XII

EDUCATION MATERIALS

1. Participants List

2. Photos

3. Texts for Leaders

Workshop of Disaster Education on the Disaster Risk Management
for
Kabilash Village

Date: **27 August 2008, 9:30 AM to 17:00 PM**

Place: **Meeting Hall of Kabilash Village**

S. No.	Name	Address	Designation
1	Mr. Jagat Malla	Kabilash 9	Teacher
2	Mr. Kul Bahadur Gurung	Kabilsah 6	Teacher
3	Mr. Bishnu Dhakal	Kabilash 3	Teacher
4	Ms. Radhika Bhattarai	Kabilash 4	Teacher
5	Mr. Katak Bahadur Gurung	Kabilash 5	Teacher
6	Mr. Bishnu Prasad Paudel	Kabilash 2	Teacher
7	Ms. Rupa Pande	Kabilash 7	Teacher
8	Mr. Eta Raj Gurung	Kabilash 2	Teacher
9	Mr. Chij Kumar Shrestha	Kabilash 5	Teacher
10	Mr. Bhowabh Bahadur Gurung	Kabilash 1	Teacher
11	Mr. Dipak Raj Sapkota	Kabilash 9	Teacher
12	Ms. Bimala Gurung	Lamagau	Teacher
13	Mr. Taranath Timilsina	Phewatar	Teacher
14	Mr. Nar Bahadur Lama	Kabilash, Kholaghari	Committee Treasure
15	Mr. Lilaman Tamang	Kabilash 9, Kusumtar	
16	Mr. Gunaraj Tamang	Kabilash 9, Kusumtar	
17	Mr. Gore Gurung	Kabilsah 7	
18	Mr. Posh Bahadur Gurung	Kabilsah 1	
19	Mr. Ganesh Prasad Lamichchane	Kabilsah 1	
20	Mr. Ganesh Gurung	Kabilash 3	
21	Mr. Dan Bahadur Gurung	Kabilash 5	
22	Mr. Hira Bahadur Gurung	Kabilash 4	
23	Mr. Tej Bahadur Alemagar	Kabilash 2	
24	Mr. Shree Prasad Gurung	Kabilash 1	
25	Mr. Krishna BK	Kabilash 2	
26	Mr. Pradhubna Kumar Khadka	Kabilash VDC	Secretary
27	Mr. Ajaya Paudel	Kabilash VDC	Assistant
28	Ms. Saraswati Adhikari	Kabilash 1	V. F. Kabilash VDC
29	Dr. Ramesh Tuladhar	DWIDP	Disaster Management
30	Mr. Shanmukesh Amatya	DWIDP	S.D. Hydrologist

31	Mr. Rajendra Sharma	DWIDP	Hydrologist
32	Mr. H. Kato	DWIDP	JICA Expert
33	Mr. Roshan Shakya	DWIDP	JICA Interperator
34	Mr. Nutan Dev Pokharel	RRN, Chitwan	Project Engineer
35	Mr. Tanka Upreti	RRN, Chitwan	District Coordinator
36	Mr. Anjit Gurung	RRN, Chitwan	Engineer
37	Mr. Jeevan Bd. Singh	RRN, Chitwan	Sub-Engineer
38	Mr. Shaligram Ghimire	RRN, Chitwan	S.A.
39	Ms. Bidhya Pokharel	RRN, Chitwan	G&SI Officer
40	Mr. Gyandhira Shrestha	RRN, Chitwan	Facilator
41	Mr. M. Eto	JICA Study Team	Team Leader
42	Mr. H. Ohno	JICA Study Team	Team Member
43	Mr. Sujan Raj Adhikari	JICA Study Team	Geologist
44	Mr. Amar Shah	JICA Study Team	Staff
45	Mr. Roshan Shrestha	Preesu Elect.	Engineer

Workshop of Disaster Education on the Disaster Risk Management
for
Kabilash Village

Date: **28 August 2008, 9:30 AM to 17:00 PM**
Place: **Meeting Hall of Kabilash Village**

S. No.	Name	Address	Designation
1	Mr. Bhoba Bahadur Gurung	Kabilash 1	Teacher
2	Mr. Jagat Malla	Kabilash 9	Teacher
3	Mr. Dipendra Sapkota	Kabilash 9	Teacher
4	Ms. Radhika Bhattarai	Kabilash 4	Teacher
5	Ms. Rupa Pandey	Kabilash 7	Teacher
6	Ms. Bimala Gurung	Lamagau	Teacher
7	Ms. Bishnu Maya Gurung	Kamalapur	Teacher
8	Mr. Bishnu Prasad Paudel	Kabilash 2	Teacher
9	Mr. Kul Bahadur Gurung	Kabilash 6	Teacher
10	Mr. Ita Raj Gurung	Kabilash 2	Teacher
11	Mr. Chij Kumar Shrestha	Kabilash 2	Teacher
12	Mr. Nar Bahadur Lama	Early Committee	Member
13	Mr. Hira Bahadur Gurung	Bhorle 4	
14	Mr. Ganesh Gurung	Ward No. 3	
15	Mr. Ganesh Lamichchani	Ward No. 1	
16	Mr. Krishna Bahadur BK	Ward No. 2	
17	Mr. Guna Raj Tamang	Kabilash 9	
18	Mr. Posh Bahadur Gurung	Kabilash 1	
19	Mr. Taranath Timalsina	Kabilash 1	
20	Mr. Katak Bahadur Thing	Kabilash 5	
21	Mr. Pradhubna Kumar Khadka	Kabilash VDC	Secretary
22	Mr. Ajaya Paudel	Kabilash VDC	Assistant
23	Ms. Saraswoti Adhikari	Kabilash VDC	VF
24	Mr. Sukman Tamang	Kabilash VDC	Staff
25	Mr. Nutan Dev Pokharel	RRN, Chitwan	Project Engineer
26	Mr. Tanka Upreti	RRN, Chitwan	District Coordinator
27	Mr. Anjit Gurung	RRN, Chitwan	Engineer
28	Ms. Gyandhira Shrestha	RRN, Chitwan	Facilator
29	Mr. Shanmukhesh Amatay	DWIDP	S. D. Hydrologist
30	Mr. Rajendra Sharma	DWIDP	Hydrologist
31	Mr. H. Ohno	JICA Study Team	Team Member

32	Mr. Sujan Raj Adhikari	JICA Study Team	Geologist
33	Mr. Roshan Shrestha	Preesu Elect.	Engineer

Second Phase

Disaster Education for Student of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Rastrya Pramirary School, Bhorle, Ward No. 4
Class: 5
Date: 15 October 2008

S. No.	Name	Class	Book Distribution
1	Mr. Sajan Gurung	5	1
2	Mr. Binod Gurung	4	
3	Mr. Rajesh Gurung	4	
4	Mr. Dol Bahadur Bhujel	5	1
5	Mr. Prem Bahadur Pun	5	1
6	Mr. Navin Gurung	5	1
7	Ms. Manisa Gurung (A)	5	1
8	Ms. Manisa Gurung (B)	5	1
9	Ms. Indra Maya Gurung	5	1
10	Ms. Durga Gurung	5	1
11	Ms. Navina Gurung	4	
12	Ms. Sajina Gurung	4	
13	Ms. Manju Gurung	5	1
14	Ms. Laxmi Gurung	4	
15	Ms. Dauri Gurung	5	1
16	Ms. Radhika Bhattarai	Teacher	1
17	Ms. Manju Gurung	Teacher	1
18	Mr. Durga Prasad Timilsina	Teacher	1
19	Mr. Lekha Nath Sigdel	Teacher	1
20	Mr. Anjit Gurung	RRN	
21	Mr. Sujan Raj Adhikari	JICA Study Team	
22	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Bhorle, Ward No. 4
Date: 15 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Ms. Manju Gurung	4	1
2	Ms. Gyan Maya Gurung	4	1
3	Ms. Lalita Gurung	4	1
4	Ms. Sunni Maya Gurung	4	1
5	Ms. Maya Gurung	4	1
6	Ms. Shirimaya Gurung	4	1
7	Ms. Sukmaya Bhujel	4	1
8	Ms. Tikisara Gurung	4	1
9	Ms. Surya Kumari Gurung	4	1
10	Mr. Rame Gurung	4	1
11	Mr. Rom Bahadur Gurung	4	1
12	Ms. Yani Maya Gurung	4	1
13	Mr. Sub Bahadur Gurung	4	1
14	Ms. Bishnu Maya Gurung	4	1
15	Mr. Kabi Raj Gurung	4	1
16	Mr. Deepak Gurung	4	1
17	Mr. Hira Bahadur Gurung	4	1
18	Mr. Jitti Bhujel	4	1
19	Mr. Krishna Gurung	4	1
20	Mr. Hira Bahadur Gurung	4	1
21	Mr. Anjit Gurung	RRN	1
22	Mr. Sujan Raj Adhikari	JICA Study Team	1
23	Mr. Amar Shah	JICA Study Team	1

Disaster Education for Student of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Rastrya Pramirary School, Syauli, Ward No. 2
Class: 5
Date: 16 October 2008

