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Habitat and Hazards in the Himalayas of Nepal

The mountains present more hazards than the plains because of their verticality and fragility. Taking examples from Nepal, this paper establishes that current, increasing interventions have augmented the magnitude of damage incurred in the mountains. Hence the need to take environmental impacts into account when planning infrastructure in mountain areas. This would imply a knowledge of the structure of the terrain on the part of the builder.

The Context

Nepal lies in a tectonic zone where the mountain-building process still continues. As a result, the area is subject to landslides, avalanches, glacial lake outburst floods, flooding, and a host of indirect or 'creeping' hazards. Thus the mountain environment, although often referred to as 'fragile', is actually quite dynamic and 'volatile'.

Modern communications have enabled the compilation of improved public records of hazard events, but the introduction of modern infrastructural facilities that are built without taking into consideration potential hazards has meant that the probability of extensive damage has increased. This is not a development paradigm but rather a development paradox.

Development interventions in Nepal started in the mid-fifties only and awareness of deterioration in natural mountain habitats increased from that time. The spread of modern medicine and increasing development interventions were not accompanied by concomitant advances in planning in Nepal. This meant that awareness of the desirability of limiting families to within sustainable limits did not become part of the received wisdom in a general sense. The increases in population that occurred along with development interventions soon meant that agriculture was extended on to marginal lands; lands that were not capable of providing yields that were commensurate with the labour and investment expended on them. The result was, as we see today, poverty, increasing outmigration of families from the hills and mountains on a permanent basis, and increasing temporary outmigration of men (and now all too often women) to seek casual labour in an effort to supplement the meagre incomes from the rapidly deteriorating farmlands.

Although historical records leave behind some impressions of the impacts of the bigger disasters, there are scores of smaller events that remain unrecorded or, at very best, within the folk memory of a village or region.

At the same time, interventionist policies dictated investments in mountain roads and other types of infrastructure, but without the accompanying concern about environmentally-friendly construction. The more localised disasters increased because little allowance was made in engineering techniques for how hazard-prone an area might be.

Thus, we have the two interfaces of habitat and hazard - the hazards inherent in the natural environment and the hazards augmented by the public infrastructure built without making allowances for possible hazards. At the same time, ever present are the dwellings and structures that have been built locally and which themselves are prone to hazard. Poorly-constructed dwellings can, at a time of natural disaster, substantially increase the number of lives lost. However, there is no doubt that the people of the Himalayas have lived with such disasters in the past and have coped. They devised indigenous responses to the crises produced by their awesome (and sometimes cruel) environment. What they are called upon to deal with now is a rapid, modern intervention in infrastructural construction; an intervention that has increased the magnitude of the crises with which their traditional responses can no longer cope.

A cursory comparative assessment of the three major earthquakes in Nepal between 1934 and 1988, and glacial lake outburst floods, between 1935 and 1985, shows a decrease in

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Comments are Welcome

Earthquakes

1934 earthquake (Jan 15th)-8.4 on the Richter scale
- 8,515 deaths (4,296 in Kathmandu)
- 80,890 houses completely destroyed
- 20,7248 buildings badly damaged

1988 earthquake (Aug. 21st) -6.6 on the Richter scale (eastern Nepal)
- 717 deaths
- 23,000 homes completely destroyed
- 65,00 homes severely damaged

1980 earthquake (July 29) - 6.5 on the Richter scale
- 178 deaths
- 40,000 houses destroyed

This earthquake was restricted to a 40,000sq.km. area which included Bajhang, Bajura, Darchula, and Baitadi (districts in far west Nepal).

Glacial Lake Outburst Floods

Nine major glacial lake outburst floods took place between 1935 and 1985, of these 3 were on the Bhote Koshi*, a tributary of the Sun Koshi (1935,1964, &1981); 2 on the Arun River* (1964 and 1982); 1 on the Trisuli River* (1964); 1 on the south slope of Ama Dablam (1977); 1 on the Barun Khola (1981); and the Bhote Koshi/Dudh Koshi/Namche GLOF (1985). Of these, the most complete records are for the latter. In that, 5 persons died, 30 houses were destroyed, and the Namche Hydel project was destroyed . The cost of the damage to the latter was Rs 40 million (US$800,000).

