and 145 schools. The project involved more than 1,300 NGO staff, volunteers and teachers. Nearly 47,000 children have undergone DRR classroom teaching.

In 2014, a third-party evaluation found that:

1. the project courses fill the gap in DRR education to some degree
2. teaching staff have been specifically trained to provide DRR education
3. the project has triggered some NGOs to integrate DRR into their business operation model
4. the project builds a mechanism for mutual technical support between NGOs and schools.

The evaluation found that in-class education became the first channel by which students acquired knowledge on natural disasters. In both the project class and the control class, more than 80% of students said that they learned about earthquakes in the classroom. With respect to storm floods, landslides, mudslides and fires, the amount of related knowledge learned in the project class was significantly higher than the control class (see Table 19).

The survey, carried out as part of the evaluation, shows that in terms of sources of knowledge, 50.35% of students from the project class stated that the classroom was their primary source, while students from the control class mostly rely on television (55.56%). The results show that the introduction of disaster reduction teaching in the classroom has contributed significantly to the way primary school students acquire information on natural disasters (surpassing television as the first source in the absence of classroom teaching).

In addition to the third-party evaluation, GDS staff prepared and distributed questionnaires to schools. There were 4,455 questionnaires were distributed to 100 schools. GDS sampled the multiple-choice section of 1,790 returned questionnaires for analysis. The analysis found that:

- 81.84% of children are satisfied with the DRR course
- 51.17% of children are satisfied with their own class performance
- 77.65% of children say they can apply the knowledge in daily life or studies
- 66.76% of children believe the timetable set for the class is highly suitable
- 82.12% of children are satisfied with the teaching
- 82.74% of children are interested in taking follow-up DRR programmes.

The third-party evaluation generally supports the conclusion that the DRR classroom is useful in promoting children's DRR

Table 19: Comparison of knowledge acquired on major disasters, between the project and control class (%)

	项目班 Project class	对照班 Control class	卡方检验 Chi-square
课堂上学习过地震 Knowledge on earthquakes acquired in class	85.30	84.52	P= 0.710
课堂上学习过暴雨洪水 Knowledge on storm floods acquired in class	56.59	35.42	P=0.000
课堂上学习过滑坡 Knowledge on landslides acquired in class	29.10	19.94	P=0.001
课堂上学习过泥石流 Knowledge on mudslides acquired in class	64.33	25.60	P=0.000
课堂上学习过火灾 Knowledge on fires acquired in class	81.87	57.74	P= 0.000

A chi-square test is a statistical test used to compare observed data with data that you would expect to obtain, based on a specific hypothesis.

awareness and improving relevant skills, though the extent to which it works is subject to further evaluations.

The project was implemented in stages, so as to learn and adapt as it progresses. In the first year, the key objective was to gauge the possibility for DRR education to be implemented for schoolchildren in central and western China. In the second year emphasis was placed on improving service quality. In the third year, GDS aims to build on the recognition from the public and government, to promote the educational programme as widely as possible.

Project experience

Meeting schools' requirements for safety education is central to the project's success. The programme is designed to complement and work with the local safety education curriculum. NGO staff and volunteers provided training and support for teachers.

Leveraging local civil society organisations' (CSO) resources is key to the successful launch of the project. The support the project received from local government departments (chiefly education bureaus and town governments) was integral to its effective establishment. GDS fostered good cooperative relationships between local NGOs and the government. These were instrumental in enabling the swift design and initiation of the project.

Shared responsibility between CSOs and the schools is essential to ensure the project runs smoothly. The project was designed, on the one hand, to emphasise the shared responsibility of NGOs and schools in DRR education (while carefully defining their respective roles); and, on the other, to enable social organisation professionals to lead teachers in DRR education in a way that fulfils the project goals.

Exploiting the potential of CSOs, and mobilising them, is crucial to success. Local CSOs usually take the lead in implementing DRR classroom programmes. Full commitment to the programme from children's education officials and professionals is very important. (Of course, this recognition of CSOs does not in any way negate teachers' contributions. However, in terms of motivation, CSOs are typically more willing to carry out activities than teachers who are relatively passive in this regard.)

Table 20: Comparison of main sources for natural disaster information (%)

N=2,377	电视 Television	网络 Internet	课堂 Class	家里人告知 Told by family members	合计 Total
项目班 Project class	33.98	11.16	50.35	4.51	100
参照班 Control class	55.56	15.32	23.12	6.01	100
合计 Total	37.04	11.75	46.49	4.73	100

Children checking the seismic property for a toy structure, during disaster risk reduction classroom activities. Photo: GDS

Project shortcomings

Insufficient support for teacher training and materials. Teaching staff in project schools require specialised training. At present only one teacher from each project site participates in the training programme. On return he or she will pass on their expertise to other teachers, causing results to deteriorate gradually. Few teachers can skilfully use the participatory training method emphasised in DRR education. It is also hard to guide trainees to carry out teaching activities.

Course content and tools cannot fully meet school needs. The course focuses on earthquakes. Teachers want more content on floods, fires, landslides and mudslides, so that schools can choose from these based on their own needs. In addition, the courses only target students aged 10 to 12 years, and overall applicability needs to be improved.

It is not possible to share outputs efficiently in the implementation process. Excellent teaching materials, plans and methods are buried in the vast amount of shared data and information. There is currently no system in place to store and share these resources between CSOs and schools. As a result, many good practices are not shared efficiently. In sorting through the teaching logs collected by the management team, the evaluation team found that many excellent materials prepared by local teachers in Wuhu City in Anhui Province were not used to their full potential.

Improvement methods

Throughout 2015, the project aims to increase teachers' involvement. It seeks to promote their sense of ownership over the project and the courses. In addition, it aims to strengthen teacher training and resource delivery, and set up an online network for participating teachers to share their resources, experiences and learning. This means that the project will shift from emphasising the role of CSOs in evolving the project, to shared development with teachers, increasing their motivation and buy-in.

Content design is also being improved and products upgraded. Products will be developed for two categories: children in lower grades and senior grade students. Both will aim to foster an integrated approach to disaster learning. By following the logic of DRR education, students' risk awareness and their ability to translate this awareness into action in daily life, should be improved.

Conclusion

Through the project, GDS has provided support to domestic CSOs devoted to DRR education, reinforcing its own core mission to 'advance civil society development in western China'. GDS believes that children's participation is at the core of DRR education. This programme not only equips children with practical DRR knowledge and awareness, but also develops a positive attitude towards DRR and trains them to be citizens qualified with disaster prevention qualities, building a more prepared country as a whole. A good DRR education system is needed for students to grasp DRR ideas, knowledge and skills in order to minimise the damage caused by natural disasters.

7. Recent earthquakes in China: the case of Yingxiu Town in Sichuan Province

Timothy Sim, Cui Ke and Yunxi Yang

Introduction

China experiences frequent natural disasters, due to its vast territory and complicated climatic and geological conditions. While natural disasters are mostly unavoidable, experience has shown that the more prepared people are, the less they suffer. Disaster prevention, reduction and relief are basic public services that governments must provide for their people (Zhang, 2011). In China, the government plays a central role in disaster planning, with regional- and local-level governments shouldering direct responsibility for disaster management (Li, 2013).

This chapter examines disaster prevention and reduction work by the Yingxiu Town government in Sichuan Province. The town sits at the epicentre of the 2008 Wenchuan earthquake. Since the earthquake, Yingxiu Town government has paid great attention to preventing some of the most frequent disaster types, such as debris flows, landslides or mountain collapse. This chapter provides an overview of current disaster risk reduction (DRR) work undertaken by the Yingxiu Town government and community. It considers some of the challenges facing the town and makes suggestions for strengthening the disaster management capacity of local Chinese governments in other towns and villages.