S. No.	Name	Class	Book Distribution
1	Ms. Rupila Gurung	5	1
2	Ms. Babita Gurung	5	1
3	Ms. Barsa Gurung	5	1
4	Mr. Jeevan Gurung	4	
5	Mr. Jeevan Gurung	5	1
6	Ms. Nisa Gurung	4	
7	Ms. Binita Gurung	4	
8	Ms. Sabina Gurung	4	
9	Ms. Dhana Kumari Gurung	4	
10	Mr. Asim Gurung	4	
11	Mr. Sandesh Gurung	4	
12	Mr. Maik Gurung	4	
13	Mr. Rupesh Gurung	4	
14	Mr. Amar B.K.	5	1
15	Mr. Resham B.K.	5	1
16	Ms. Shirjana Gurung	5	1
17	Ms. Urmila Gurung	5	1
18	Mr. Min Bahadur Gurung	5	1
19	Mr. Maita Gurung	5	1
20	Ms. Anita Gurung	5	1
21	Ms. Santa Maya Gurung	5	1
22	Mr. Etaraj Gurung	Teacher	1
23	Ms. Kamal Gurung	Teacher	1
24	Mr. Anjit Gurung	RRN	
25	Mr. Sujan Raj Adhikari	JICA Study Team	
26	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Syauli, Ward No. 2
Date: 16 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Dev Lal Gurung	2	1
2	Mr. Som Bahadur Gurung	2	1
3	Mr. Phim Bahadur Magar	2	1
4	Mr. Jit Bahadur Gurung (A)	2	1
5	Mr. Chandra Bahadru Gurung	2	1
6	Mr. Nir Bahadur Gurung	2	1
7	Mr. Resham Lal Gurung	2	1
8	Mr. Jit Bahadur Gurung (B)	2	1
9	Mr. Prem Bahadur Gurung	2	1
10	Mr. Bir Bahadur B.K.	2	1
11	Mr. Guna Bahadur Gurung	2	1
12	Mr. Mana Bahadur Gurung	2	1
13	Mr. Ratna Bahadur B.K.	2	1
14	Mr. Suk Bahadur Gurung	2	1
15	Mr. Mehar Man Gurung	2	1
16	Mr. Amrit Gurung	2	1
17	Mr. Dirgha Bahadur B.K.	2	1
18	Mr. Som Lal Gurung	2	1
19	Ms. Parvati Parja	2	1
20	Ms. Santa Kumari Gurung	2	1
21	Ms. Phool Maya Gurung	2	1
22	Ms. Bimaya Gurung	2	1
23	Mr. Etaraj Gurung	2	1
24	Ms. Nam Kumari Gurung	2	1
25	Ms. Laxmi Gurung	2	1
26	Ms. Kamala Gurung	2	1
27	Mr. Anjit Gurung	RRN	
28	Mr. Sujan Raj Adhikari	JICA Study Team	
29	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Road Side 17 KM, Ward No.3
Date: 17 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Santa Bahadur Gurung	3	1
2	Mr. Sanukancha Gurung	3	1
3	Mr. Bir Bahadur Bhujel	3	1
4	Ms. Bhomaya Gurung	3	1
5	Ms. Gyanmaya Gurung	3	1
6	Ms. Mana Maya Gurung	3	1
7	Ms. Bisara Gurung	3	1
8	Ms. Gomaya Gurung	3	1
9	Mr. Anjit Gurung	RRN	
10	Mr. Sujan Raj Adhikari	JICA Study Team	
11	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Road Side 21+500 Km , Ward No.5 & 6
Date: 17 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Bharat Gurung	5	1
2	Mr. Lal Bahadur Gurung	5	1
3	Mr. Tek Bahadur Ranamagar	6	1
4	Mr. Khesaram Gurung	6	1
5	Ms. Sanumaya Thapa	6	1
6	Mr. Janak Shrestha	6	1
7	Mr. Durga Bahadur Gurung	6	1
8	Mr. Bhim Bahadur Gurung	6	1
9	Mr. Shiromani Gurung	6	1
10	Ms. Asmita Gurung	6	1
11	Mr. Ganga Bahadur Gurung	6	1
12	Mr. Kalu Bahadur Magar	6	1
13	Ms. Phool Maya Magar	6	1
14	Ms. Sarimaya Gurung	6	1
15	Mr. Suna Ram Gurung	6	1
16	Mr. Santa Bahadur Gurung	5	1
17	Mr. Thamang Singh Magar	6	1
18	Mr. Bishnu Lama	36 KM	1
19	Mr. Abdul Hakim Miya	6	1
20	Mr. Anjit Gurung	RRN	
21	Mr. Sujan Raj Adhikari	JICA Study Team	
22	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Tandrang, Ward No. 2
Date: 17 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Suk Bahadur Gurung	2	1
2	Mr. Kami Gurung	2	1
3	Mr. Krishna Bahadur Gurung	2	1
4	Ms. Suk Maya Gurung	2	1
5	Ms. Santa Maya Praja	2	1
6	Ms. Puja Gurung	2	1
7	Ms. Birmaya Gurung	2	1
8	Ms. Maya Gurung	2	1
9	Ms. Bishnu Maya Gurung	2	1
10	Ms. Dhak Maya Magar	2	1
11	Mr. Santa Bahadur Gurung	2	1
12	Mr. Ram Bahadur Gurung	2	1
13	Mr. Ichcha Bahadur Gurung	2	1
14	Mr. Yam Bahadur Praja	2	1
15	Mr. Kumar Gurung	2	1
16	Mr. Gore Bahadur Gurung	2	1
17	Mr. Bikash Gurung	2	1
18	Mr. Ravi Gurung	2	1
19	Mr. Buddhi Bahadur Gurung	2	1
20	Ms. Mati Gurung	2	1
21	Ms. Chiz Maya Gurung	2	1
22	Mr. Hira Gurung	2	1
23	Ms. Bhumisara Gurung	2	1
24	Ms. Aaiti Maya Gurung	2	1
25	Ms. Uma Gurung	2	1
26	Mr. Surya Magar	2	1
27	Mr. Bimal Gurung	2	1
28	Mr. Milan Gurung	2	1
29	Mr. Anjit Gurung	RRN	
30	Mr. Sujan Raj Adhikari	JICA Study Team	
31	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Road Side Khahare Khola and Daskhola, Ward No. 1 & 2
Date: 18 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Tul Bahadur Gurung	2	1
2	Mr. Prem Kumar Shrestha	2	1
3	Mr. Shankar Kumar Shrestha	2	1
4	Mr. Rajendra Magar	2	1
5	Mr. Bishnu Magar	2	1
6	Ms. Krishna Maya Gurung	2	1
7	Ms. Jasarupi Gurung	2	1
8	Mr. Bhakta Bahadur Gurung	2	1
9	Ms. Kamala Pandey	2	1
10	Ms. Bishnu Kumari Sapkota	2	1
11	Mr. Lal Bahadur Paudel	2	1
12	Ms. Maya Gurung	2	1
13	Mr. Nara Bahadur Rana Magar	2	1
14	Mr. Bharat Gurung	2	1
15	Santosh Gurung	2	1
16	Mr. Navaraj Magar	2	1
17	Mr. Bir Bahadur Rana Magar	2	1
18	Mr. Madan Devkota	2	1
19	Mr. Mahendra Gurung	2	1
20	Mr. Hira Giri	2	1
21	Mr. Sakila Miya	2	1
22	Mr. Sher Bahadur Lama	2	1
23	Ms. Bindu Magar	2	1
24	Mr. Dil Bahadur Gurung	2	1
25	Mr. Surya Bahadur Magar	2	1
26	Mr. Man Bahadur Rana Magar	2	1
27	Mr. Ganesh Gurung	2	1
28	Mr. Shyam Magar	2	1
29	Mr. Ram Bahadur Gurung	2	1
30	Mr. Nir Bahadur Sarki	2	1
31	Mr. Mouladin Miya	2	1
32	Mr. Dhana Bahadur Gurung	2	1
33	Ms. Gauri Maya Gurung	2	1
34	Ms. Mina Gurung	2	1
35	Ms. Rabina Khatun	2	1
36	Mr. Pharsa Lal Gurung	2	1
37	Mr. Dev Bahadur Gurung	2	1
38	Mr. Milan Gurung	2	1
39	Ms. Pampha Gautam	2	1
40	Mr. Pratab Gurung	2	1
41	Mr. Rajendra Sharma	DWIDP	1
42	Mr. Anjit Gurung	RRN	
43	Mr. Sujan Raj Adhikari	JICA Study Team	
44	Mr. Amar Shah	JICA Study Team	

Disaster Education for Student of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Rastrya Pramirary School, Kamalpur, Ward No. 3
Class: 5
Date: 19 October 2008

