Earthquakes without frontiers

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The city of Muzafarabad, Pakistan lays in ruins after the 2005 Kashmir earthquake that hit the region. Credit: Timothy Smith, U.S. Navy

The Alpine–Himalayan belt, which stretches from the Mediterranean to the Pacific, is one of the world's most seismically active regions. Now, a combination of earth science, social science and education is being used to help the region become more resilient to earthquakes, protecting lives and property.

The Ganges is India's most iconic river, flowing from the Himalaya to the Bay of Bengal, and its massive river basin is one of the most fertile

and densely populated regions in the world. The Ganges flows through 29 cities with a population over 100,000, 23 cities with a population between 50,000 and 100,000, and close to 50 towns.

But someday – perhaps tomorrow or perhaps in 100 years – a massive earthquake will hit the region, and the consequences could be catastrophic: as many as a million lives in the Ganges river basin could be at risk, primarily because buildings have not been constructed to be earthquake resilient, despite the fact that the relevant building codes are in place.

Of course, earthquakes don't respect borders, and India is not alone in being at risk due to poorly constructed buildings. Northern India lies in the Alpine–Himalayan earthquake belt, which stretches from the Mediterranean to the Pacific. It is the second-most seismically active region in the world, and responsible for around 20% of the world's largest earthquakes. The belt is being created by ongoing plate tectonics: as the African, Arabian and Indian plates continue to move northwards, they collide with the Eurasian plate.

The earthquake belt includes the most famous of the great trade routes, the Silk Road, which follows the edges of deserts and mountains, and high plateaus like Tibet. The landscape of the Silk Road has been shaped by earthquakes over millions of years: forcing mountains upwards and making life in the desert possible by controlling where water comes to the surface.

As the earthquake faults grind rocks together they make an impermeable clay, which often forces water to the surface along spring lines, determining where people live. To the casual observer, it seems as if the major earthquakes in this part of the world often seem to 'target' towns and cities but, in reality, people are often simply living where the water is, which is also where earthquakes happen.

Between 2 and 2.5 million people have died in earthquakes since 1900. Approximately two thirds of those deaths occurred in earthquakes in the continental interiors – places like northern India. Over that time, advances in the scientific understanding of earthquakes have been translated into impressive resilience in places where the hazard is well understood, which are mainly on the edges of the oceans. Comparable advances have not, however, taken place in most parts of the continental interiors, where the hazard is still much less well identified and poorly understood.

"Earthquake science has progressed so that we're now much better at recognising the signals in the landscape that tell us whether a particular place is dangerous," says Professor James Jackson, Head of Cambridge's Department of Earth Sciences. "We can't tell you exactly when an earthquake is going to happen, but we can say it will happen, not least because it's happened before. If it's happened before, it will happen again. What we can do, however, is to understand earthquakes better and use that knowledge to help make buildings safer."

Four years ago, with funding from the Natural Environment Research Council, Jackson and colleagues from other universities in the UK established Earthquakes Without Frontiers (EWF), an international partnership bringing together earthquake scientists from across the great earthquake belt, from China to Italy, in order to share expertise. "But it soon became clear that the project was about much more than earthquake science, and the real issue was how to translate science into effective policy, which requires an understanding of the social context in which people live," says Jackson.

With additional funding from the Economic and Social Research Council, EWF expanded to include social science and policy dimensions. The project, which runs until 2017, has three overarching objectives: to increase knowledge of earthquake hazards across the region; to establish

greater resiliency against these hazards; and to establish a well-networked interdisciplinary partnership to support local earthquake scientists. Within Asia, there are more than 50 national level stakeholders who are working with EWF on earthquake risk reduction.

Across much of the earthquake belt, people live in large cities, mostly in poorly built apartment blocks and buildings that have not been designed to withstand earthquakes. Large cities such as Tehran, Almaty and Bishkek have all been destroyed multiple times by earthquakes, and it's only a matter of time before the next one hits. The problem that EWF faces is convincing the public and policy makers of the importance of making towns and cities more earthquake resilient.

"In these big cities, everyday life is difficult enough: they're very congested, they have huge problems with traffic, air quality, water quality, food supply and poverty," explains Jackson. "And quite understandably, the risk of an earthquake seems quite remote compared to daily worries. But that doesn't make the threat go away."

"We face two main problems: the first is that there is a lack of awareness of the fact that seismologists cannot predict earthquakes – it's just not something we are able to do or will be able to do," says Dr Supriyo Mitra of the Indian Institute of Science Education and Research Kolkata. Mitra obtained his PhD at Cambridge, and is now one of the key Indian academic collaborators on the project, primarily working in Indian-administered Kashmir. "The other problem is that there is a lot of resistance to making buildings safe. It is an additional cost, but it's a necessity and we need to get that across to people."

Perhaps the most important change that can be made to increase earthquake resilience in these areas is the enforcement of building codes. The building codes in Los Angeles and Tehran are similar, but the difference is that in Los Angeles, most buildings are constructed

according to those codes, while in Tehran most are not, so as a result, Los Angeles is highly resilient to earthquakes, while Tehran remains very vulnerable.

"Enforcement comes not just from legal enforcement, but education," adds Jackson. "People are really starting to realise that this is important. And once you educate the public, it rises up the agenda because the public insists that it does.

"There are going to be around a billion new homes built across Asia over the next 10 years – let's build them so they are safe."

Provided by University of Cambridge