WAITING FOR THE BIG ONE

Seismicity in the Himalaya

Seismicity is still an inexact science in the Himalaya. This leads to concerns over disaster preparedness as well as proposals for construction of high dams in these moving mountains.

By Suman Pradhan

She is 90 years old now, frail and wrinkled with age. Her memory has been fading despite the neuro vitamins the doctor has prescribed. But even today Asha Devi, a resident of Barasuani village near the border town of Birgunj, clearly remembers the terror of 1934.

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Picking up the pieces - after the 1988 quake, Dharan, eastern Nepal.

That was the year when the "Big One" struck Nepal. The earthquake, burned into the collective memory of Nepalis, destroyed a large part of central Nepal and the bordering Indian state of Bihar. "The house shook," recalls Asha Devi straining to remember that distant day. "There were no deaths in my village. But we heard that Kathmandu had been totally destroyed. The ground shook so violently that people were knocked off their feet."

Recent re-interpretation of that data by seismologists show that the "Bihar-Nepal Earthquake", as the 1934 quake is technically known, measured 8.4 on the Richter scale and that its epicentre was located near Bhojpur in Nepal's eastern hills.

Houses and structures tumbled like nine pins. Thousands died both in Nepal and northern India and countless numbers were left wounded and homeless. But 64 years after that seminal event, the dangers posed by earthquakes seem to have been forgotten by planners, politicians and the public.

Those who have made it their career to study and analyse tectonic plate shifts, however, have pored through every detail of the '34 quake, and even earlier ones. Their conclusions: the Himalaya are prone to such killer earthquakes and there are sure to be regular repeats of earthquakes as strong as the 1934 event.

"Studies show that in the 19th century alone there were four major earthquakes in the Himalaya comparable in magnitude to the '34 quake," says Amod Dixit, a geologist and General

Kathmandu Valley from the air.

PANOS/Kunda Dixit

PANOS/Arthur Pazo

From ground level: Kathmandu's quake trap.

Secretary of National Society for Earthquake Technology – Nepal (NSET). "So far this century, only one has been recorded. But one never knows when the next big one will hit."

Experts are particularly worried that if a big one were to strike now or in the near future, the damage would be many times more than that caused by the 1934 earthquake. "There's been a population boom in the intervening years," says Mahesh Nakarmi, an engineer of Kathmandu Valley Earthquake Risk Management Project (KVERMP).

Experts note that as the population has increased over the years, so have the risks. "Haphazard urbanisation of cities and towns has led to the sprouting of dense and unsafe concrete jungles which would come crashing down in a 7 to 8 magnitude quake," says Nakarmi.

Kathmandu valley's population today has grown to 1.2 million from 300,000 in 1934 when the quake killed 1.5 percent of the population. Even if only that same ratio holds true, in a future quake the casualty figure could be a staggering 18,000 people although experts expect the figure to be much higher given the current population density and nature of housing. Hospital and emergency services will be unable to cope with the scale of the disaster.

As Kathmandu marked the anniversary of the quake in 1998, there were attempts here to dismiss the doomsday scenario as "alarmist" by

Bhaktapur, 1988.

HIMAL/Gopal Chitrakar

some critics. But experts say they are only trying to raise awareness about impending disasters so that efforts can be made to mitigate the damage and to have contingency plans for relief and rescue. In any case, alarmist or not, the projections are backed up by science.

Geologists have known for long that the high Himalaya was formed 60-70 million years ago when the Indian subcontinental plate separated from the ancient continent of Gondwanaland, drifted northwards and collided with Asia. The "subducting" of the hard rock layers of the Indian plate into the relatively softer sedimentary formations of the Tibetan plateau is still continuing at the rate of 2-4 centimetres annually.

The result is, new fault lines are being created beneath the Himalaya while the old faults like the ones that triggered the 1934 earthquake are still active.

Earthquakes happen when movement occurs along the subduction plane. In simple terms, tension builds up along the fault line as tectonic plates slide past each other and there is sudden release of energy as the two layers snap. Quakes also lead to secondary phenomena, such as landslides, glacial lake outbursts and river damming that can inflict additional damage.

"Because the tectonic plates are still scraping past each other beneath the Himalaya, earthquakes are a frequent phenomena in this part of the world," says Dixit of NSET-Nepal. "But we have to remember that earthquakes don't kill people. It's falling houses that do."

Unsafe structures

"Practically, none of the buildings in Kathmandu and across Nepal, except for the recently constructed International Convention Centre, are designed to minimise earthquake risks," says Professor Li Tianchi, a geologist and academic at the Kathmandu-based International Centre for Integrated Mountain Development (ICIMOD).

Dixit points to the Udaypur, Nepal, earthquake of 1988 as a reminder of the dangers. The quake measured a relatively low 6.6 on the Richter scale but destroyed thousands of houses from Dharan in the foothills to Bhaktapur up in the Kathmandu valley. The final casualty figure was nearly 700 killed and more than 2000 wounded.