S. No.	Name	Class	Book Distribution
1	Mr. Bishu Gurung	5	1
2	Mr. Milan Gurung	5	1
3	Mr. Min Bahadur Gurung	5	1
4	Mr. Akal Gurung	5	1
5	Ms. Matina Gurung	5	1
6	Ms. Sita Gurung	5	1
7	Mr. Laxman Gurung	5	1
8	Ms. Chizmaya Gurung	5	1
9	Ms. Sharmila Gurung	5	1
10	Mr. Bhakta B.K.	5	1
11	Mr. Jeevan Praja	5	1
12	Ms. Shanta Praja	5	1
13	Mr. Sandesh Gurung	5	1
14	Mr. Hari Bahadur Gurung	5	1
15	Ms. Kalpana Gurung	5	1
16	Ms. Jamuna B.K.	5	1
17	Ms. Bishnu Maya Ghimire	Class Teacher	1
18	Mr. Aak Bahadur Gurung	Chairman, School Mgt	1
19	Mr. Rajendra Sharma	DWIDP	
20	Mr. Anjit Gurung	RRN	
21	Mr. Sujan Raj Adhikari	JICA Study Team	
22	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Kamalpur, Ward No. 3
Date: 19 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Rana Bahadur Gurung	3	1
2	Mr. Nirmal Pariyar	3	1
3	Mr. Tek Bahadur Gurung	3	1
4	Mr. Narayan Gurung	3	1
5	Mr. Kumar Praja	3	1
6	Mr. Dil Bahadur Gurung	3	1
7	Mr. Krishna Gurung	3	1
8	Ms. Chiz Kumari Gurung	3	1
9	Mr. Suresh Gurung	3	1
10	Mr. Krishna Bahadur Gurung	3	1
11	Mr. Nirmal Gurung	3	1
12	Mr. Suresh Praja	3	1
13	Mr. Lal Bahadur Gurung	3	1
14	Mr. Aak Bahadur Gurung	3	1
15	Mr. Rum Bahadur Gurung	3	1
16	Mr. Guna Bahadur Gurung	3	1
17	Mr. Bir Bahadur Gurung (A)	3	1
18	Mr. Padam Bahadur Gurung	3	1
19	Mr. Bir Bahadur Gurung (B)	3	1
20	Mr. Kul Bahadur B.K.	3	1
21	Mr. Chandra Bahadur Gurung	3	1
22	Mr. Man Bahadur Gurung	3	1
23	Mr. Bir Bahadur B.K.	3	1
24	Mr. Babu Lal Pariyar	3	1
25	Mr. Man Bahadur B.K.	3	1
26	Mr. Bekha Bahadur Gurung	3	1
27	Mr. Dhan Bahadur Gurung	3	1
28	Mr. Jit Bahadur B.K.	3	1
29	Mr. Padam B.K.	3	1
30	Mr. Buddi Gurung	3	1
31	Mr. Bhakta Bahadur Pariyar	3	1
32	Mr. Waibi Gurung	3	1
33	Mr. Jung Bahadur Gurung	3	1
34	Mr. Bir Bahadur Gurung	3	1
35	Mr. Dil Bahadur B.K.	3	1
36	Mr. Hukum Bahadur Gurung	3	1
37	Mr. Krishna Bahadur Gurung	3	1
38	Ms. Santa Kumari Gurung	3	1
39	Mr. Rajendra Sharma	DWIDP	
40	Mr. Anjit Gurung	RRN	
41	Mr. Sujan Raj Adhikari	JICA Study Team	
42	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Ratomate and Kipot, Ward No. 5
Date: 20 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Iman Singh Gurung	5	1
2	Mr. Suka Bahadur Gurung	5	1
3	Mr. Lal Bahadur B.K.	5	1
4	Mr. Dan Bahadur Gurung	5	1
5	Mr. Amrit Gurung	5	1
6	Mr. Amrit B.K.	5	1
7	Mr. Kata Bahadur Gurung	5	1
8	Mr. Kaman Singh Gurung	5	1
9	Mr. Aashi Lal Gurung	5	1
10	Mr. Hasta Man Gurung	5	1
11	Ms. Asha Maya Gurung	5	1
12	Ms. Tak Maya Gurung	5	1
13	Mr. Dev Gurung	5	1
14	Mr. Chiza Kumar Shrestha	5	1
15	Ms. Suka Maya Gurung	5	1
16	Ms. Jap Maya Gurung	5	1
17	Ms. Maya Gurung	5	1
18	Ms. Kalpana Gurung	5	1
19	Ms. Sani Maya Gurung	5	1
20	Mr. Dil Bahadur Gurung	5	1
21	Mr. Rajmani Gurung	5	1
22	Ms. Kabita Gurung	5	1
23	Ms. Maya Gurung	5	1
24	Ms. Dhan Sukhi Gurung	5	1
25	Ms. Mana Maya Gurung	5	1
26	Mr. Buddhi Gurung	5	1
27	Mr. Nir Bahadur Gurung	5	1
28	Mr. Shree Prasad Gurung	5	1
29	Ms. Janimaya Gurung	5	1
30	Ms. Sunita Gurung	5	1
31	Ms. Aahuti Maya Gurung	5	1
32	Ms. Nanda Kumari Gurung	5	1
33	Mr. Laxman Gurung	5	1
34	Mr. Man Bahadur Gurung	5	1
35	Mr. Kul Bahadur Gurung	5	1
36	Mr. Rajendra Sharma	DWIDP	
37	Mr. Anjit Gurung	RRN	
38	Mr. Sujan Raj Adhikari	JICA Study Team	
39	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Dumre Gaun, Ward No. 6
Date: 21 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Makkan Bahadur Chepang	6	1
2	Mr. Bhim Bahadur Gurung	6	1
3	Mr. Santa Bahadur Chepang	6	1
4	Mr. Deu Bahadur Gurung (A)	6	1
5	Mr. Suman Chepang	6	1
6	Mr. Jokkhu Chepang	6	1
7	Mr. Biraj Gurung	6	1
8	Mr. Raj Kumar Gurung	6	1
9	Ms. Bimaya Gurung	6	1
10	Ms. Mangali Praja	6	1
11	Ms. Dil Kumari Praja	6	1
12	Mr. Deu Bahadur Gurung (B)	6	1
13	Mr. Tek Bahadur Gurung	6	1
14	Mr. Kanya Gurung	6	1
15	Mr. Subarna Gurung	6	1
16	Mr. Santosh Gurung	6	1
17	Mr. Makkhan Bahadur Gurung	6	1
18	Mr. Kame Gurung	6	1
19	Mr. Krishna Bahadur Chepang	6	1
20	Mr. Rajendra Sharma	DWIDP	
21	Mr. Anjit Gurung	RRN	
22	Mr. Sujan Raj Adhikari	JICA Study Team	
23	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Dumre Besi, Ward No. 6
Date: 21 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Ram Bahadur Thapa	6	1
2	Ms. Sukamaya Gurung	6	1
3	Ms. Taka Maya Gurung	6	1
4	Mr. Taka Lal Gurung	6	1
5	Ms. Maya Gurung	6	1
6	Ms. Sharmila Gurung	6	1
7	Ms. Mitthu B.K.	6	1
8	Ms. Sunsari B.K.	6	1
9	Mr. Jokha Lal Gurung	6	1
10	Mr. Sougant Magar	6	1
11	Ms. Mana Kumari Parja	6	1
12	Mr. Rajendra Sharma	DWIDP	
13	Mr. Anjit Gurung	RRN	
14	Mr. Sujan Raj Adhikari	JICA Study Team	
15	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Road Side Simaltal, Ward No. 6 & 8
Date: 22 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Mana Bahadur Gurung		1
2	Mr. Tek Bahadur Gharti		1
3	Mr. Chandra Bahadur Gurung		1
4	Mr. Man Bahadur Gurung		1
5	Mr. Indra Bahadur Gurung		1
6	Mr. Nara Bahadur Gurung		1
7	Mr. Himal Gurung		1
8	Mr. Kamal Thapa Magar		1
9	Mr. Nishan Gurung		1
10	Mr. Arjun Thakali		1
11	Mr. Purna Bahadur Gurung		1
12	Ms. Mohina Sunar		1
13	Mr. Lal Bahadur Gurung		1
14	Ms. Shreemaya Gurung		1
15	Mr. Garva Singh Gurung		1
16	Mr. Kharka Bishnu Gurung		1
17	Mr. Guna Bahadur Gurung		1
18	Ms. Ambika Gurung		1
19	Ms. Bimala B.K.		1
20	Ms. Amrita Gurung		1
21	Ms. Manamati Gurung		1
22	Ms. Phool Maya Gurung		1
23	Ms. Puja Gurung		1
24	Mr. Santa Bahadur Gurung		1
25	Mr. Udaya Gurung		1
26	Mr. Rajendra Sharma	DWIDP	
27	Mr. Anjit Gurung	RRN	
28	Mr. Sujan Raj Adhikari	JICA Study Team	
29	Mr. Amar Shah	JICA Study Team	

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Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Bangesal & Lamagaun Ward No. 8
Date: 22 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Purna Bahadur Gurung	8	1
2	Mr. Dev Gurung	8	1
3	Mr. Shyam Bhujel	8	1
4	Mr. Ishan Gurung	8	1
5	Mr. Shankar Bhujel	8	1
6	Mr. Dil Bahadur Gurung	8	1
7	Mr. Bir Bahadur Gurung	8	1
8	Mr. Birta Lal Gurung	8	1
9	Mr. Dhana Bahadur Gurung	8	1
10	Mr. Hita Bahadur Lama	8	1
11	Ms. Pahcha Maya Gurung	8	1
12	Ms. Purna Maya Gurung	8	1
13	Ms. Gori Gurung	8	1
14	Mr. Jit Bahadur Gurung	8	1
15	Mr. Navaraj Paudel	8	1
16	Ms. Sapana Singh Gurung	8	1
17	Ms. Devisara Gurung	8	1
18	Ms. Somani Gurung	8	1
19	Ms. Goma Dhakal	8	1
20	Mr. Kul Bahadur Gurung	8	1
21	Mr. Surya Bahadur Gurung	8	1
22	Mr. Maila Gurung	8	1
23	Mr. Hasta Bahadur Gurung	8	1
24	Mr. Mohan Gurung	8	1
25	Mr. Buddhi Bahadur Gurung	8	1
26	Ms. Anita Gurung	8	1
27	Ms. Sarmila Gurung	8	1
28	Ms. Durga Gurung	8	1
29	Ms. Maya Gurung	8	1
30	Mr. Parcharaj Gurung	8	1
31	Mr. Rajendra Sharma	DWIDP	
32	Mr. Anjit Gurung	RRN	
33	Mr. Sujan Raj Adhikari	JICA Study Team	
34	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Dhodeni, Ward No. 9
Date: 23 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Birsa Bahadru Lama	9	1
2	Mr. Rajkumar Chepang	9	1
3	Mr. Mana Bahadur Lama	9	1
4	Mr. Dil Bahadur Chepang	9	1
5	Mr. Sujan Magar	9	1
6	Mr. Chitra Bahadur Lama	9	1
7	Mr. Dil Bahadur Lama	9	1
8	Mr. Purna Bahadur Chepang	9	1
9	Mr. Lalit Kumar Chepang	9	1
10	Mr. Rom Kanta Neupane	9	1
11	Mr. Ambar Bahadur Gurung	9	1
12	Mr. Mana Bahadur Lama	9	1
13	Mr. Jaman Singh Lama	9	1
14	Mr. Lok Man Lama	9	1
15	Mr. Ramesh Lama	9	1
16	Mr. Kaila Chepang	9	1
17	Mr. Dhan Bahadur Magar	9	1
18	Mr. Raj Kumar Lama	9	1
19	Mr. Tul Bahadur Lama	9	1
20	Mr. Gore Bahadur Lama	9	1
21	Mr. Tej Bahadur Lama	9	1
22	Mr. Min Bahadur Lama	9	1
23	Ms. Maili Chepang	9	1
24	Ms. Subi Lama	9	1
25	Mr. Devendra Lama	9	1
26	Mr. Raju Lama	9	1
27	Mr. Santa Lal Lama	9	1
28	Mr. Babu Ram Chepang	9	1
29	Mr. Mangal Chepang	9	1
30	Mr. Kul Bahadur Gurung	9	1
31	Mr. Bhakata Bahadur Magar	9	1
32	Mr. Khadka Bahadur Lama	9	1
33	Mr. Suk Bahadur Chepang	9	1
34	Mr. Jagat Bahadur Gurung	9	1
35	Mr. Tasbire Chepang	9	1
36	Ms. Kanchchi Maya Tamang	9	1
37	Mr. Jug Bahadur Lama	9	1
38	Mr. Chandra Bahadur Chepang	9	1
39	Mr. Jagat Lama	9	1
40	Mr. Rajendra Sharma	DWIDP	
41	Mr. Anjit Gurung	RRN	
42	Mr. Sujan Raj Adhikari	JICA Study Team	
43	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Chauki, Ward No. 7
Date: 24 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Kame Gurung	7	1
2	Mr. Gore Maya Gurunhg	7	1
3	Ms. Rupa Pandey	7	1
4	Mr. Bhakta Bahadur Gurung	7	1
5	Mr. Ganesh Bahadur Gurung	7	1
6	Mr. Dinesh Magar	7	1
7	Mr. Sagar Gurung	7	1
8	Mr. Tej Bahadur Gurung	7	1
9	Mr. Hom Bahadur Gurung	7	1
10	Ms. Somati Praja	7	1
11	Mr. Dhana Bahadur Gurung	7	1
12	Ms. Sukmati Gurung	7	1
13	Mr. Tul Bahadur Gharti	7	1
14	Mr. Kazi Gurung	7	1
15	Mr. Dev Gurung	7	1
16	Ms. Ganga Gurung	7	1
17	Mr. Bir Bahadur Praja	7	1
18	Mr. Chasi Bahadur Praja	7	1
19	Ms. Buddhi Maya Praja	7	1
20	Ms. Lal Maya Praja	7	1
21	Mr. Suk Bahadur Gharti	7	1
22	Mr. Rajendra Sharma	DWIDP	1
23	Mr. Anjit Gurung	RRN	1
24	Mr. Sujan Raj Adhikari	JICA Study Team	1
25	Mr. Amar Shah	JICA Study Team	1