Yingxiu Town

On 12 May 2008, a magnitude 8.0 earthquake struck Wenchuan County in the Aba Autonomous Region of Sichuan Province. The earthquake had one of the highest casualty rates in China's modern history. According to the International Federation of Red Cross and Red Crescent Societies (IFRC), it killed 87,449 people, and displaced 15 million, requiring the building of 5 million new homes (IFRC, 2009, cited in Sim, 2011).

Yingxiu Town sits at the earthquake's epicentre. There are eight villages within the town, each severely affected. Approximately 9,000 of Yingxiu's 12,000 villagers lost their lives. The earthquake caused more damage and affected a wider geographical area than any other earthquake since the founding of the People's Republic of China (China National Commission for Disaster Reduction, 2015). It caused irreparable losses. Under the leadership of the central government, a whole range of immediate response and relief work took place, including: search and rescue, medical assistance, sanitation provision, epidemic prevention, construction of temporary residential houses and schools, resettlement of victims, education, financial support to victims, recovery of livelihoods and emotional and psychological support.

After the earthquake, Yingxiu Town underwent a two-year post-disaster recovery and reconstruction period. Residents moved back to the rebuilt town at the end of 2010. However, the earthquake had caused lasting damage to the local geophysical conditions, leading to a series of secondary geological disasters such as landslides and debris flows. In particular, two major debris flows, on 14 August 2010 and 10 July 2013, brought new and serious challenges to the town. Over the years, with accumulating experience in disaster reduction, recovery and reconstruction, the Yingxiu Town government has moved beyond the longstanding Chinese practice of 'putting rescue before prevention', paying greater attention to the assessment, mitigation and prevention of natural disasters.

This study

This study is primarily qualitative. Specific research methods include:

- Literature review: a review of documents, policies and reports relating to the Yingxiu Town government's disaster response measures.

Debris flow dam in Zhangjiaping Village, built in 2014 to protect the village during heavy rainfall. Photo: Yingxiu Town government

- Field observation: targeted surveys and group interviews with local residents. Through these, we were able to learn more about the local environment and people's daily lives, as well as how people perceive and feel about the government's disaster management efforts.
- In-depth interviews: with local government officials across different ranks and departments, enabling a deeper understanding of local government capacity in disaster management and the problems and confusion of local-level government officials in the town's disaster management system.

Collected data (documents, field notes and interviews) were content-analysed with the aid of the computer-assisted qualitative data analysis package NVivo.

Current disaster risk reduction work by the Yingxiu Town government

Earthquake-resilient buildings and debris flow prevention projects

Since the 2008 Wenchuan earthquake, the Yingxiu Town government, under the leadership of upper-level governments, has undertaken major construction work to strengthen the resilience of buildings and key infrastructure to earthquakes and secondary hazards, such as debris flows, landslides and mountain collapse.

The reconstructed buildings have incorporated a variety of seismic construction technologies. The Yingxiu government comprehensive service centre used flexible earthquake-resistant design techniques when building houses, encompassing energy dissipation within the frame structure. The Yingxiu central health centre was rebuilt with a reinforced concrete structure and a rubber-reinforced seismic isolation foundation. The new Yingxiu primary school buildings were constructed using rubber-reinforced seismic isolation foundations, two-span horizontal frames and lightweight steel panel walls. The school buildings were constructed to withstand earthquakes up to number 10 intensity.

Our research found that residents in Yingxiu Town now had confidence in the resilience of their houses to earthquakes, and were no longer fearful of their collapse. However, they were worried about the impact of debris flows, believing that the 2008 earthquake had loosened the mountains surrounding the village, leaving them vulnerable each rainy season. In 2009, in response to this, the Wenchuan County government land and resource bureau undertook major infrastructure construction, including retaining walls, and active and passive protection fences across all Yingxiu Town villages. In 2010, the

Retaining wall in Zhangjiaping Village, built in March 2014 to protect against small landslides and rockfalls. Photo: Yunxi Yang

land and resources department of the Sichuan provincial government commissioned the implementation of 'debris flow treatment projects' in four Yingxiu town villages: Hongchungou Village, Shaofanggou Village, Niujuangou Village and Zhangjiaping Village.

Emergency response plans

Since 2012, a month before the rainy season (May to October), the Yingxiu Town government produces two disaster plans:

- Yingxiu Town Geological Disaster and Flood Prevention Work Plan (referred to as the Work Plan hereafter)
- Yingxiu Town Geological Disaster and Flood Prevention and Rescue Emergency Response Plan (referred to as Emergency Plan hereafter).

The Work Plan is based on a number of national and regional regulations and documents including:

- national geological disaster prevention and treatment regulations
- the National Sudden Geological Disaster Emergency Response Plan
- the Wenchuan County People's Government Sudden Public Incidents General Emergency Response Plan.

The Work Plan applies to both natural and human-induced geological disasters that threaten people's lives and properties in the town. It identifies high-risk areas, describing in detail the types of risk and locations of potential hazards for each village. In addition, it outlines escape routes for each risk location.

The Emergency Plan provides further detail on the measures and actions to be taken for geological disaster and flood prevention and rescue. It aims to ensure effective disaster prevention and response, increasing the local government's capacity to deal with disasters and to protect lives and property. Moreover, these plans ensure that higher-level government officials are informed of the local capacity to cope with disaster. Upper levels of government can then provide additional capacity support accordingly. For example, the civil affairs bureau of Wenchuan County provides resources to Yingxiu Town, at the request of the town government.

These two plans form the basis for individual emergency response plans in the eight villages of Yingxiu Town. Each village plan corresponds to its specific disaster hazards and risk points. In general, the village plans outline:

- the local emergency response team
- the roles and responsibilities of the team members

- the contact information for the designated person for each risk point
- warning signals
- escape routes
- post-disaster logistics.

Establishing accountability

Following the 2008 Wenchuan earthquake, the Yingxiu Town government set up a flood control and disaster relief headquarters, run by government officials from different levels, departments and public offices. The headquarters established a subordinate office called the flood control office. When there is a known threat, this office is responsible for contacting the police station, fire brigade, traffic police and health centre to ensure timely and coordinated action.

The Yingxiu Town government has set up a geological disaster relief leadership group. The government committee secretary leads the group. Members of the land resources office and civil affairs office make up the eight deputy group leaders. Group members comprise town government officials and the head of the police station, fire brigade, town health centre, telecommunication centre, power supply station, as well as the village committee directors.[5]

The village committee directors and group members stationed in villages are responsible for:

- communicating information
- reporting flood disaster control and relief data
- organising discussions and meetings on disasters
- coordinating the work of supporting departments from higher levels.

They are also responsible for assisting public security departments in maintaining social order and stability, and organising the evacuation and resettlement of people in the event of a disaster.

Local disaster response and rescue teams

As part of the Emergency Plan, the Yingxiu Town government has put together eight emergency response support teams, working across the town and villages:

- information collection and reporting team
- disaster rescue and management team
- social order maintenance team
- traffic support team
- medical assistance team
- logistics and materials support team
- vehicle allocation team
- supervision and surveillance team.

The Emergency Plan details the roles, responsibilities and contact information of the leaders and members in each team, to ensure that all members perform their duties appropriately.

In addition, the Yingxiu Town government has formed a geological disaster and flood prevention and rescue team. It is made up of 80 militia members from eight villages, and is organised by the town party committee and the armed forces office. The militia generally comprise male volunteers from the villages, between 18 and 35 years old. They regularly attend government-run training sessions to improve their knowledge and ability in disaster rescue. Since the Wenchuan earthquake, the militia has become the core force of Yingxiu Town's disaster management. For example, after the debris flow in July 2010, 10 militiamen in the worst-affected village were responsible for evacuating villagers. When machinery could not be used, they went from door to door and evacuated vulnerable or injured villagers to safety. After all villagers were evacuated, they took charge of protecting residential houses, properties and clearing away mud.