The dangers are known, the risks can be assessed. So is anyone doing something to minimise the risks of damage when the next big quake eventually rattles the Himalaya? Experts shake their heads in frustration.

Professor Tianchi says that to minimise risks, authorities must first prepare earthquake hazard zonation maps for quake sensitivity. "This way, we can identify which areas are more sensitive and take measures accordingly. But so far in Nepal, Bhutan, India and Pakistan – nations south of the Himalaya – no such maps exist."

Despite the absence of maps, some countries in the region have introduced building codes to strengthen structures with an eye on future earthquakes. But in India, though stringent building codes have been in existence for several years, following the prescriptions is not mandatory. They are taken more as good construction practice.

In Nepal and Bhutan the situation is dismal. Bhutan does not have a building code. And in Nepal, the codes prescribed by the local councils such as municipalities are so inadequate that seismologists regard them as a joke. Calls to modernise Nepali building regulations by including earthquake resistant measures led to the first complete drafting of a new set of codes. It was introduced in parliament and passed in 1999 as the Building Council Act. But the government has

yet to constitute the Building Council empowered to enforce the Act.

Says Nakarmi: "We have to stop construction of dangerous buildings which are still being built. It is absolutely necessary to set up the Building Council as soon as possible and sincerely enforce the Act."

Adapted from The Kathmandu Post, October 13, 1998,

HIGH DAMS, HIGH RISKS

Compared to 1934 when Great Earthquake struck north India and Nepal, there are more people living in larger, taller buildings in bigger and more crowded cities. More massive projects are being taken up, many in seismically active regions. The most serious debates revolve around seismicity and high dams in the Himalaya.

Many specialists have been trained for technological solutions based on case studies that greatly underestimate the Himalayan dimensions of cloudbursts, glacial lake outburst floods, and earthquakes in this part of the world. Rainfall volume, sedimentation levels, and the size and frequency of earthquakes in the Himalaya far outstrip parameters laid out in engineering textbooks prepared for comparatively docile climes. One of the great uncertainties about building high dams in the Himalaya for hydropower, irrigation and flood control is the threat they pose to downstream areas in the event of a major earthquake.

Rock strata bent by enormous forces beneath the Himalaya trigger thousands of small tremors every year.

HIMAL

Kulekhani reservoir. How safe in an earthquake?

But every once in a while there is a major crack as the pressures are too much for the elasticity of the rocks, and the strata snap. When that happens, there is a Richter 8+ magnitude earthquake. Geologists now agree that there occurs a high intensity earthquake once every 100 years along any section of the Himalayan chain.

The stretch between Dehra Dun in India and Kathmandu in Nepal is one area where a magnitude 8 earthquake has not occurred now for at least a century. This 'seismic gap' makes a major earthquake in the central Himalaya inevitable in the near future. The Big One is long overdue. "Such an earthquake can have a ground acceleration of more than 1 g. What this means is that if the ground is moving downwards, anything that is lying loose on the surface – a boulder for instance or a high dam and the massive volume of water behind it – will be left up in the air," wrote water experts Dipak Gyawali and Michael Thompson in a recent paper.

The catastrophic impact downstream of the failure of a high dam like Tehri or the proposed Pancheswar with 20 cubic kilometres of impounded water is unthinkable. But there are failures of natural dams caused by landslide blockage of rivers in the past that give us an indication of the scale of such a disaster. In 1893, a rockslide on a river in the Garhwal Himalaya burst, causing a huge flashflood and a great loss of life in the plains. In 1970, debris on the Alaknanda River created a 60-metre high dam on this tributary of the Ganga. When this burst, it caused a flashflood that thundered down all the way to the plains of Uttar Pradesh, destroying settlements, bridges and highways.

Some scientists believe that as long as the dangers are known, there are engineering measures that can be taken to make the catastrophic failure of a high dam less likely. But the question is how much is it going to cost and if the risk, however minimal, is acceptable. Thirty years after they happened, reports are just filtering out now of dam bursts in south-central China that killed tens of thousands of people.

The Great Bihar-Nepal Earthquake of 1934 registered 8.4 on the Richter scale and virtually destroyed Kathmandu, killing about 4,000 people – about one in every ten inhabitants. Kathmandu's population was a lot less then, and there were fewer lethally unstable concrete structures. If an earthquake of similar intensity were to occur today, the National Society for Earthquake Technology – Nepal estimates that as many as 40,000 people could be killed in Kathmandu valley alone. A single high dam failure would multiply that tragedy many fold.

But dam failures are like nuclear war; you don't want to think about them. Designing earthquake-proof storage dams is a question of how much risk countries are prepared to take for their own people and for people living downstream.

Adapted from Himal, Kathmandu, January 1, 1999.