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Isti Khola, Ward No. 1
Date: 25 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Mr. Hukum Sing Gurung	9	1
2	Mr. Parbati Baral	9	1
3	Ms. Salamaya Gurung	9	1
4	Ms. Punimaya Gurung	9	1
5	Ms. Kathahi Gurung	9	1
6	Ms. Mitthu Bagale	9	1
7	Ms. Mina Gurung	9	1
8	Ms. Kalpana Lama	9	1
9	Mr. Tek Bahadur Thapa	9	1
10	Mr. Harka Bahadur B.K.	9	1
11	Mr. Chitra Bahadur Gurung	9	1
12	Mr. Anjit Gurung	RRN	
13	Mr. Sujan Raj Adhikari	JICA Study Team	
14	Mr. Amar Shah	JICA Study Team	

Disaster Education for Village People of Kabilash Village Committee
Study on Disaster Risk Management for Narayangharh-Mugling Highway

Venue: Biretar and Kusumtar, Ward No. 9
Date: 26 October 2008

S. No.	Name	Ward No.	Book Distribution
1	Ms. Mati Maya Tamang	9	1
2	Ms. Lila Maya Tamang	9	1
3	Ms. Dolma Tamang	9	1
4	Ms. Shyam Kumari Tamang	9	1
5	Ms. Sarita Tamang	9	1
6	Mr. Sukmati Tamang	9	1
7	Ms. Mana Kumari Tamang	9	1
8	Ms. Rasmita Gurung	9	1
9	Ms. Buddhi Maya Gurung	9	1
10	Ms. Pyari Sunar	9	1
11	Ms. Chandra Maya Sunar	9	1
12	Mr. Harka Bahadur Shrestha	9	1
13	Mr. Aaita Bahadur Lama	9	1
14	Ms. Manarupi Lama	9	1
15	Ms. Bishnu Maya Tamang	9	1
16	Ms. Rupshila Tamang	9	1
17	Ms. Gita Tamang	9	1
18	Ms. Manmaya Tamang	9	1
19	Ms. Kaushila Tamang	9	1
20	Ms. Deumaya Lama	9	1
21	Ms. Takmaya Lama (A)	9	1
22	Ms. Takmaya Lama (B)	9	1
23	Ms. Setimaya Tamang	9	1
24	Ms. Buddhi Maya Tamang	9	1
25	Mr. Sanu Lama	9	1
26	Ms. Samjhana Lama	9	1
27	Mr. Tanka Ram Tamang	9	1
28	Ms. Pabitra Lama	9	1
29	Mr. Bhuwanraj Sapkota	9	1
30	Mr. Suk Bahadur Lama	9	1
31	Mr. Til Kumari Lama	9	1
32	Mr. Rasmaya Lama	9	1
33	Ms. Tara Devi Lama	9	1
34	Mr. Anjit Gurung	RRN	
35	Mr. Sujan Raj Adhikari	JICA Study Team	
36	Mr. Amar Shah	JICA Study Team	

Disaster Education for School Students and Communities of Kabilash VDC, Chitwan
First phase



Disaster Education at Kabilash School on 23 September 2008 Ward No 1



Disaster Education at Lamagaun School on 24 September 2008 Ward No 8



Disaster Education at Chauki School on 25 September 2008 Ward No 7

Disaster Education at Dhodeni School on 26 September 2008 Ward No 9


Disaster Education for Kholaghari, Devitar community on 27 September 2008 Ward No 1

Second phase


Disaster Education at Bhorle School on 15 October 2008 Ward No 4


Disaster Education for Bhorle Community on 15 October 2008 Ward No 4


Disaster Education at Syuali School on 16 October 2008 Ward No 2


Disaster Education for Syuali Community on 16 October 2008 Ward No 2


Disaster Education for 17 km and 21 Km Roadside Community on 17 October 2008 Ward No 3, 5, 6


Disaster Education for Tandrang Community on 17 October 2008 Ward No 2


Disaster Education for Khahare Khola and Daskhola Road side Community on 18 October 2008 Ward No 1


Disaster Education at Kamalpur School on 19 October 2008 Ward No 3


Disaster Education for Kamalpur Community on 19 October 2008 Ward No 3


Disaster Education for Kipot and Ratamate Community on 20 October 2008 Ward No 5


Disaster Education for Dumbre Goan Community on 21 October 2008 Ward No 6


Disaster Education for Dumbre Goan Community on 21 October 2008 Ward No 6


Disaster Education for Simaltal Community on 22 October 2008 Ward No 6


Disaster Education for Lamagoan and Bangesal Community on 22 October 2008 Ward No 8


Disaster Education for Dhodeni Community on 23 October 2008 Ward No 9


Disaster Education for Chauki Community on 24 October 2008 Ward No 7

Disaster Education for Isti Khola Community on 25 October 2008 Ward No 1

Disaster Education for Biretar and Kusumtar Community on 26 October 2008 Ward No 9

SEDIMENT-RELATED DISASTER MANAGEMENT IN KABILASH VILLAGE

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Contents of Text Book

CHAPTER 1

INTRODUCTION

1.1 General Method of Disaster Management

Sediment related disaster had been occurred under heavy rain in 2003 and 2006 which claimed many lives of villagers and damaged houses. These disasters showed where dangerous areas are and when is critical term.

Topo-geological condition, rainfall of 2003 and 2006, are studied in the JICA study. And, in the pilot project, the early warning/evacuation system was formulated with hazard maps of Kabilash village which was made up by collaborative work of the study team and villagers, and simple countermeasure works for collapsed slopes affecting the harvest land. These results shall be disseminated to village people to share knowledge to cope with coming sediment-related disasters in the village.

We need to have the resistance to the disaster, i.e. power for prevention and enduring of disaster. And we should have resilience to disaster even if we have resistance. We might get these such powers because we understand and grasp the disaster risk.

(1) Category of Disaster Management

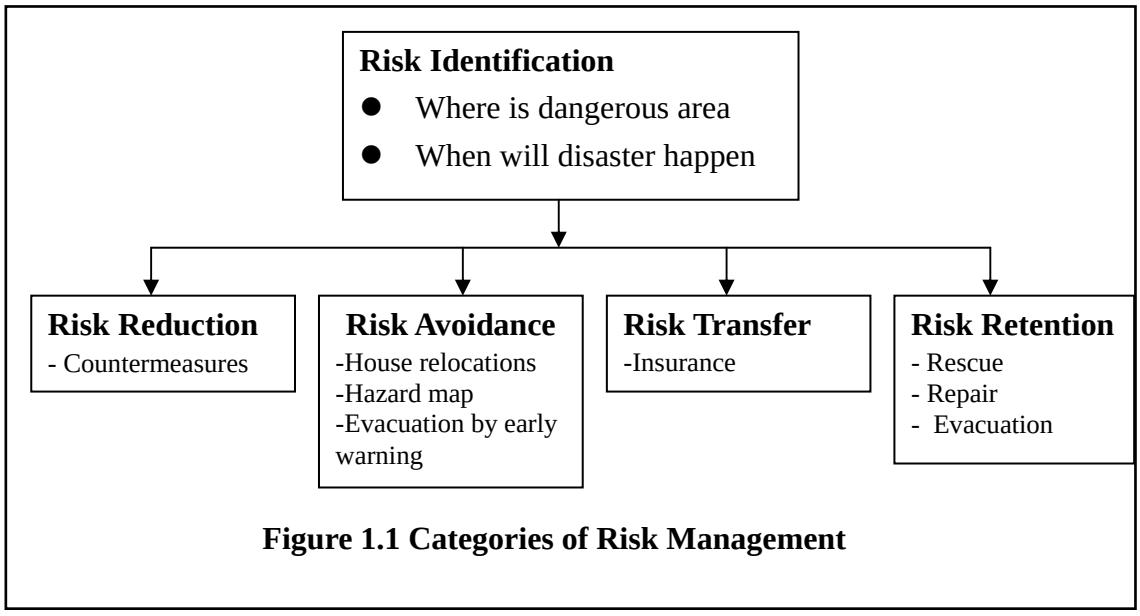


Figure 1.1 Categories of Risk Management

Disaster risk management is defined as action program to prevent and mitigate potential disaster risk. (Damage scale and occurrence probability) Potential risks are grasped and evaluated, and we should control and finance the disaster risk. Risk management is generally programmed by combination of four categories shown in Figure 1.1. The occurrence of risk is prevented and it is reduced, beforehand (risk control), and we should prepare for money in the case that risk occurs (risk finance).

(1) Risk reduction: Implementing countermeasures

(2) Risk avoidance: House relocations in dangerous area or evacuation before disaster occurrence

(3) Risk transfer: Procurement of disaster insurance

(4) Risk retention: Recognition risk level and retain the situation and preparation for disaster occurrence.

It is so difficult to implement sufficient countermeasures to prevent disaster occurrence that risk avoidance program essential to mitigate damage of disasters in Kabilash village.