Community-led work, with expert input

The guiding ethos of Yingxiu Town's flood control and disaster reduction work is 'the community prevents and monitors disaster, working with experts where necessary'. At the heart of this is engaging local people in disaster prevention and recovery efforts. As such, the community plays a key role in the investigation of potential risk points of geological disasters, as well as in monitoring disasters, designing escape routes and training in geological disaster knowledge.

Identification and assessment of potential geological disaster hazard and risk points

After the 2008 Wenchuan earthquake, experts from geological agencies assessed and located 60 potential disaster hazard and risk points in the town. They named and identified each risk point by type (such as debris flow or mountain collapse). From then on, before and during the rainy season (generally from May to October) the county land resources bureau commissions professional agencies to conduct two to three assessments.

Disaster monitoring

During the rainy seasons, the government appoints 'monitors' to survey each potential hazard point. These are usually members of the village committees. Though they may not have geological expertise, they are experienced and familiar with local geological conditions.

Designing escape routes

In 2013, the town government required all village committees to design escape routes based on the village's

5 A villagers' committee is a self-governance organisation established through villager election under the jurisdiction of towns and counties in mainland China.

The Yingxiu Emergency Response Team responding to a debris flow on 10 July 2013. Photo: Yingxui Town government

potential hazard and risk points. Encouraging village committees and villagers to participate in the design of escape routes ensured that local knowledge of geographical surroundings was taken into account. Furthermore, it meant that the escape routes and emergency shelters were suitable for that particular village. The villages reported their escape plan designs to the government, and the government assigned officials to corroborate and conduct on-the-spot examinations and modifications.

Training villagers

The Yingxiu Town government currently invites experts from the Wenchuan County Land Resources Bureau to provide annual training sessions to village volunteers who are responsible for monitoring geological disasters. The training covers how risks are formed, and how to mitigate and prevent risks. Each session usually lasts for two to three hours. The villagers attending the sessions had not been involved in disaster-related work before the Wenchuan earthquake and had no relevant experience. However, after several years of working, they now have a good understanding of the basic geological disasters and prevention techniques.

Warning systems

The Chinese government has placed great importance on the establishment and improvement of the Yingxiu Town disaster warning system. Shortly after the debris flow in August 2010, the civil air defence office in Chengdu Province set up an air raid alarm system in Yingxiu Town. Military air defence use this type of alarm and it reaches much farther than other disaster alarm systems. Currently, specially appointed staff maintain the alarm, and during the rainy seasons two watch-keepers are assigned to check it is functioning properly.

During rainy seasons, the county bureau of meteorology provides weather information to the town government. In periods of excessive rain, the Wenchuan County land resources bureau, the water conservancy bureau and the meteorology bureau inform the town government to be prepared for heavy rain and related secondary hazards. Yingxiu land resources officials are responsible for informing the village volunteers in charge of monitoring, so that they can step up monitoring and surveillance activities.

Every rainy season, the town government will equip village volunteers with powerful intercoms. This is because when disasters strike, normal telephones or internet signals cannot function properly. In such situations, the intercoms, which do not require any network support for communication, ensure continued communication between village volunteers and government officials in different departments.

As a final fail-safe, the most remote villages in Yingxiu Town have hand-operated alarms. When disaster happens, the village committee will use gongs to warn villagers to evacuate quickly. The sound of the gong can travel up to 100 metres, whereas other high-tech gadgets such as hand-operated alarms are limited in range of coverage.

Community awareness, public education and drills

Before each rainy season, the land resources department officials of Yingxiu Town will distribute an 'information card', a 'disaster reduction card' and an 'emergency plan form' to village committees and vulnerable villagers. The two cards inform people how to spot danger signals, whom to contact and how to evacuate, when danger is near or already at hand.

Village volunteers send the land resources department information to identify vulnerable residents. Volunteers are responsible for collecting data and assessing the number of households and people at risk in the village.

The town government and village committee perform evacuation drills with the villagers before every rainy season, to prepare in case of disaster. The drills include testing alarm signals and getting all villagers to follow escape routes. After a few years of public communication and evacuation drills, the villagers in Yingxiu Town have significantly increased their awareness of how to respond when disasters strike. From our visit to and survey in one village particularly prone to debris flows, we found that 73% of the villagers were aware of the warning signs before a debris flow. We discovered that 95% knew the places in their village that were prone to debris flow, and 68% knew what to do to avoid danger when a debris flow occurs.

Resettlement of victims and distribution of relief materials

In post-disaster emergency response, local-level government is responsible for providing victims with relief materials. In addition to ensuring adequate quantities of materials, the Yingxiu Town emergency response headquarters must take into consideration the needs of different groups of people. For example, they provide nappies, milk and porridge for babies, sanitary products for women, and eggs for older people and children (for additional nutrition). The town health centre gives pregnant women and disabled people special attention. This model of materials distribution not only reduces the tension resulting from the lack or late supply of relief materials during emergencies, but also prevents, to a certain extent, injuries, sickness and malnutrition for the victims, especially vulnerable groups.

Challenges for disaster management at town level

The Yingxiu Town government disaster management planning has moved beyond the common notion of 'putting rescue before prevention'. It is increasing disaster mitigation and prevention planning. However, there are still issues requiring further attention.

Lack of professional input

While the Yingxiu Town government has been proactive in establishing a flood control and rescue office, a geological disaster rescue team and village disaster response teams, these systems still lack professional input. The people in charge of flood control and disaster prevention only began their work after the 2008 Wenchuan earthquake and have little professional training. The village emergency response teams comprise lay people. Although they are very familiar with local geological conditions and hazards, they are limited in their expertise (such as in geological analysis or disaster surveillance). More training is now taking place, as discussed above. With supervision, support and training from more informed sources, such as the Wenchuan County Land Resource Bureau, local volunteers and government officials are learning basic knowledge and skills. However, this falls short of what is needed. Local volunteers require further training and supervision in disaster management.

Protecting volunteers

Volunteers are engaged as 'disaster monitors' in the villages. They are on the frontline of Yingxiu Town's disaster management system and are integral to it – but they are also the most vulnerable. In normal situations, disaster monitors are in charge of regularly investigating potential hazard points and coordinating the disaster management work in the village. The local government gives the volunteers an annual allowance of a few hundred yuan. Although this is not a large sum of money, they take their responsibility seriously. Volunteers view their duty as lifesaving and are highly vigilant.

During the July 2013 debris flow, local volunteers were so busy evacuating other villagers that they neglected their own families, some of whom were injured. As a result, some volunteers suffered psychosocial problems, such as panic, depression, anxiety, insomnia or even behavioural disorders (Wang et al., 2013). Even when there is no natural disaster, volunteers have experienced panic and anxiety, feeling the weight of responsibility and knowing that their negligence could threaten people's lives and property. We found that this was more severe when volunteers did not have access to information on natural disasters.

In addition to the psychological risks, currently there are limited safety measures in place for volunteers, who are highly susceptible to physical dangers during disasters – for example, when carrying out investigations into potential risk points during torrential rains.

Raising awareness

The guiding ethos of the disaster management of the Yingxiu Town government is 'the community prevents and monitors disaster, working with experts where necessary'. Over the years, the government has adhered to this notion, working to inform communities about disaster prevention and risk mitigation by organising regular training and drills. These efforts have improved residents' disaster awareness.

However, we found that 46% of villagers were still unclear about how to prepare for geological disasters. In addition, the survey results showed that more than half of the residents could not provide basic first aid.

Training organised by the Yingxiu government so far has only targeted village committee members and volunteers. Ordinary residents have had little opportunity to access relevant training. On the other hand, we found from our interviews that villagers have limited interest in such training mainly because they have previously found them to

A safety drill organised by Yingxiu Town government, May 2014. Photo: Yingxiu Town government

be impractical and boring. This raises another challenge for the local government: how to engage communities.

