TITLE:

Geo-Disaster and Its Mitigation in Nepal

AUTHOR(S):

Dahal, Ranjan-Kumar; Bhandary, Netra-Prakash

CITATION:

Dahal, Ranjan-Kumar ...[et al]. Geo-Disaster and Its Mitigation in Nepal. Matsue Conference Proceedings (The Tenth International Symposium on Mitigation of Geo-disasters in Asia 2012: 27-32: 共同研究（一般研究集会）24K-02.

ISSUE DATE:

2012-10-08

URL:

<http://hdl.handle.net/2433/180421>

RIGHT:

www.ranjan.net.np

Geo-Disaster and Its Mitigation in Nepal

Ranjan Kumar Dahal, PhD
with
Netra Prakash Bhandary, PhD

Visiting Associate Professor
Ehime University Center for Disaster Management
Informatics Research,
Faculty of Engineering, Ehime University, JAPAN

Asst Professor, Department of Geology, Tribhuvan University,
Tri-Chandra Campus, Kathmandu, Nepal

Fellow Academician, Nepal Academy of Science and Technology

1

Presentation structure

- Brief overview of Geology and Climate of Nepal
- **Rainfall as triggering agent**
- Stability analysis
- Rainfall threshold of Landslide for the Nepal Himalaya
- Landslide hazard mapping in Nepal
- **Mitigation measures**
- **Conclusions**

Photo: BN Upreti

2

The Nepal Himalaya

- The longest division of the Himalaya
- Extended about 800 Km
- Starts from west at the Mahakali River
- Ends at the east by the Tista River (India)

Punjab Himalaya
Kumaon Himalaya
Nepal Himalaya
NEFA Himalaya
China
India
Nepal Himalaya

6

<p>1. Labor intensive method Applied for construction of early roads in Nepal Labor groups employed as labor contract, no work contracts No heavy equipment used except work tools Mostly full cut roads, Structures and embankments minimized Side casting of surplus material permitted, Blasting for rock breaking</p>	<p>Road Construction Practice in Nepal</p>
<p>2. Conventional Mechanized Road Construction Practice Applied in highways, feeder roads and urban roads Earthwork equipment used for cut, slope trimming and embankment construction Mechanized compaction of backfill and embankments Laborers used for minor works – drainage, slope finishing Blasting for rock breaking permitted</p>	
<p>3. Labor-Based Road Construction Method Mostly used for district roads and feeder roads Only light equipment used, no heavy equipment used Maximum use of local laborers for works Limited blasting permitted for rock breaking</p>	
<p>4. Low-cost Environment-friendly or Green Road Method Stage construction of road (1 m, 2 m, 3 m and 4m) in combination with bioengineering Only local laborers used through community based organizations Balanced cut and fill principle – no haulage of surplus material Bioengineering measures as an integral part in each stage Natural compaction principle – no artificial compaction Only local material used except some gabion wires Use of cement discouraged Blasting for rock breaking not permitted Road formation out cambered for sheet flow – no side drains Equipment may be used only for graveling and pavement Prevailing method for rural and agricultural roads Also applicable for construction of highways and feeder roads Method is inherently poverty focused and uses poorest people</p>	

(Modified after Adhikari 2004)

Very dynamic setting and construction practice of donor agency – JICA

2. Conventional Mechanized Road Construction Practice
We even capture course of River, Dhulikhel-Nepalthok Road

Very dynamic slope and construction practice of donor agency – JICA

Basic rules of engineering even suggest that the site is suitable for Tunneling, But...

日本道の観所は、非公式です

3. Labor-Based Road Construction Method

Road Construction Practice, Sanfe-Martadi Feeder Road (1998)

4. Low-cost Environment-friendly or Green Road Method

Butchering of Himalayan Slopes – An example of cruelty on Himalayan environment in the name of “Lost Cost”

Failure at contact between rock and soil

Ruptured artery

The Department of Roads is racing against the monsoon to finish grading the heavily damaged Mugling-Narayanghar highway before heavy rains arrive next month.

A landslide over central Nepal unleashed 50 hours of rain in a 24-hour period last July, triggering more than 70 major landslides along the 140-km mountain highway. Although it was a natural disaster, the government's response in rebuilding the important artery used by some 5,000 vehicles a day has been slow. Scarcely a road in that budget initially allocated last September for repairs were diverted to a road in the incident for the repair work done. But faced with the threat of Kathmandu being cut off in this monsoon, an additional Rs 35 million has been sanctioned and repair work has resumed on a war footing.

The highway was finished in 1978 with Chinese aid and passed through one of the most geologically unstable areas of the Himalayas characterized by steep mountainsides and heavy precipitation. "The public doesn't understand this, and blame us for everything," laments Director General Madan Gopal Mahboob of the Department of Roads. "This would have been a major disaster in any country, and would take months to rebuild even with an unlimited budget and the most modern equipment."

A 1.5-km retaining wall in the worst-affected area at the Jethi point is already under construction and should be finished in a month. Although rains were mainly to blame, there are also man-made factors like deformation along the highway caused by the too deep and bumpy roadbed constructed by the roadbed. Mining sand and gravel along the river has also increased the speed of the water during monsoons.