(2) Cycle of Disaster Management

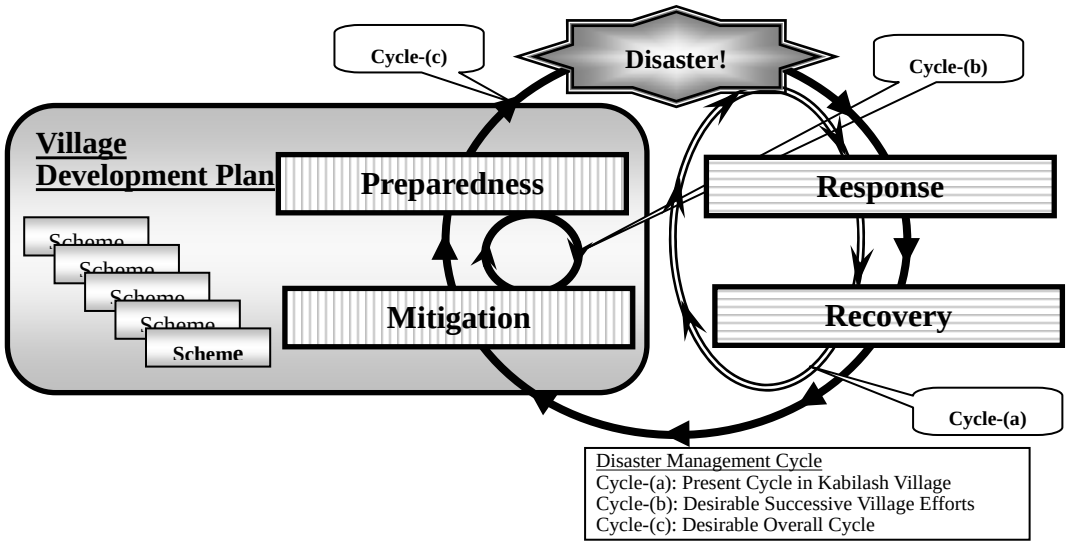


Figure 1.2 Disaster Management built-in to Community Development

Cycle of disaster management is shown in Figure 1.2.

(a) Present Cycle in Kabilash Village; Cycle-(a)

Present disaster management cycle is shown in “Cycle-(a)”. That is disaster management at present is only response and recovery after disaster without mitigation.

(b) Desirable Successive Effort; Cycle-(b)

In addition to response/recovery effort for mitigation and preparedness shall be introduced to disaster management in Kabilash Village . So, it is recommended to make up disaster management plan which is included “Early Warning and Evacuation System” under heavy rain and risk reduction plan by implementing simple countermeasures or reforestation in the pilot project.

(c) Desirable Overall Cycle; Cycle-c

Desirable overall cycle of disaster management is shown in Cycle-(c). As it is required huge money to reduce disaster risk by implementing countermeasures, disaster management plan shall be built-in step by step to any village development plan such as roads, water supply, and irrigation and so on.

1.2 Importance of Disaster Management by Village

Hazard map made in the pilot project will show many dangerous areas to be treated by suitable countermeasures which required huge money to implement sufficient countermeasures. But, considering current situation of disaster management in Nepal it is very difficult to realize sufficient countermeasures against sediment-related disasters in Kabilash village. So, it is important to disaster management shall be plan and implement by villagers themselves.

The purpose and output landslide management can be summarized as shown in Table 1.1.

Table 1.1 Purpose and Outputs of Village Landslide Management

Ultimate Goal	**Community development（income generation, poverty reduction）**
Project proposes	- Disaster prevention （avoidance of casualty, damage reduction） - Development of community infrastructure for life and industry
Project outputs	-Plan and implementation of sediment-related management and community infrastructure development -Formulation of organization (Working commission) for planning and execution promotion in the community -Organization and system for landslide monitoring and early warning -Civil works for landslide disaster reduction and community infrastructure development - Organization and system for reforestation

The primarily purpose of disaster management is to reduce dead/injured persons by disaster. Safer life environment is an important element for human life. Appropriate disaster management can mitigate social/economical loss. From these viewpoints, it is important for carrying out disaster management. However, disaster management is not only to mitigate casualty/damage, but also it is several other effects.

By carrying out of disaster management, the mutual assistance between inhabitants would occur. Transmission of warning information between inhabitants is made by grasping inhabitant situation such as staying, working and illness. This is worrying each other. Rescue of injured persons is implemented by cooperation of inhabitants. From these activities would promote to increase togetherness of village.

And, if the number/scale of disaster is decreased by the disaster management, it is expected that the objective area becomes more safety zone. From this result, in the safer area, the traffic volume would be increasing. By more traffic activities, inhabitants are able to accept more materials and more information. By more materials, economical quantity and quality becomes better, and social quality would be improved by more information. By higher social and economical quality, inhabitants are able to accept more knowledge. Thus, the safety situation is also higher. As above mentioned, the positive cycle occurs. From the long term viewpoint, the disaster management will generate positive affects to social/economical situation.

1.3 Purpose of Disaster Education

The general method of disaster risk management has four categories. However, if villagers do not have knowledge for disaster, they could not manage to reduce/mitigate the disaster risk. For example, if villagers do not grasp hazardousness of place which they live, they could not judge the appropriate evacuation. Thus disaster education have to be carried out to reduce disaster risk. The knowledge is defined/regulated the action of the human being.

This text book has been prepared utilizing results mentioned above which is composed of four component concerned with disaster management.

- ✧ Basic knowledge for sediment-related disasters;
- ✧ Preventive measures for sediment related disasters along N-M Highway

- ✧ Hazard maps in Kabilash village
- ✧ Early warning and evacuation system in Kabilash village

This knowledge shall be disseminated and shared among village people to cope with coming disasters. It is expected that damages by coming disasters would be mitigated by disaster education for villagers and students utilizing this text.

CHAPTER 2

BASIC KNOWLEDGE FOR SEDIMENT-RELATED DISASTER MANAGEMENT

2.1 Topography and Geology of Kabilash Village and its Vicinity Area

2.1.1Topography and Geology of Nepal

(1) Zoning of Nepal from View Points of Topography and Geology

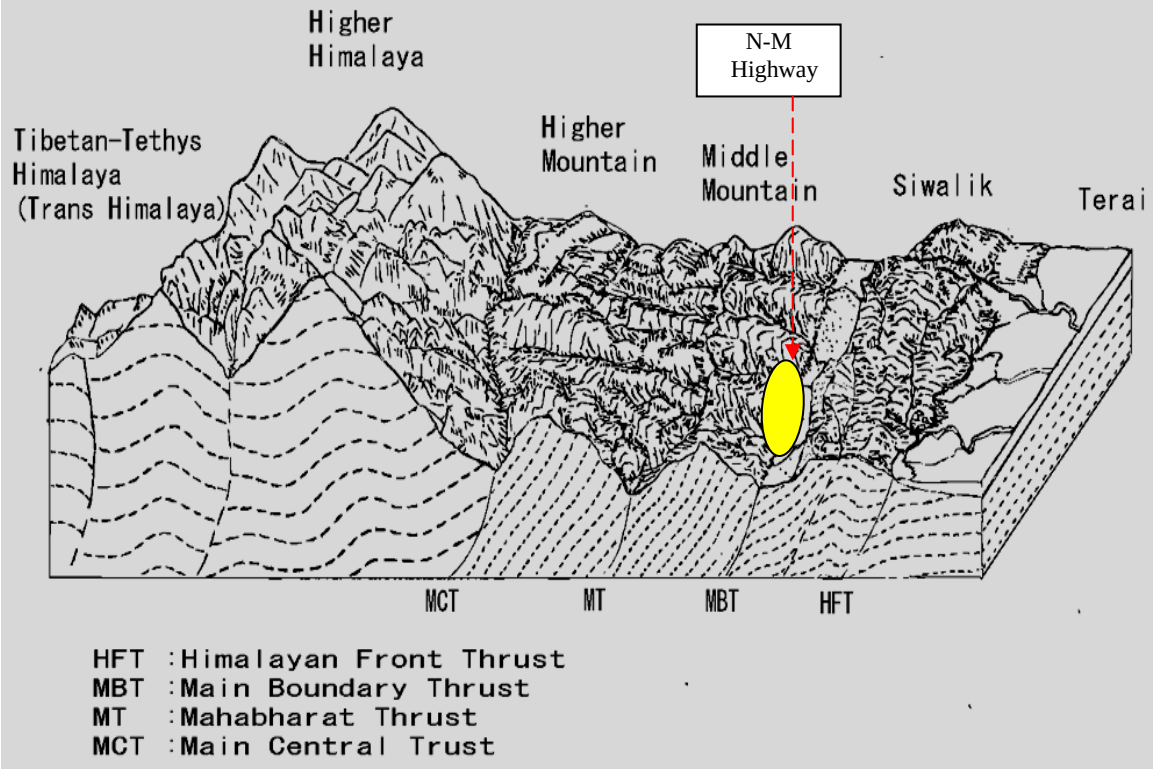


Figure 2.1.1 General Topography/ Geology of Nepal

Nepal is a mountainous country located in the middle belt of Himalayas which is divided into four zones by Ganser (1964) considering topo-geologic features as shown in Figure 2.1 and Table 2.1.