Opportunities for disaster risk reduction at the local government level

Local government officials and volunteers require ongoing professional training and supervision to increase knowledge and skills in disaster risk reduction. Moreover, it is crucial that local government ensures the psychological and physical safety of volunteers and staff.

In terms of promoting community awareness of natural disasters, there needs to be more creativity in public education strategies and in motivating villagers to participate in training. The authors of this chapter suggest that capacity-building exercises need to be made more attractive and appropriate to residents. Local governments could consider using tea sessions with older people, using films about geological disasters or conducting drills to increase people's capacity to cope when faced with sudden incidents.

Last but not the least, local governments could communicate and collaborate with CSOs to optimise the available resources and strategies. After the 2008 earthquake, there were many CSOs, NGOs and higher education institutions that actively participated in the post-disaster relief and recovery work, offering substantial human, material and financial resources. However, CSOs are less involved in the preparation and reduction of disaster risks. It is essential to clarify and coordinate functions and tasks as well as resources between the government and non-government efforts. In doing so, the government could incorporate CSOs into its disaster management system and engage them to play a complementary role in disaster prevention, reduction, recovery and reconstruction.

Conclusion

The disaster management system in Yingxui Town in Sichuan Province has made groundbreaking advances. Compared to many other towns in China, it has moved beyond the concept of 'putting rescue before prevention'. Large-scale construction and infrastructure work has significantly reduced the risk of earthquake and secondary hazards. Comprehensive emergency response planning, from the upper government levels down to the village level, means that communities are prepared to respond to disaster quickly and effectively.

The Yingxui Town ethos is that 'the community prevents and monitors disaster risk, working with experts where necessary'. In practice, this means that community staff and volunteers are responsible for monitoring hazard risk points, forming emergency response teams and raising awareness. Although there is room for improvement, the Yingxiu Town model provides useful lessons for other areas in China, grounded in the people's lived experience of a huge earthquake and the recurring secondary hazards.

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8. Global experiences and lessons for NGOs to promote earthquake disaster risk reduction

Brian Tucker

The importance of being prepared

A comparison of earthquake fatalities illustrates the tragic toll of not being prepared and of not mitigating seismic risk. Haiti's magnitude 7.0 earthquake in 2010 reportedly killed more than 200,000 people and accounted for most of the earthquake deaths that occurred in the world that year. Much of the suffering could have been prevented. There were 22 earthquakes of equal or greater strength in 2010, including a magnitude 8.8 in Chile that affected an equal number of people. According to the United States Geological Survey PAGER (Prompt Assessment of Global Earthquakes for Response) programme, the ratio of the number of 'strongly shaken' people who died in Haiti compared to Chile was 100 to 1, reflecting the effectiveness of Chile's risk mitigation measures and the need for such in Haiti. Much of this stark difference in loss of life and human suffering can be attributed to the significant work undertaken by the Chilean government since the 1960s to improve building codes and to ensure compliance with them.

GeoHazards International (GHI) was established in 1991 to promote the adoption of well-known preventive measures and the avoidance of risky practices, as Chile has done. The aim is to help the world's most vulnerable communities end *preventable* death and suffering from natural disasters. GHI's approach has four components:

1. Raising awareness about the risk, and risk mitigation options.
2. Building the capacity of governmental organisations, NGOs and academic institutions.
3. Strengthening public policies and critical infrastructure, such as schools and hospitals.
4. Promoting preparedness and prevention.

This chapter draws on GHI's experience over the past 24 years working in more than 40 communities around the world. NGOs in particular play an important role in community-based earthquake disaster risk reduction (EDRR) work.

Three challenges to promoting EDRR

1. Lack of earthquake information

In 2011, GHI and the Center for Disaster and Risk Analysis (CDRA) at Colorado State University conducted an 18-month study of EDRR challenges facing 11 diverse cities around the world (San Fransisco, USA; Delhi, India; Lima, Peru; Chinch, Peru; Istanbul, Turkey; Antakya, Turkey; Padang, Indonesia; Timphu, Bhutan; Guwahati, India; Bandung, Indonesia; and Christchurch, New Zealand). These cities ranged greatly in size, wealth and recent experience of strong earthquakes. In-depth interviews and surveys were conducted in each city with disaster reduction professionals across five sectors: government, business, health care, education and grassroots NGOs. The survey data show (see Box 2) perceived barriers to EDRR work across the five sectors and 11 geographical locations. Lack of funding was ranked as the most important challenge to promoting EDRR, followed by competing social/economic problems, and then lack of resources relating to personnel and technical expertise. Lack of earthquake information was ranked as sixth most important.

The participants in the survey were then presented with a long list of possible types of earthquake information (see Table 21), and they were first asked which, if any, of these types of information they possessed. The most commonly available information was on how individuals and families

Box 2. Top nine challenges facing EDRR professionals, ranked in order of most important to least important.

1. Funding
2. Competing social/economic problems
3. Lack of available personnel
4. Lack of technical expertise
5. Lack of interest among the public
6. Lack of earthquake information
7. Competing serious hazards
8. Time
9. Lack of interest among colleagues

Source: GeoHazards International 2012: 99

can prepare for an earthquake, with 40% of respondents citing that they had this information. However, it was clear that other vital information was missing. For example, fewer than 25% had information on the projected impact of an earthquake on their community's hospitals and schools, the number of expected deaths or injuries, or the potential economic loss of a major disaster.

Table 21. Breakdown of types of information and percentage of survey respondents with access to the information

Type of earthquake information	Do you have it?	Do you want it?
Individual/family preparedness	40%	59%
Projected ground shaking intensity	37%	62%
Maps of earthquake fault lines	36%	63%
Organisational preparedness	34%	66%
How to strengthen buildings	33%	66%
How to fasten contents of buildings	29%	67%
Projected damage to housing	27%	70%
Maps of potential earthquake-induced landslides	26%	74%
Projected damage to schools	25%	75%
Projected damage to hospitals	22%	75%
Projected number of injuries	21%	74%
Projected number of deaths	21%	76%
Projected economic losses	20%	73%

Source: GeoHazards International 2012: 68

Then the survey participants were asked which types of information they would like. Participants overwhelmingly said that they would like to have access to all of types of information in order to better understand the risks for their city, with about three quarters wanting information on projected damage to schools and hospitals (see Table 21).

The data in Table 21 calls into question the significance of the sixth-place ranking of the lack of earthquake information in terms of barriers to promoting EDRR. How could these people possibly expect to get the funding needed to reduce earthquake risk if they didn't know – and make known – what losses their communities could expect in the event of a damaging earthquake? How could earthquake risk reduction compete successfully against other social/economic problems facing these communities if the consequences of earthquakes were not known?

2. Accountability

Responsibility for mitigating earthquake risk lies at international, governmental, organisational and community levels. This ranges from international organisations funding and leading global EDRR efforts, to national and local governments enforcing building codes and land-use zoning.

In 2005, the United Nations International Strategy for Disaster Reduction (UNISDR) adopted the Hyogo Framework for Action, with the goal 'to substantially reduce disaster losses by 2015'. Evidence suggests that this goal was not met, because disaster exposure is in fact increasing faster than vulnerability is decreasing, and new risks are generating a steady rise in disaster loss. The UN World Conference on Disaster Risk Reduction, held in Sendai, Japan in 2015, gave UNISDR an opportunity to report on its progress, to be frank about the failure to meet its goal, and to discuss openly the new challenges facing international EDRR work.

Unfortunately, this opportunity was missed. 'Progress has been achieved in reducing disaster risk… leading to a decrease in mortality in the case of some hazards,' reads the preamble of the newly adopted Sendai Framework for Action (2015). Later, however, that same preamble says, 'Evidence indicates that exposure … has increased faster than vulnerability has decreased, thus generating new risk and a steady rise in disaster losses …'. And the new goal, adopted in Sendai? 'The substantial reduction of disaster loss (by 2030).' It can be difficult for organisations and institutions to admit failure, and they typically resist accountability. This is a significant barrier to learning and improving global and local EDRR efforts.