* These originated in Tibet, China
Source: Ives 1986 and Deoja 1994

loss of human lives and in damage to domestic habitats (Box 1). However, no direct comparison can be made of separate events without taking into consideration the various associated factors. On the other hand, the cost of damage to public infrastructure from floods and landslides (Box 2) also incurs enormous fiscal and psychological setbacks to a developing country like Nepal.

However, should an earthquake the size of the 1934 earthquake take place today, and experts believe that a much bigger one could be in the offing (Bilham *et al.* 1995), the additional infrastructure would mean much greater losses in life and property.

The proneness of the Himalayas to hazards is awesome. The risk the Nepalese mountain farmer takes when she or he plants crops on carefully tended terraces at breath-taking heights and on painfully steep gradients can be in no way assessed in comparison to the risk an average European might take in crossing a busy road. In the latter we are dealing with risks to the individual and in the former to whole communities. In this environment, even rainfall is a risk (Chalise *et al.* 1995).

However, it is landslides that the people of Nepal are most familiar with, every monsoon triggers more and more, especially in areas recently excavated to add more infrastructure (Upreti 1995). So what can be done to make the human habitat safer?

Hazard mitigation involves both public infrastructure and private property. Concern for the risks that the establishment of public infrastructure posed to mountain communities led to ICIMOD introducing a mountain risk engineering programme to train engineers mainly in engineering geology. The philosophy behind this being that additional impacts caused by construction are bound to accelerate natural destabilisation and that, therefore, infrastructural development cannot be the domain of a single discipline. A programme on Mountain Risk Engineering commenced in 1988. In 1991 a handbook was published (Deoja *et al.* 1991) which is in actual fact a comprehensive text on many of the issues related to building roads.

ICIMOD's Mountain Risk Engineering project is in its third phase. Important as public infrastructure and methods of building might be, ICIMOD realises that hazards in the mountains are a natural process that cannot be changed, mitigation is the most that can be hoped for. In this respect, the Centre, under the Landslide Hazard Management and Control Project, has been documenting work on mountain risks and hazards, and particularly in their mapping, management, and control in China (Li Tianchi 1996), India (Thakur 1996), Nepal (Upreti and Dhital 1996), and Pakistan (Malik and Farooq 1996).

On the part of the Government of Nepal, there has been a realisation for some time now of the hazards that some indigenous dwelling structures and poor building materials pose to the inhabitants; particularly when this hazard is compounded with the natural hazards described above. Extensive surveys of building materials, foundations, walls, floors, roof types, and openings in some hazard-prone areas have taken place (UNDP/UNHCS 1994) in preliminary attempts to design buildings that can better withstand mountain seismic hazards. Vulnerability of rural buildings was examined in order to identify weak points inherent in construction practices and materials. The strategy in mind is to formulate policies and plans for upgrading existing

Landslides and Flood Damage

(N.B. 10-25% of hill roads following river valleys are completely washed out every four to five years through a combination of floods and landslides.)

- 1979: The Bijayapur Khola (30m) and Karra Khola (60m) bridges (cost Rs 8 million)
- 1981: 27km of the 114km Arniko Highway was damaged (cost Rs 62 million)
- 1983/84: Dharan-Dhankuta Road damage (500m) (cost Rs 23 million/km)
- 1987: 350km of road damaged, 41 bridges damaged of which 15km of road and 3 bridges were completely destroyed; the worst portion was the Charnawati landslide damage to the bridge and road(Rs 190million) (cost between Rs 520 to 730 million in total)
- 1991: Seti Bridge collapse - Pokhara
- 1993: damage to the Prithvi Highway, Tribhuvan Highway, E-W highway, Phidin-Taplejung Highway, Bardibas-Sinduli road, Dhalkebar-Birtamod road. Floods were devastating, along the Tribhuvan highway 2,000 landslides occurred (over 200 of them major) and the road was washed out in 20 places. Traffic was stalled between Kathmandu and the *Terai* for 28 days.