Table 2.1.1 Table Title 12point Times New Roman

Zone	Elevation	Bed Rocks	SDR Disaster Types
Terai	**60-330m**	✧ Clays/Sands/Gravels (Deposits younger than 1mil.; Holocene)	◆ Bank Erosion, ◆ Flood, ◆ Inundation
HFT			
Siwalik	**330m-1,000m**	✧ Soft sedimentary rocks (Deposit of 45mil.-1mil.ago; Tertiary-Quaternary)	◆ Soil Erosion, ◆ Debris Flow, ◆ Landslide, ◆ Slope Failure, (Earthquake)
MBT			
Lesser Himalayan	**1,000-2,000m**	✧ Phyllite ✧ Quartzite ✧ Limestone (1650mil.-570mil.ago; Late Cambrian)	◆ Landslide, ◆ Slope Failure, ◆ Debris Flow, ◆ Soil Erosion, (Earthquake)
MCT			
Higher Himalayan	**2,000-3,000m**	✧ Metamorphic rocks ✧ Granites (Older than 1650mil.; Cambrian)	◆ Slope Failure ◆ Avalanche (Earthquake)
STD	**3,000>**	✧ Sedimentary rocks (Deposit of500mil.-65mil.;Paleozoic-Mesozoic)	◆ Slope Failure ◆ Avalanche (Earthquake)
Tibetan-Tethys Himalayan Zone			

(2) Property of Rocks of Each Zone

a) Lesser Himalayan/Higher Himalayan/Tibetan-Tethys Himalayan Zones

- Generally sound and hard rocks are distributing.
- So, steep and high slopes are formed along deeply cut valleys.
- But, partially, fractured and sheared by faults; dislocation of geological layer. This is major cause of occurring sediment-related disasters.

b) Siwalik Zone

- Rocks are generally soft and fragile,
- Bitterly broken along the Main Boundary Thrust,
- And so, many landslide and slope failures are occurring which is major materials of debris flow under heavy rains.

c) Terai Zone

- Soft and weak clays, sands, and gravels,
- So banks are easily eroded by river streams

(3) Major Fault Dividing Topo- Geological Zones

- Each zone is considered to be bounded by a major thrust faults shown in Figure 2.1.1
- These faults are developed by collision of Indian Plate and Asian Plate as shown in Figure2.1.2.
- Each zone is divided by structural faults developed in the process of Himalayan Mountain Building which started from around 45 millions years ago.

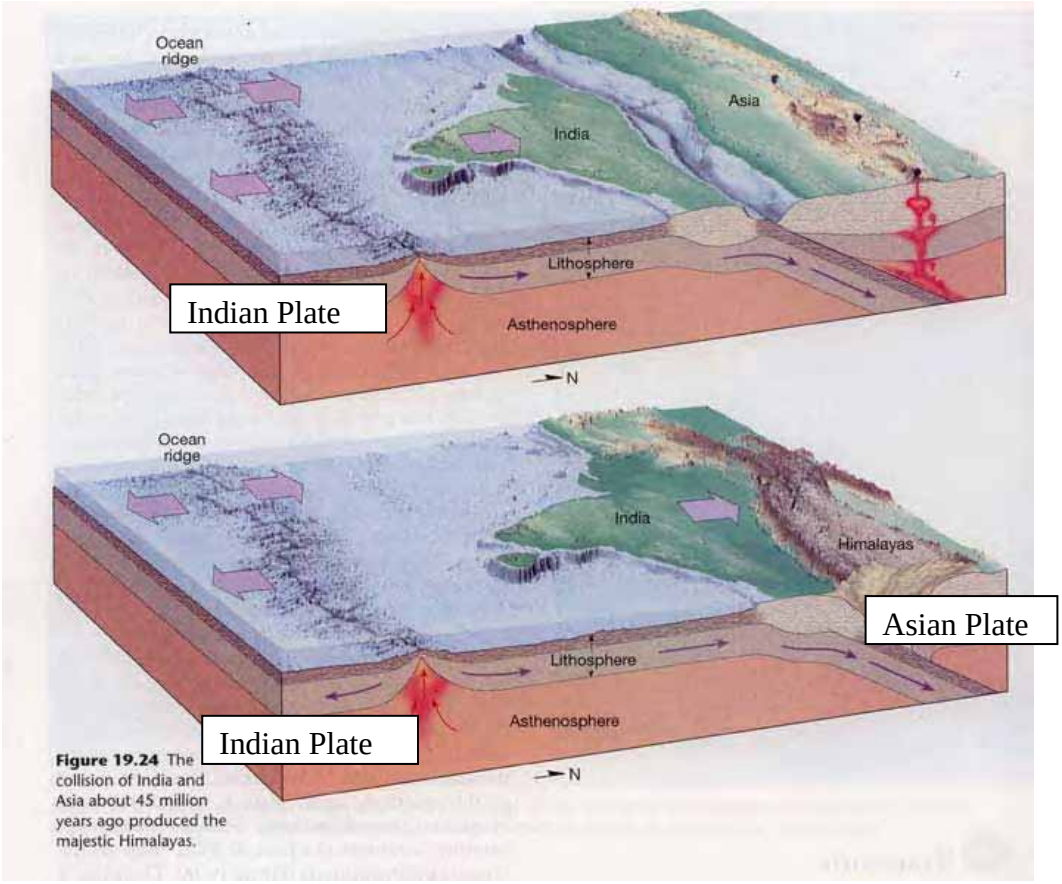


Figure 2.1.2 Schematic Illustration of Himalayan Orogeny

From the north to the south

- The South Tibetan Detachment Fault Systems (STDS) bounds the Tibetan Tethys Himalayas and the Higher Himalyas.
- The Main Central Thrust (MCT) bounds the Higher Himalayas and the Lesser Himalayas.

- The Main Boundary Thrust (MBT) bounds the Lesser Himalaya and the Siwaliks (the Sub-Himalaya).
- The Main Frontal Thrust (MFT) bounds the Siwaliks and the Terai plain.

2.1.2 Topography and Geology of Kabilash Village and its Vicinity Area

(1) Topography

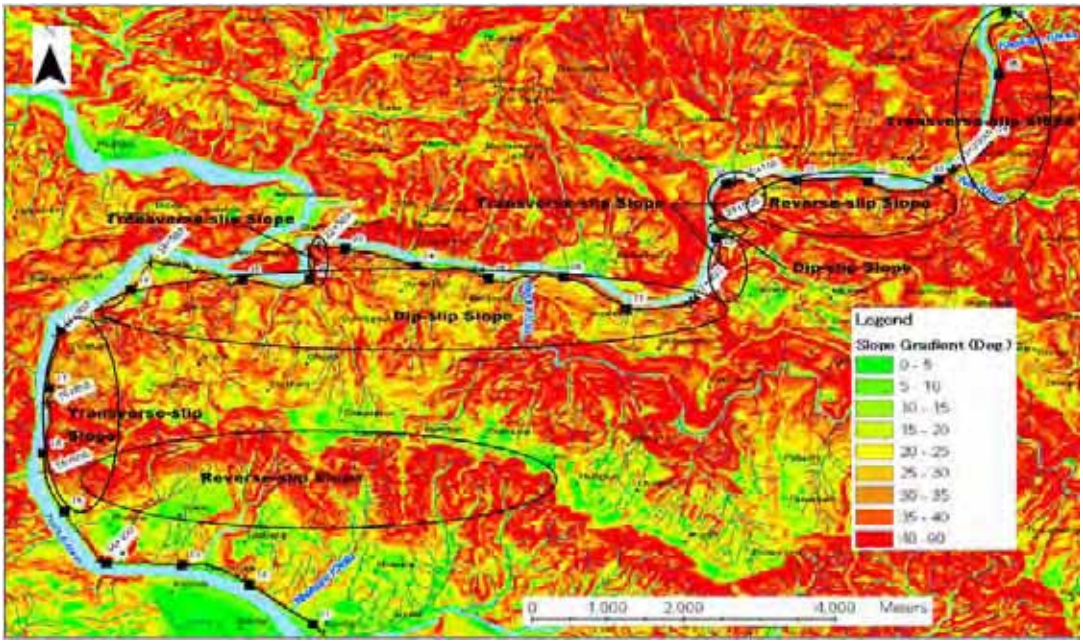


Figure 2.1.3 Slope Gradient Map in Kabilash Village and its Vicinity Area

Figure 2.1.3 is the slope gradients map in Kabilash village and its vicinity area.

- At all area, there are many steep slopes which angle is more than 30 degree,
- Slopes gentler than 15degree are lower part (southern part) and the dividing ridge,
- Southern part slope in Kabilash village is patchy pattern of steeper than 30 degree and gentler than 20 degree where slope is parallel to bedding or cracks of bedrocks (Dip slip slope)