At the national level, governments are responsible for enforcing building codes and developing strong infrastructure before an earthquake hits. In 2005 a magnitude 7.6 earthquake occurred in Pakistan, violently shaking and levelling entire villages, triggering landslides and cutting off access to remote areas in north east Pakistan. It was the deadliest earthquake in the recent history of the sub-continent, killing more than 73,000 people. In the immediate aftermath, Pakistani President Pervez Musharraf publicly declared the earthquake an act of God and in doing so implied that he and his government were not responsible for the impact of the earthquake. While no government can be held responsible for the occurrence of an earthquake, it *is* responsible for ensuring that the country's infrastructure is prepared for the disaster.

A good example of the positive consequences of strong government accountability mechanisms is the enforcement of school safety building regulations in California, USA. In 1964, the California State Attorney General ruled that members of the board of education were personally responsible for any deaths that occurred in a school as a result of an earthquake, if the members had been told the school was vulnerable and the schools continued to be used without correction. The construction of schools in California had been steadily improving since the 1933 Long Beach earthquake (magnitude 6.3) where school buildings incurred some of the most severe damage. However, despite progress with new construction, it was not until the 1964 Attorney General ruling that the safety of the schools built prior to 1933 significantly improved.

3. Social acceptance

A magnitude 7.4 earthquake struck the Garm Oblast region of Tajikistan in 1949. The earthquake shook the region and triggered a landslide that covered an entire village and killed up to 20,000 people. In 1975, I was part of a US–USSR exchange programme that allowed me to work and live in Tajikistan over the period 1975 to 1980. I observed that villagers constructed their homes using the same pre-1949 traditional methods. The main building material was mud, with thin pieces of wood lining the tops of windows and doors. Each year several inches of mud were added to the roof.

One day, I visited the home of a friend named Borot and found a construction unlike any other building in the village. Each corner was supported by a large log, locked together with sockets at the base and top of the building. The construction was strong – a perfect example of an earthquake-resilient building, using local materials and low expense. Borot explained that the house had been built by his father and was the *only* house in the village to survive the 1949 earthquake. Delighted by this discovery, I thought it was just what was needed to promote seismic-resistant construction practices within the village. When Borot told me that he was building a new home for his family, I asked if he was constructing it in the same style as his father. 'I am not stupid,' he said. 'I will build my house the traditional way. I am not crazy like my father.' This astonished me. There was no question that Borot felt *accountable* for the safety of his family. The construction of his father's home was not more expensive to build. He *knew* that all the other buildings in the village had collapsed during the 1949 earthquake. What was missing was a *socially acceptable* solution. Borot's father was considered 'crazy' in the village because of his individual approach to building. It seems that Borot did not want to be different from his neighbours

Borot on the site where he will build his new home, Tajikistan 1975. Photo: Brian Tucker

Five opportunities for NGOs in Shaanxi to promote EDRR

1. The use of 'earthquake damage scenarios'

An earthquake damage scenario is an assessment and description of the estimated effects that a large but likely future earthquake could have on the critical infrastructure in a geographical area. It traces the complex structural, social and economic events that are likely to be triggered by an earthquake. This information can be used by NGOs to develop a long-term strategy for EDRR.

In 2009 GHI conducted an earthquake damage scenario to determine the impact on modern Kathmandu if there were a repeat of its 1934 earthquake, which killed 4,500 people in the Kathmandu Valley. The study found that as many as 60% of all buildings in the Kathmandu valley would likely experience heavy damage, many beyond repair. It was estimated that it would result in 22,000 deaths and 25,000 injuries requiring hospitalisation. The detailed information was reviewed by government, businesses, NGOs and international technical advisers and the earthquake damage scenario formed the basis for the establishment of the National Society for Earthquake Technology – Nepal (NSET), shaping the strategic mitigation plan for NGOs in Kathmandu for the next decade.

Earthquake damage scenarios present an opportunity to address several of the challenges highlighted in the first part of this chapter. They facilitate the collection of critical local earthquake and infrastructure information upon which an NGO can build its mitigation strategy.

2. Strengthening local university seismic engineering for rural buildings

Structural engineering in highly technical societies, such as China, tend to work on more complex urban structures. The opportunities and incentives for academics to address EDRR challenges for rural buildings is often simply not there, leaving rural communities and infrastructure vulnerable.

In 2007, responding to the major 2005 earthquake, GHI launched a three-year project to boost Pakistan's earthquake engineering and retrofit construction (that is, seismically strengthened construction). By partnering with the University of Engineering and Technology in Karachi, GHI strengthened curricula for both practising and student engineers.

3. Hospital earthquake safety and training

Post-earthquake, hospitals play a crucial role in immediate and ongoing medical and trauma care. If hospitals are not working in the aftermath of an earthquake, more people will die. An earthquake can cut off hospital utilities, such as water, electricity or transportation, so it is important that in addition to secure building structures and contents, there are suitable back-up capabilities.

In 2011, GHI found that even new hospital facilities were not always designed with earthquake resilience and post-earthquake functions in mind. GHI was engaged by the World Health Organization to assess the earthquake vulnerabilities at Bhutan's national hospital and two district hospitals. The assessments looked at the structural integrity of the building, how secure the contents were, equipment stability and utility infrastructure. Working with local partners, GHI produced a detailed report of the assessment findings, including potential damage. The report included recommendations for short- and long-term improvements. Though it may take years to fully implement all the recommendations, the Bhutan Ministry of Health and the hospital administrators have a clear roadmap for improvements that will save lives and enable the hospitals to provide vital services should an earthquake occur.

Given the importance of hospital safety to EDRR, there is a real opportunity for NGOs to work with hospital administrators and government officials to strategically develop hospital earthquake infrastructure.

4. School earthquake safety and training

A survey of residents in a village in the Kathmandu Valley asked: 'If you knew that your city hall was at risk of collapse in an earthquake, would you be willing to spend your own money or for taxes to be spent to improve it?'. Overwhelmingly the response was no to both suggestions. Participants were asked then, 'If you knew that your temple, or your place of work was at risk of collapse in an earthquake, would you spend your own resources (time or money) to strengthen it?'. Again, overwhelmingly the answer was no. When asked the same of their children's school, the answer was overwhelmingly yes. GHI provided half the funds needed to strengthen one local school in the village of Nangkhel, and the residents did indeed provide the money and labour to complete the work. NSET engineers trained local masons to 'retrofit' the school. While this was a relatively small study in just one location, it demonstrates the value of promoting EDRR work through schools.

More significant than strengthening the school, a GHI-NSET survey of the construction in Nangkhel over the 10 years following the school retrofit project showed that about four fifths of all new construction incorporated at least one of the earthquake-resistant features used in the retrofit school. Thus, the project created the *supply* of earthquake-resistant construction, in the form of the trained masons, and the *demand* for earthquake-resistant construction from the villagers.

GHI has developed a number of successful teacher training programmes. Training for teachers includes information on what an earthquake is, what to expect and what to do in the case of an earthquake. However, it is important to note while training programmes help raise awareness and inform swifter and more efficient responses to earthquakes, they do not necessarily make children safe. There are some very practical measures that can be taken to secure the contents of a school building, such as fixing bookcases to the wall. In Bhutan, GHI worked with local engineers to identify vulnerable schools and to train local masons to retrofit and strengthen the school buildings.

5. Earthquake-resistant school desks

It is common practice for classroom training and drills to teach children to get under their desk in the case of an earthquake. However, in a major earthquake a normal, wooden desk of the type found in many developing countries offers no protection in a non-secure building. There is a further risk that this sort of training makes children feel safe and that governments are not held accountable to do more to make the school buildings safe.