"You can have the best highway in the world, but it won't stand a chance with rains like last year, even without taking the man-made factors into account," says Babu Shrestha, the senior technical engineer in charge of the Mugling highway repairs. Asked what are the chances of the highway remaining open during the monsoon, Shrestha is optimistic that if there are no major disruptive landslides, blockades and heavy pre-monsoon showers, the work should be finished before the main rains arrive. (Pragati Shrestha)

Frequently we read in the News Paper about the blockade of the road

Problems in Road

A National highway after debris flow

Butwal-Tansen Road, near Siddhababa

The photograph shows the site of civil structures of Namche (Thame) Small Hydel Project, which were completely destroyed by the GLOF (photograph taken on 4 August 1985, WECS 1987)

Glacial lake outburst flood (GLOF) and Damage

Glacial lake and burst

Destruction along the path of a Glacial lake Outburst Flood in Nepal

Destruction along the path of a Diksho Glacial lake Outburst Flood in Nepal

1255-Flash flood in Seti River, Pokhara – May 5, 2012

Earthquakes in Nepal

a. Magnitude-Frequency Data on Earthquakes in Nepal and the Surrounding Region in the period of 1911-1991 (modified after BCDP, 1994)

Earthquakes of Magnitudes in Richter Scale	5 to 6	6 to 7	7 to 7.5	7.5 to 8	>8
No. of Events	41	17	10	2	1
Approximate Recurrence Interval, yr.	2	5	8	40	81

b. Past earthquakes and damage records

Year	Epicenter	Magnitude	Deaths	Houses Destroyed
1934	East Nepal	8.1 (M _w)	8,519 people died out of which 4,296 died in Kathmandu Valley alone	Over 200,000 buildings and temples etc. damaged, about 55,000 buildings affected in Kathmandu Valley (12,397 completely destroyed).
1936	Annapurna	7.0 (M _i)	Record not available	Record not available
1954	Kaski	6.4 (M _i)	Record not available	Record not available
1965	Taplejung	6.1 (M _i)	Record not available	Record not available
1966	Bajhang	6.0 (M _i)	24	6,544 houses damaged (1,300 collapsed)
1980	Chainpur	6.5 (M _i)	103	25,086 buildings damaged (12,817 completely destroyed)
1988	Udayapur	6.5 (M _i)	721	66,382 buildings damaged
2011	Sikkim/ Nepal border	6.9 (M _i)	6 died and 30 injury (2 died in Kathmandu valley alone)	14,544 house damaged (6,435 completely destroyed)

M_i - Richter Magnitude, M_w - Moment Magnitude

Mitigation and Management practice

117

People's perceptions towards debris flow risk...

Same either developed or under-developed countries

117

Hazard and susceptibility mapping practice for landslides and flood hazard mitigation

The predictive modeling approach for landslide hazard study

White box model vs Black box model

- Heuristic qualitative approach: ✓
- Statistical quantitative approach: **Black box model** ✓
 - Data driven multivariate statistical analysis and
 - Experience driven bivariate statistical analysis.
- Deterministic approach: **hazard analysis in true sense, highly white box model**

120

Management of landslide hazard zones

Community participation

- Till date no definite initiation from government, only few works
- The hazard maps should be brought into the knowledge of local people in order to aware and motivate them in proper land use and disaster management practices.

121

Landslide hazard map prepared in Nepali language to use in community level

The three colours presented in maps could energize people's feeling towards Siwaliks degradation and aware them to manage.

122

Landslide hazard map of Basbari-Badegau VDC

9'X 6' poster in each ward
in front of school buildings

123

Flood hazard map- Koshi River

Fig. 18: Flood hazard map of the Sapta Koshi alluvial fan.

Flood hazard map- Bagmati River

Engineering approach of geo-disaster mitigation

Low cost technology in roadside slope protection

Concluding remarks

- Highly dynamic physical processes dominate the mountainous terrain of Nepal, and therefore, mitigating geo-disaster is a challenge.
- **Monsoon rainfall is the main trigger of landslides and floods in Nepal**
- Construction, maintenance and rehabilitation of infrastructure under the unique Himalayan condition require innovative and more pragmatic approach compared to less critical terrains in other parts of the world.
- **Land management code should be implemented in coordination with landslide and flood hazard zonation map of the area**
- “Low cost” infrastructure is not always right for low income countries like Nepal

Concluding remarks contd.

- Over the years, Nepal has gained both good and bad experiences in geo-disaster mitigation:
 - in design and survey of geo-disaster mitigation programs,
 - in the fields of hazard and risk assessment,
 - in low cost rural road engineering – how much bad and how much good
 - in community based river training work, and
 - in slope maintenance incorporating indigenous techniques.
- The governmental agencies involved in geo-disaster management must change their status from implementer to facilitator.
- Government should enhance institutional capacity building at local level to enable local bodies to undertake the immense responsibility of geo-disaster mitigation.
- Positive people perception for geo-disaster mitigation and community participations in mitigation program are very important for geo-disaster management in Nepal

Temple city Kathmandu

Mt. Everest

Amazing Jomsom

Beautiful Pokhara

Welcome to Nepal

Thank you very much for your kind attention !!