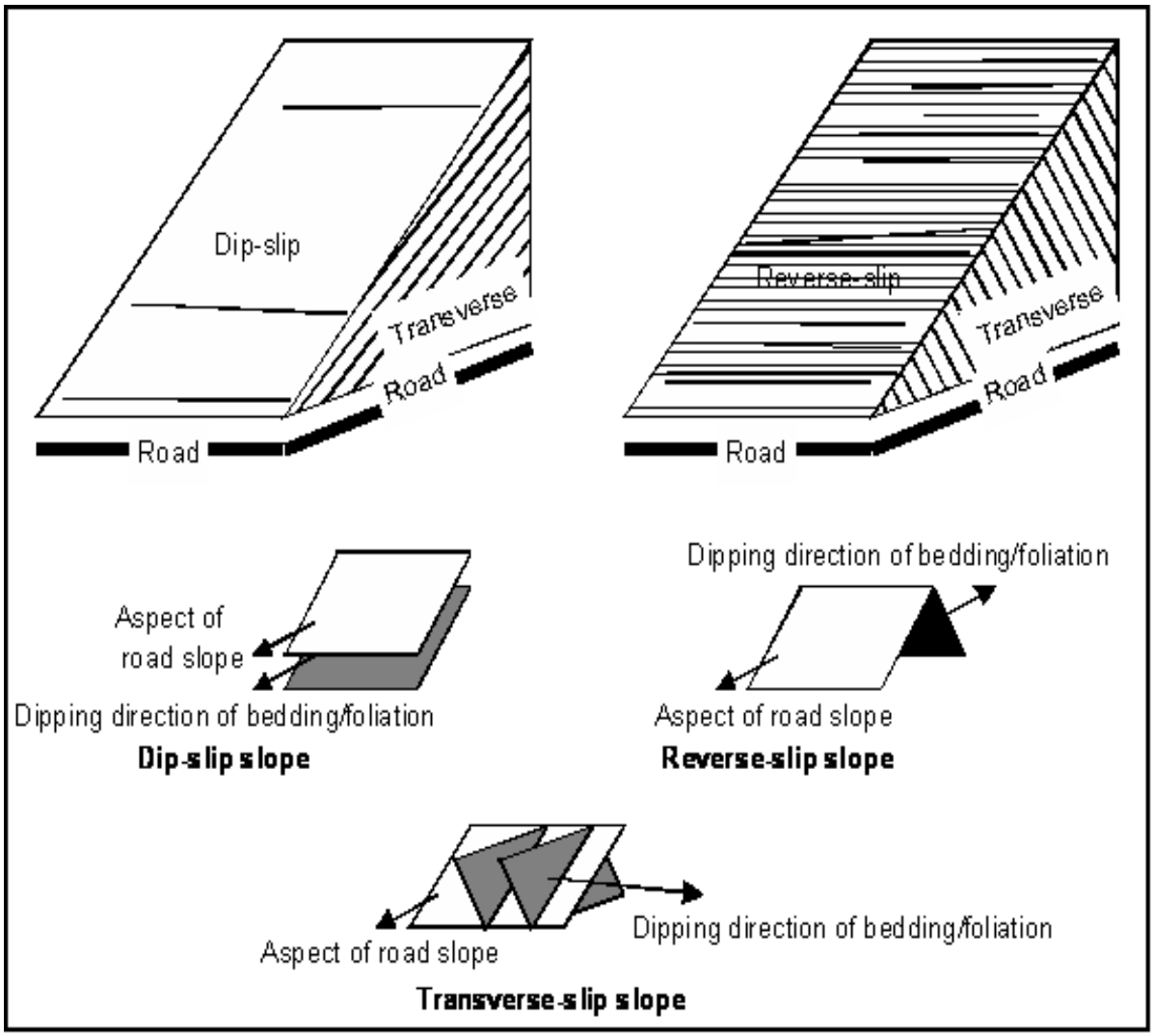


Figure 2.1.4 Slope Geometrical Classification

(2) Geology

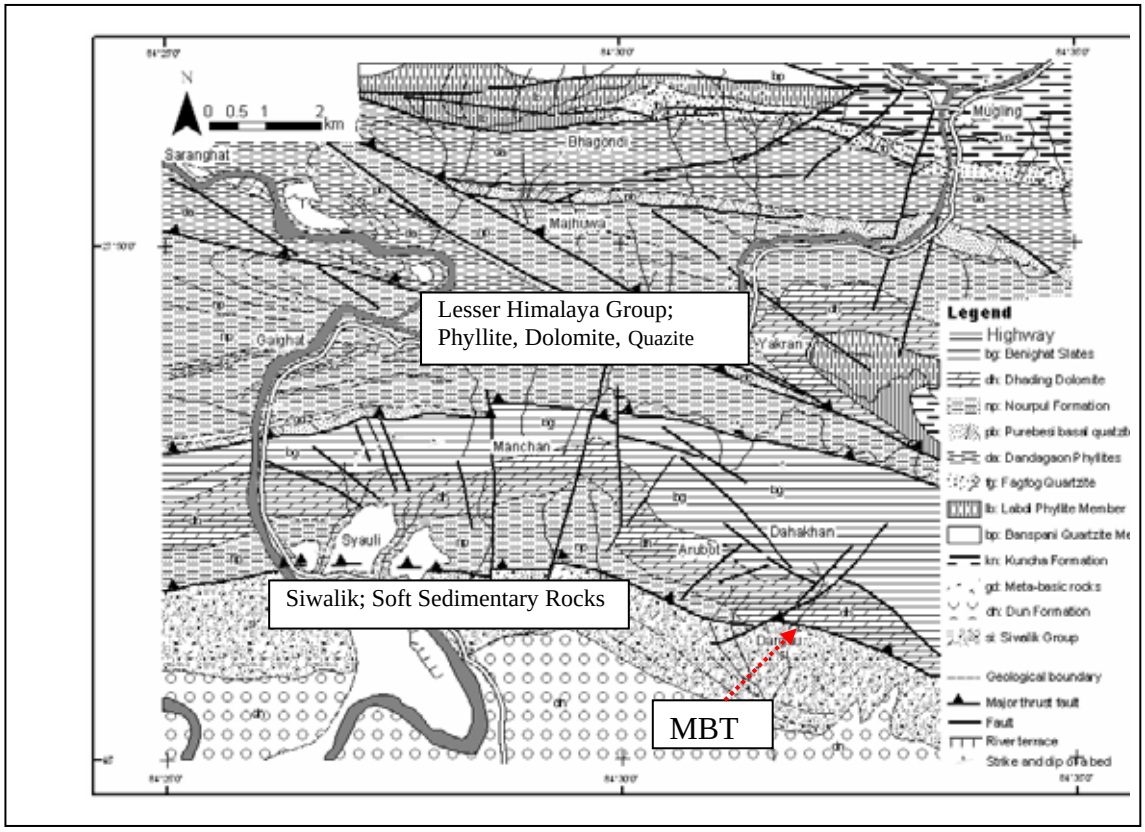


Figure 2.1.5 Geological Map in Kabilash Village and its Vicinity Area

(Modified after Stöcklin and Bhattarai, 1980 and 1982)

- MBT(Main Boundary Thrust) is developing E-W trend in the lower (southern) part which is active (moving) yet,
- Siwalik Group(soft sedimentary rocks) is distributing in the lower(southern) area of MBT,
- Lesser Himalaya Group (phyllite, quartzite, dolomite, hard sedimentary rocks) is distributing in the upper (northern) area of MBT,
- Many fault is developing in the Lesser Himalaya Group which breaks rocks of the group/

- sedimentary rocks; rocks made up in marine or lakes by consolidation
- dolomite; Calcareous rocks containing magnesium, iron, manganese
- quartzite; metamorphic rocks which contains mainly quartz.
- phyllite; metamorphic rocks from sedimentary rocks in which thin cracks are developing

2.2 Sediment-related Disaster Types along N-M Highway and its Vicinity

2.2.1 General Classification of Disaster Type

The term landslide denotes “the movement of a mass of rock, debris or earth down a slope” (Cruden, 1991), and snow avalanches and ice falls are excluded.

Types of movement are divided into five (5) main groups considering failure mechanism as shown figure 2.2.1: FALL, TOPPLE, SLIDE, SPREAD, and FLOW. (U.S. Geological Survey, 2004).

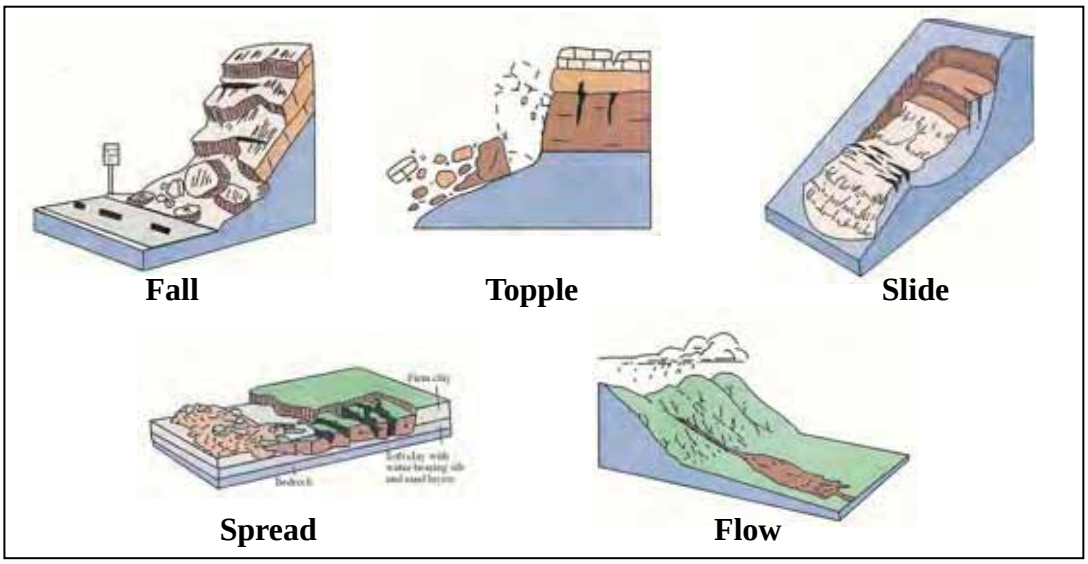


Figure 2.2.1 Schematic Illustrations of the Major Types of Landslide

(US Geological Survey 2004)

- **Fall**: A fall starts with the detachment of rock from a steep slope along a surface on which little or no shear displacement takes place. The material then descends largely through the air by falling, leaping or rolling. Movement is very rapid to extremely rapid.

- **Toppling**: A topple is the forward rotation out of the slope of a mass of soil or rock about a point or axis below the center of gravity of the displaced mass. Toppling is sometimes driven by gravity exerted by material upslope of the displaced mass and sometimes by water or ice in cracks in the mass. Topples range from extremely slow to extremely rapid, sometimes accelerating throughout the movement.

- **Slide**: A slide is a down slope movement of a soil or rock mass occurring dominantly on surface of rupture or on relatively thin zones of intense shear strain. Movement does not initially occur simultaneously over the whole of what eventually becomes the surface of

rupture; the volume of displacing material enlarges from an area of local failure.

Spread: Spread is defined as extension of a cohesive soil or rock mass combined with a general subsidence of the fractured mass of cohesive material into softer underlying materials. The surface of rupture is not a surface of intense shear. Spreads may result from liquefaction or flow of the softer material.

(Debris) Flow: A flow is a spatially continuous movement in which surfaces of shear are short-lived, closely spaced, and usually not preserved. The distribution of velocities in the displacing mass resembles that in a viscous liquid.

2.2.2 Disaster Types along M-N Highway

Most types of disasters mentioned above can be seen along M-N Highway, but a unique classification was made considering features of disaster occurrence that is more practicable and more suitable planning countermeasures of road disasters, referring only to Varnes' classification. The proposed classification is composed of the mode that is based on the review of slope disasters in N-M Highway, especially the catastrophic disasters in 2003. The classification in the Study and their characteristics are shown in Table 2.2.1, and each type is described as follows and is schematically illustrated in Figure 2.2.2.