A new design being developed in Israel by Ido Bruno and Arthur Brutter offers a solution. The simple desk design has many features that mean that it can offer real safety to children in vulnerable schools. Initial tests in the lab indicate that the desk can withstand up to 1,000 kg dropped on it from four metres' height. We have proposed to train Bhutanese furniture manufacturers to build these desks. The Ministry of Education has made a commitment to purchase them for school classrooms. This simple

A new design of school desk that can withstand up to 1,000 kg dropped on it from four metres height. Photo: Ido Bruno.

initiative could create jobs, raise awareness and make thousands of schoolchildren safer, while the Bhutanese school buildings are being strengthened.

Conclusions

The 2015 World Conference on Disaster Risk Reduction in Sendai highlights the persistent challenges to reducing seismic hazard that are faced by governments, NGOs and communities around the world. However, the comparison of earthquake fatalities between the 2010 Haiti and Chile earthquakes demonstrates that there are also real opportunities to confront these challenges.

GHI believes that a community will reduce earthquake disaster when a trusted peer shows that the risk is real and large, and when that peer can demonstrate an *affordable, socially acceptable* and *verifiable* solution that reduces the risk. It is simply not enough to offer an affordable solution if it is not socially acceptable, or in situations where people do not believe that they and their children are at unacceptably large risk.

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9. Conclusions

John Young

1. China recognises the need to do more to mitigate risk of earthquakes, as well as respond to them

China is extremely vulnerable to natural hazards due to its size, complex weather and geographical conditions, rapidly changing social and economic conditions, and an increasingly urban population. For more than 25 years, China has had a comprehensive approach to disaster reduction and impressive centrally coordinated response and reconstruction mechanisms. However, since the 2008 Wenchuan earthquake, there is growing recognition of the need to do more to mitigate the risk and reduce the impact of disasters, as well as respond to them. There is also increasing emphasis on the need to involve community groups, NGOs and the private sector in these efforts.

2. The challenge is how to coordinate activities between government and NGO agencies

The China Earthquake Administration was established shortly after the disastrous 1966 Xingtai earthquake to monitor seismic activity, estimate the likely damage of earthquakes and inform earthquake disaster risk reduction (EDRR) policies. The comprehensive National Plan of Earthquake Disaster Mitigation and Reduction (2006–2020) sets out a framework, which is being replicated at sub-national levels. This includes a wide range of activities to improve resilience at community level through work by government and non-government actors. The challenge is in how to coordinate activities between these two stakeholders.

3. Earthquake risk in Shaanxi Province is not well understood by community residents and NGOs

Earthquake hazard is prevalent throughout Shaanxi Province. Nowhere within the province is more than 25 km from a fault, all of which have been active since the late Pleistocene epoch (that is, the past 10,000 years). There have been many disastrous earthquakes in recorded living history. However, the risks are changing rapidly because of migration, urbanisation and other changing social, economic and cultural factors. The science underpinning this is well understood by government agencies, including the Shaanxi Seismological Bureau. But it is less well understood by community residents and NGOs, whose community development DRR programmes tend to focus on more common disasters including droughts, fires, floods and landslides.

4. There is a wealth of DRR experience in Shaanxi Province, but little sharing of knowledge

There are many government and non-government projects to improve DRR at the community level, and a wealth of experience about how it could be improved. Much work has been done on EDRR in Sichuan Province, following the Wenchuan earthquake in 2008. This is widely regarded to have contributed to diminishing the impact of, and increasing the speed of response to the 2013 Lushan earthquake in the same province. However, there is little knowledge-sharing between government and non-government organisations involved in EDRR, and relatively little incorporation of work on earthquake-resilient buildings and infrastructure in ongoing DRR programmes. This is beginning to change.

5. International experiences highlight persistent challenges to reducing seismic hazard, but also provide real opportunities to confront them

Global experiences of promoting EDRR identifies three major challenges: a lack of information about the actual impact of an earthquake and what can be done to reduce it; the need for accountability at the national, community and individual level; and finding socially acceptable solutions to support communities to better protect themselves. Global experience also highlights different approaches that have been effective in other countries and might be relevant for Shaanxi.

As well as identifying persistent challenges to reducing seismic hazard, global experiences also demonstrate real opportunities to confront these challenges. Five opportunities for NGOs in Shaanxi Province include:

1. Using earthquake damage scenarios to inform and convince stakeholders of the risks.
2. Working with local universities to develop earthquake-resistant rural buildings.
3. Working with hospitals to ensure its infrastructure is secure.
4. Training schools and local masons in how to secure school buildings.
5. Looking to new and innovative technologies, such as earthquake-resistant school desks.

6. We need an integrated approach to increasing resilience to earthquakes

The diversity of views expressed in this publication reinforces the message that there is no single approach to increasing resilience to earthquakes that will work everywhere. Approaches need to link together the physical science, social science and local knowledge. They need to involve close integration between communities, non-government and government organisations, and go beyond treating communities in isolation.

Village construction in Heyang county, Shaanxi province. Photo: ODI/Louise Ball

10. Interpreting and applying lessons learned

The need for action

Over the last decade, natural disasters have affected an average of 70 million people in China each year. China's National Poverty Alleviation Office states that natural disaster is the primary cause of poverty and of pulling people back into poverty. In recent years, a number of unprecedented catastrophic natural disasters, such as the Wenchuan earthquake in 2008, have resulted in severe loss of life and destruction of property. In response, the Chinese government has increased its capacity to reduce the risk of such natural disasters. China's civil society also has been developing disaster risk reduction (DRR) strategies and programmes, contributing to an increased awareness and capacity to respond to these risks.

However, cooperation between the government and civil society in China is not always good. Civil society organisations (CSOs) face numerous difficulties, such as a lack of access to government information or the blocking of community DRR programmes. In particular, at the county and township levels, local governments remain prejudiced against such civil society work. There is a strong need for improved communication and mutual understanding between the two sectors, in order to achieve greater coordination in disaster risk reduction and in building pathways to resilience.

Gender Development Solution's (GDS) township-based Disaster Prevention and Reduction Mechanism Pilot Project combines social science and natural science. It integrates disaster reduction and prevention planning with community development work, and it unites the government's formal disaster reduction and prevention mechanisms with similar non-governmental informal mechanisms.

Objectives and expected outcomes

The pilot project aims to strengthen the overall disaster prevention and reduction systems in two counties (Heyang and Huxian) – both located on the Guanzhong earthquake belt. In doing this, the project aims to establish a more comprehensive means of protecting vulnerable persons (especially vulnerable groups such as women, children and older people) in emergencies and to increase the sense of duty and capacity of responsible parties (such as government agencies, communities and NGOs) to protect these vulnerable groups.

Project objectives

- To assist the government in establishing new and improving existing disaster risk reduction work and service mechanisms.
- To build a township-level comprehensive disaster prevention and reduction platform for resource-pooling, information-sharing and service provision.
- To increase the sense of duty and capacity of disaster-related government agencies, NGOs and other responsible parties to respond to the disaster-related risks faced by vulnerable groups (such as women, children and older people).

Project outcomes

- Increased abilities of disaster-related government agencies and NGOs to protect vulnerable groups in emergencies.
- Improved cooperation mechanisms between NGOs and the government, encouraging them to jointly initiate, take action, monitor, advocate and protect vulnerable groups in emergencies.
- Increased opportunities for NGOs to participate, voice concerns, and cooperate with the government, and enable them to make use of such opportunities to participate in community recovery and reconstruction.
- Raised awareness among vulnerable groups of their rights during emergencies and of the ways they can seek help accordingly.