Road rehabilitation costs from 1979 to 1993 were Rs 2,250 million or $U.S. 50 million.

The 1993 floods and landslides alone caused the following damage.

- 1,612 people lost their lives
- 85,00 families affected through loss of or severe damage to their homes
- extensive areas of cultivated land were damaged and crops destroyed
- damage to the Bagmati barrage (Rs 50 million)
- damage to the Kulekhani* hydro project (Rs 200 million)
- destruction of bridges at Malekhu, Belkhu, Agra Khola, and Bhainse

* This project had been damaged before by landslides in 1984. Even considering the fluctuation in dollar exchange rates over the years documented here (from approximately 45 to 55 rupees per U.S. Dollar), the cost in terms of human lives and destruction to both public and private property is enormous.

Sources: Deoja 1994, Dhital *et al.* 1993, and Upreti and Dhital 1996.

dwellings and other buildings; to carry all this out, economic growth is, of course, a *sine qua non*. Needless to say, some indigenous buildings have their strong points, otherwise the population would not have continued to build the same type of dwelling in the same locations, generation after generation; hazards to person and property have certainly not decreased over the centuries.

Traditional buildings are vernacular mostly (non-engineered) and are often built with mud and timber and quite often, in the villages, with wattle and daub. Since damage data on buildings in Nepal in the past were never specific, it is difficult to project a damage ratio for them (UNDP/UNHCR 1994). As with the mountain risks and hazards themselves, damage ratios of Nepali buildings in the near future can only be modified within the limitations of the structures themselves. The possibility of damage is not going to go away, at least not in the short term.

Despite awareness about the importance of safe habitat in hazard-prone areas, people in the mountains continue to build and rebuild in the same areas for generation after generation. Never was this more acutely brought home than in November 1995. Several days of continuous rainfall triggered life-threatening hazards in several areas of Nepal.

One such spot is Bagarchhap in the Manang district of Nepal, an important transit point to trekking spots like Annapurna and Muktinath. It rained from the 9th to the 11th of November and then a debris flow occurred on November the 10th upstream from Bagarchhap bazaar. At 18.30 on the 10th the banks of the stream also burst bringing down a tremendous amount of debris flow. There was a sound like thunder and large boulders of gneiss and schist came down, destroying 14 houses. Again, on the 11th of November, at half-past twelve, the thunder was heard again and more debris came down, moving left from the head of the village. Of 70 foreign trekkers staying there that night, 9 were killed, 11 Nepalese also lost their lives; 6 of them were porters and cooks attached to the trekking parties. Of the 14 buildings destroyed, seven were lodges and two shops. But the fact is, in 1968, a similar debris flow took place in the same area and the whole village was destroyed; after some months the people returned and settled on the debris fan (WIDPTC 1995).

The Nepalese say that the extraordinary beauty of the Himalayas was created by the gods to make their inhabitants forget the excruciating hardship and ever present danger of survival

The capacity of human beings to forget, or set aside, the negative is quite frightening; it is particularly frightening when one considers the astounding mountain folds of the Himalayas, their young rocks, and unstable terrain.

on the highest mountains on earth. In light of what we know about the recurring danger of serious hazards in this habitat, they are obviously right.

With this in mind perhaps, the government has been busy over the last decade preparing a National Action Plan along with activities connected with the United Nations International Decade for Natural Disaster Reduction (HMG 1995). The plan has both a 'Disaster Preparedness Action Plan Matrix and a Disaster Response Action Plan Matrix'. The only problem with these is that action on the former was scheduled to begin in 1996 with institutional arrangements and formalisation of organisations and structures and action on the latter in 1997 only (HMG 1995). Sad to say, these activities, coming as they do, in the latter third of the Disaster Decade, were not in time for the devastating floods of 1993 or for the Bagarchhap Landslide in late 1995. Nevertheless, the response to crises in this Himalayan land has always been remarkable, given the resources at its disposal.

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