Designing the initiative

The first pilot project site is Heyang County. GDS has already established women's community development programmes in the county, supported by the Kadori Foundation. GDS has strong partnerships with the local residents and government officials, making it a good location for the first pilot project. The second pilot site is to be confirmed. Heyang County sits on the fault belt in the northern margin of Weihe Basin, and is therefore particularly vulnerable to frequent minor earthquakes.

The Heyang government already had county-level DRR plans. However, GDS observed that these plans did not take into account NGO contributions and work in the region. This project seeks to integrate all stakeholders into local-level DRR planning. To achieve this, close collaboration with local government partners would be essential. As such, the local government has been involved in the design of this project, and has provided feedback on the initial proposal, recommending that the project operate at town level within the counties (rather than exclusively at village level, as initially proposed).

The knowledge used to produce this project proposal comes from a number of sources including:

- GDS's local knowledge and practical experience in community development and DRR work
- local government DRR planning documents and proposal feedback
- meetings with local and international NGOs, including World Vision and Save the Children
- a series of meetings with Earthquakes without Frontiers (EwF) researchers.

The project will design and implement a number of educational courses. GDS has developed the course outlines, based on its knowledge and experience in this area. The content will be produced in collaboration with a number of stakeholders, including EwF and the relevant government departments.

Delivering the initiative

GDS will take a lead in managing the planning and implementation of all project activities. This includes the budget management and project evaluation. GDS will also lead in mobilising community groups and raising public awareness of the DRR work.

The National Commission for Disaster Reduction (NCDR) will establish a project consultation group to steer the strategic project development. It will also provide the necessary scientific data in the initial assessment phase.

The third collaborator, EwF, will provide technical support including assisting with the baseline research, the development of training materials and research into mechanism effectiveness.

The project comprises four main activity areas.

1. **Baseline research and assessment of existing disaster prevention and reduction systems.** The first phase of the project will aim to establish what is already being done and how these activities can be improved or better coordinated. This will involve conducting surveys and dialogue with both communities and NGOs. Earthquakes without Frontiers will provide technical support, for the assessment criteria referring to the government's 2011 National Comprehensive

Heyang county, Shaanxi province, the site for GDS's next disaster reduction community programme. Photo: ODI/Louise Ball

Disaster-reduction Demonstration Community Standards.

2. **Pioneering improved disaster prevention and reduction standards, procedures, policies and systems.** This will entail compiling a more effective and practical community disaster prevention and reduction handbook, based on practical experiences of the communities. It also involves jointly improving the disaster prevention and reduction service system with different stakeholders in the existing system.
3. **Disaster prevention and reduction course design and capacity-building for stakeholders.** GDS aims to empower vulnerable groups to use official and unofficial disaster prevention and reduction mechanisms to solve problems, meet their own needs in emergencies and develop greater capacity to cope with disaster and risk. The project will establish township-based disaster prevention and reduction education and rescue training centres, providing county-level government disaster management personnel, non-governmental relief organisations and community disaster rescue volunteers with designated locations for conducting drills. It will also compile a series of disaster prevention and reduction publicity materials to raise awareness among major stakeholders, using different media channels. GDS will work with the NCDR and experts in relevant fields to design a series of participatory courses and training for capacity-building that applies to multiple sudden disasters, in order to increase major stakeholders' capacity for disaster prevention and reduction.

Courses to be designed and implemented:

- **Capacity-building of disaster risk reduction management mechanisms through a regular drill system.** This is a 24-hour disaster simulation drill. Designed for both county-level government officials and local NGO workers, it aims to bridge the gap between official disaster risk reduction mechanisms and unofficial NGO mechanisms.
- **Capacity-building of volunteer (NGO) disaster risk reduction emergency response teams.** This is a five-day training course, composed of 30% theory and 70% practical activities. The course is aimed at anyone involved in emergency response, including NGO staff, relief volunteers, public services, security guards and community health workers. This course is also especially relevant to remote communities where external emergency response teams may not be able to reach them quickly.
- **Disaster risk reduction medical first aid and self-aid training.** This one-to-two day course is for all community members and especially schools and public institutions.
- **Field survival and rescue outward-bound training.** This course is designed to be fun and active, building team spirit and engagement with disaster response work. It is based on problem solving and simulation training.

- **Disaster prevention and reduction parent-child summer camp.** Lasting two to three days in the summer, this course is 25% taught and 75% games, competitions and participatory activities. It includes disaster awareness raising, survival techniques and first aid.
- **Social and psychological support training.** A two to three day course that is 30% taught and 70% role play and simulated activities, aimed at government officials, social workers, teachers and business staff. It focuses on the needs and provision of health and sanitary equipment for women, children and older people in emergencies.
- **A course to produce a series of disaster prevention and reduction products collaborating** with local business development plans.

4. **Monitoring and evaluation. GDS will undertake continuous project monitoring.** It uses a participatory monitoring and evaluation model, whereby all stakeholders are involved in identifying the measurable indicators. At the end of the project, GDS will invite the relevant experts to undertake a systematic evaluation.

What we hope to learn and contribute

This project will contribute advanced DRR knowledge and capacity in two towns. It is hoped that bringing together government officials, social workers, NGO staff and other community members to share knowledge and practice on DRR will lead to better cooperation and more effective disaster management in the area.

The knowledge gained by GDS and other stakeholders will contribute to an understanding of DRR at local level. However, GDS is also keen to learn from the international experience.

World Vision: Establishing a disaster risk reduction community school project in Yaozhou District, Shaanxi Province

Patrick Zhang Jun

The need for action

Yaozhou is a district of Tongchuan City, in Shaanxi Province, central western China. The geographical elevation of the district is high in the north and low in the south. Central Yaozhou is hilly with a gully surrounded by mountains to the east, west and north, and flatland to the south. It is rich in mineral resources, mainly coal, limestone and natural gas, and is an important energy and building material base for the province. Coal resources are most abundant; in 2013 there was a total of 31 coal mines recorded in the district. Over the past few years the land has seen widespread mineral extraction and major road and railway construction. Forests have been cleared for farmland, destroying the original vegetation and damaging the slope structures, undermining their stability. Heavy rainfall and earthquakes present great risk to the area in terms of geological disasters such as landslides, mountain collapse or debris flows. There are 89 potential geological hazards in the district, including 59 landslides, 22 collapses and one ground fracture. Geological disaster in the region threatens people's lives and properties, and is impacting on the district's economic development.

In tectonic terms, Yaozhou is an uplifting belt at the margin of Ordos, which inclines south-east to Weibei, with gentle strata and simple structures. Its body is a monoclinic structure gently inclined to the north-west, with a wide and gentle slope and faults in between. This means that the district is unlikely to experience a large earthquake, but several smaller earthquakes have occurred in the region, making it a key area of seismic monitoring and prevention in Shaanxi Province. From 21 November 1958 to the end of 2000, there were more than 30 earthquakes in the area, with a maximum magnitude of 3.3. The area is also at risk of impact to peripheral earthquake seismic zones, due to its geographical location on the north side of the Weihe Basin.

Yaozhou district government is actively pressing ahead with rural construction, transferring villagers who live in remote mountains to open and flat terrain. This means that villagers can benefit from social services, such as medical care and schools, while also reducing potential risk from earthquakes through better evacuation.

The municipal party committee and the Tongchuan City government treat DRR seriously, paying particular attention to establishing emergency response mechanisms. At present, the seismological bureau in Tongchuan City is responsible for earthquake prevention and disaster reduction. It compiles documents, organises and implements earthquake prevention and disaster reduction activities, collects disaster monitoring and reporting data, and guides work in disaster area and post-disaster reconstruction. A civil secretary is assigned to each village and town, who, together with civil leaders, implements relief work assigned by other departments.

However, while the county and municipal governments demonstrate an increased commitment to DRR, there is still a lack of knowledge and preparation for disasters at town and village levels.

World Vision is an international rescue, development and public education organisation, with many years of practical experience in rescue and DRR. Between 1980 and 2014, it carried out disaster relief and reconstruction work in nearly 20 provinces in China. Since 2008 in particular, it has incorporated disaster prevention and reduction work into sustainable community development projects in several counties and districts in Shaanxi Province, to mitigate local disaster risk and vulnerability, and to strengthen community resilience.

Objectives and expected outcomes

The World Vision Community School Project aims to build the capacity of two towns in Yaozhou District to mitigate the risk of disaster. The project proposes an initial five-year period and will directly benefit more than 2,000 people, with the potential to indirectly benefit nearly 260,000 people in neighbouring communities within the district.

With a history of frequent earthquakes and vulnerability to landslides and other associated natural disasters, this project aims to complement government investment in seismic reporting to increase the resilience of towns and villages to natural disasters.

Project objectives

- To increase awareness of DRR among community members and partners; and to integrate global experiences of DRR and prevention with World Vision's experiences and practice, through cooperation with EwF and involving natural and social scientists in China.
- To raise awareness of and investment in DRR planning among stakeholders.
- To develop a comprehensive community emergency response plan, building the capacity of the community to mitigate the risks of disaster.
- To achieve community resilience by improving the security of the target community's environment.

Project outcomes

- Community members will have increased awareness of local DRR issues, including integrated natural and social science knowledge.
- The target community will have increased capacity to effectively respond to natural disasters.
- The target community will have the knowledge and skills to implement the Emergency Management System.
- The target community will have the necessary physical equipment and environment (including an evacuation square and relief equipment) to effectively mitigate disaster risk and respond to emergency situations.

Designing the initiative

The proposed demonstration project is a five-year programme with an estimated budget of $440,000. The project design process began in August 2014 and has built on World Vision's years of community development work, as well as a number of meetings and consultations with local and international stakeholders, including community residents, government officials, EwF and international NGOs working on DRR in Japan and Taiwan.

While DRR is incorporated into all its programmes, this is the first World Vision project to focus specifically on DRR. The protection of children and other vulnerable groups remains at its heart, although beneficiaries extend to the entire community.

Yaozhou District comprises 13 villages and towns. Each township has a number of villages, with a total approximate population of 260,000 people. The World Vision DRR demonstration project proposes to work in three villages in three different towns.

Community participation has played a significant role in the design phase so far. In 2014 and 2015, the World Vision team spent four weeks in the villages of Yaozhou District, holding community focus group meetings. Focus groups tended to include seven to eight people, and during the four-week period, up to 10 focus groups were conducted in each village. Residents volunteered to take part in the meetings, and were therefore generally those most interested in the programme. However, in some instances local government officials helped to identify influential community members to take part. World Vision strives at all times to ensure that the focus groups are representative and inclusive.

Delivering the initiative

The project's proposed activities are broken down into three main stages:

1. Initial assessment (year one)
2. Development and implementation of a community DRR plan (years two to four)
3. Evaluation (year five)

Stage one: information-sharing, engagement and initial assessment

The first stage brings together all the stakeholders. World Vision's local partners include the district level committee for disaster reduction, the district level bureau of civil affairs and the bureau of meteorology. World Vision will share the information gathered through the community focus groups while government officials will bring information concerning the local population and regional government DRR knowledge. Together they will conduct an initial assessment of the region and determine the project sites. During this stage, they will also identify and locate the required resources for stage two.

Stage two: the development and implementation of a community DDR plan

Stage two is the implementation phase. World Vision has nine staff members working to implement the five-year programme, with two staff dedicated to this project. World Vision will work closely with the local district government to implement the activities. In addition, World Vision volunteers from the community, largely high school and college students from the town, will be involved in activities. The plan proposes four major activity types:

1. **Emergency response planning.** The development of a village emergency response plan based on the local context. The plan will include the formation of an emergency response committee comprising both internal and external rescue teams. The committee will work with new and existing early-warning and communication systems.
2. **Shelters construction, materials and equipment.** The project will work with the community and the government to identify a suitable evacuation site, based on the geographical landscape, population and accessibility. The evacuation site is a large open space known as the 'evacuation square'. On the edge of the square are a number of buildings containing relief materials, supplies and equipment. In the case of a disaster, tents are constructed on the evacuation site to provide shelter. The project will work to build the shelters, and acquire the supplies and equipment. It will also involve getting generators, solar-powered lamps and signs that are visible in the dark to light up evacuation routes from around the village. Once constructed, the project will organise community social activities in the evacuation square so that community residents are familiar with the space and know how to get there.
3. **Community DRR knowledge promotion and preparation.** Raising awareness of DDR and what to do in an emergency is a major part of preventing loss of life in a disaster. World Vision will work with the local community and schools to produce flyers and training materials about using emergency relief supplies and equipment. It will also identify and train suitable individuals to carry out regular emergency drills. Relevant partners from the government will be invited to participate, to carry out DRR drills in the community and to help implementation. The aim is to incorporate the community (village-level) DRR plan and system (such as the construction of the evacuation square, preparation and management of emergency materials) into the government DRR system. Publicity, training and drills will increase awareness among people beyond the community. An application will be made for the community to become a DRR demonstration community. It is hoped this will prompt partners to pay more attention to DRR work, and possibly cause the project to be emulated elsewhere.
4. **Secure environment and awareness promotion.** The evacuation square and its surrounding environment will need to conform to the national government standards for a secure environment.

Stage three: project evaluation

Monitoring and evaluation will take place throughout the project lifecycle. The World Vision project will use relevant indicators from the Shaanxi Comprehensive Disaster Prevention Demonstration Community Project Guidelines, issued by the Seismological Bureau of Shaanxi Province, the National Commission for Disaster Reduction and the Bureau of Civil Affairs. These guidelines will be adjusted to reflect the actual situation of the local community in order to measure project progress and effectiveness.

World Vision evaluation tools, such as project reports, questionnaires and interviews, will be undertaken. Evaluation content includes: the effectiveness and sustainability of the project, and how far it can be generalised.

At regular intervals World Vision will check in with local partners and government officials to evaluate progress. Monitoring will feed information into the evaluation process, so that the project plan is regularly updated and adjusted according to need.

In year five, World Vision will carry out a complete project evaluation jointly with EwF and the National Commission for Disaster Reduction and Bureau of Civil Affairs.

Project sustainability

To ensure the sustainability of the project, World Vision will:

- Integrate the DRR project with existing World Vision community development work in Yaozhou District. DRR will be incorporated into the area development project frame, reinforcing sustainability within World Vision's community work.
- Undertake training with key professionals within the community to establish a local DRR team that will encourage the use of local resources and people to implement the project and sustain it after the end of the project life.
- Adopt national DRR building standards and implement them with local partners. Furthermore, the evaluation of the project will be incorporated into the national DRR community demonstration project evaluations.

What we hope to learn and contribute

DRR is a relatively new focus area for World Vision (and China) and there is still a long way to go. The organisation is constantly learning and developing its community DRR work. World Vision hopes to combine overseas experiences with domestic practice to advance community DRR work in Shaanxi Province.

It is hoped that by drawing on expertise and DRR knowledge from outside China, and combining it with local knowledge and experience, this project will meet the local needs and realities of the villages and towns.

If successful, World Vision will seek to replicate this project in other villages and towns. However, there are still many challenges facing this project. At the time of writing this is a project proposal. World Vision is seeking funds to implement the project and is still forming partnerships with the relevant government officials and agencies. EwF is supporting this partnership. Without the Chinese government's cooperation, this and other DRR projects are not possible.

ODI is the UK's leading independent think tank on international development and humanitarian issues.

ISSN: 2052-7209

All ODI Reports are available from www.odi.org

Cover photo: Photo by GDS, Children receiving the GDS disaster risk reduction kit, Shaanxi Province, China

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