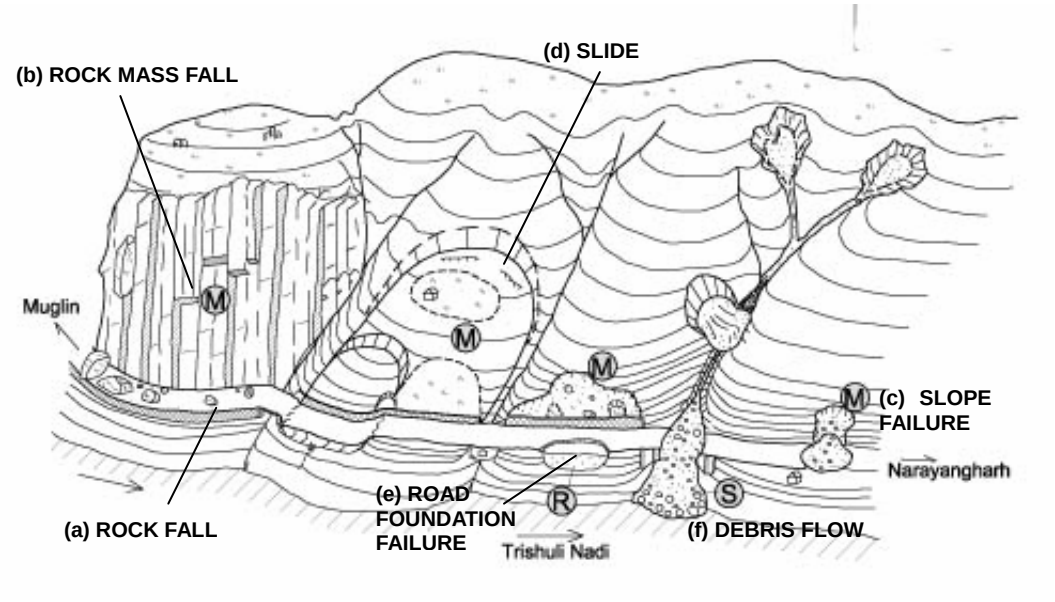


Figure 2.2.2 Illustration of Sediment-related Disaster Type along N-M Highway

(M: Mountainside slope, R: Road and riverside slope, S: Crossing stream)

Table 2.2.1 Classification and Characteristics of Slope Hazard Type in the Study

Slope type	Slope hazard type	Main material	Rate of movement	Predominatel y scale	Main trigger
Mountainside slope	(a) ROCK FALL	bed rock (fresh)	very rapid	Small	rainfall, earthquake
	(b) ROCK MASS FALL	bed rock (fresh)	very rapid	moderate - large	rainfall, earthquake, artificial construction
	(c) SLOPE FAILURE	weathered rock, residual soil, debris	rapid - very rapid	Small - moderate - large	rainfall, earthquake, artificial construction, riverside erosion
Road and riverside slope	(d) SLIDE	bed rock, weathered rock, soil (produced by repeat of sliding), debris	slow -very slow, very rapid	moderate - large	rainfall, earthquake, artificial construction, riverside erosion
	(e) ROAD FOUNDATION FAILURE	embankment material	rapid - very rapid	small - moderate	rainfall, earthquake, artificial construction, riverside erosion
Crossing stream	(f) DEBRIS FLOW	weathered rock, debris, residual soil	very rapid	moderate - large	rainfall

(a) Rock fall

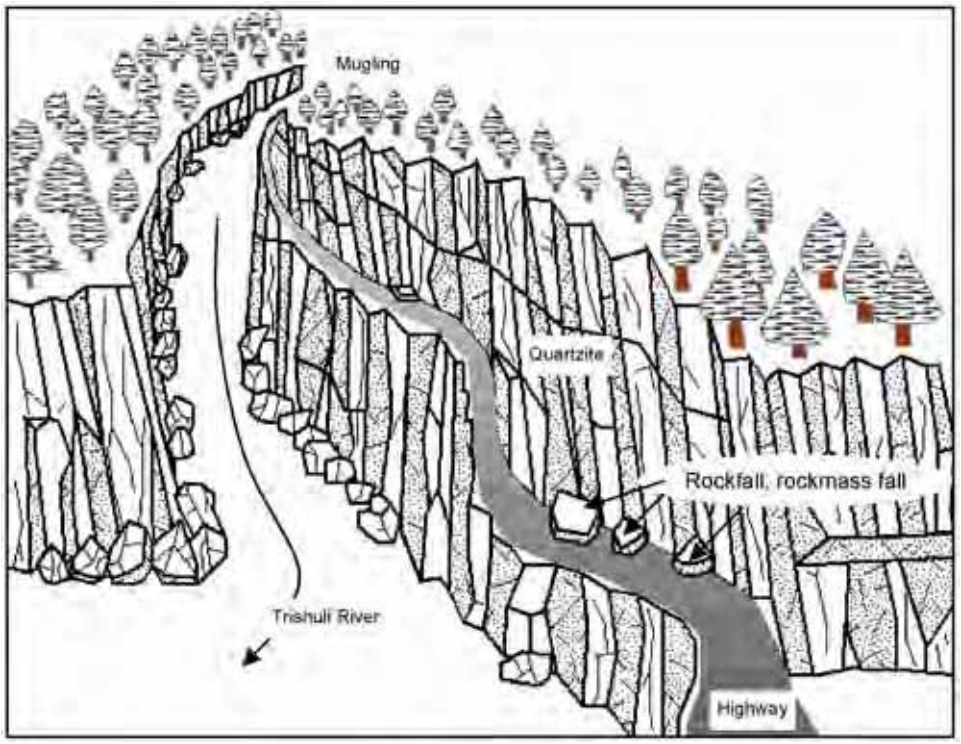


Figure2.2.3 Rock/Rock Mass Failure Prone Section in N-M Highway

(St.34km to 36km)

a) Rock Fall

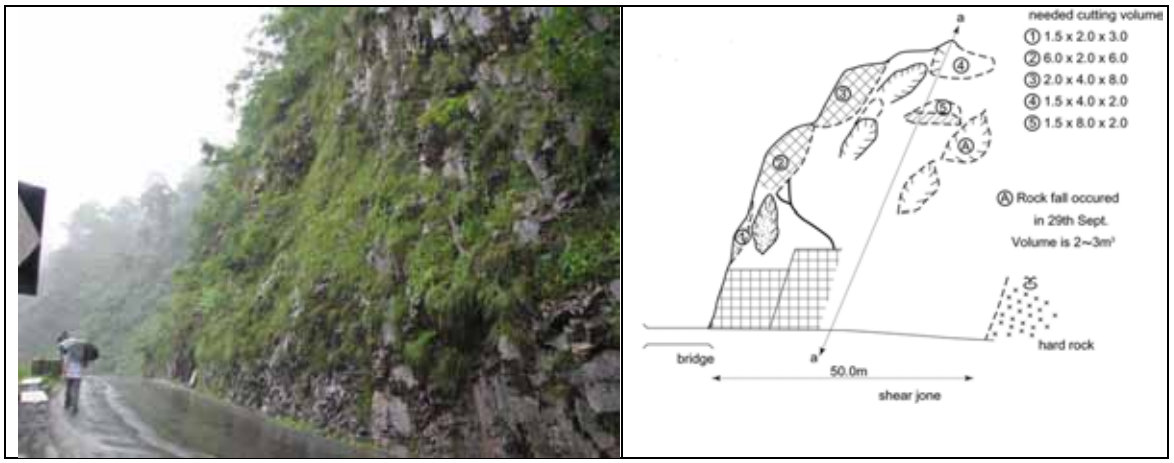


Figure 2.2.3 Rock Fall Occurring intermittently at 34km+200 in N-M Road

- A rock fall is a very rapid detachment from hard rock slopes or soil slopes including boulders and rock,
- It occurs on slopes with gradients over 50 degrees,
- Many discontinuity is developing in rocks,
- Rock falls are usually below dozens of cubic meters,
- Might occur simultaneously with slope failures,
- The modes of failure are free fall, saltation or rolling down of the rock.

(b) Rock mass fall

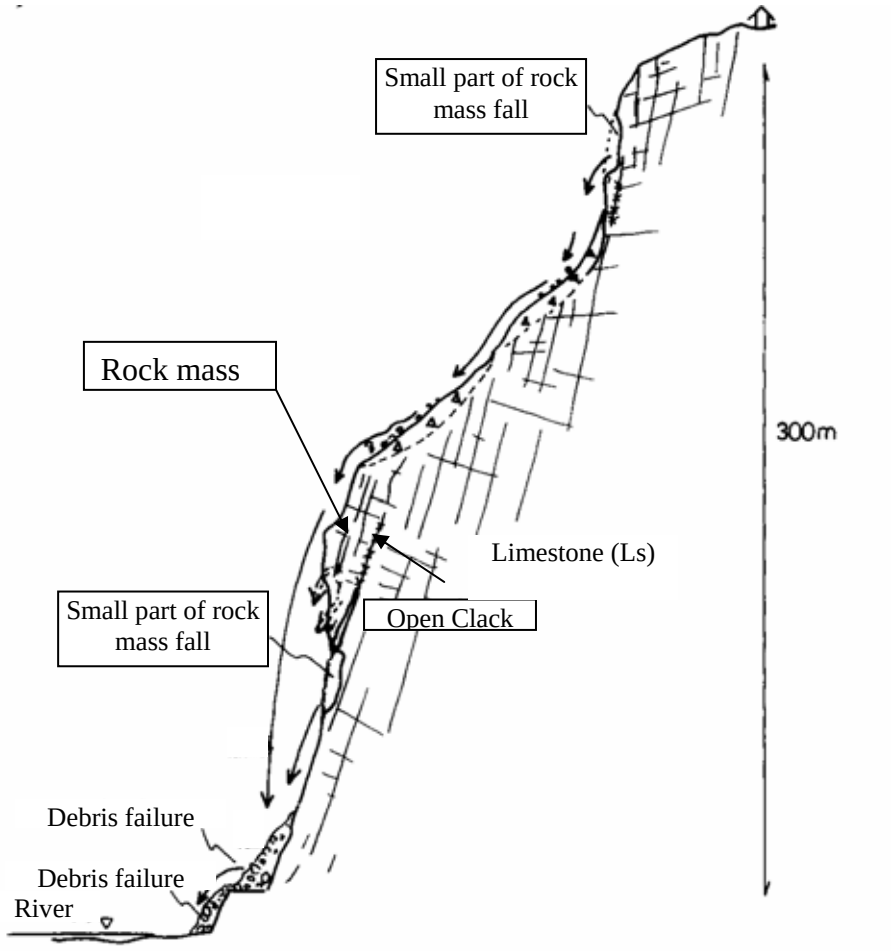


Figure 2.2.4 Schematic Illustration of Rock Mass failure

- A rock mass fall is a very rapid detachment from hard rock slopes in steep cliffs,
- It is influenced by the distribution of cracks and fractured bed rocks,
- The scale of rock mass fall is over a hundred cubic meters or more,
- Damage to roads will be considerable

(a) Slope failure

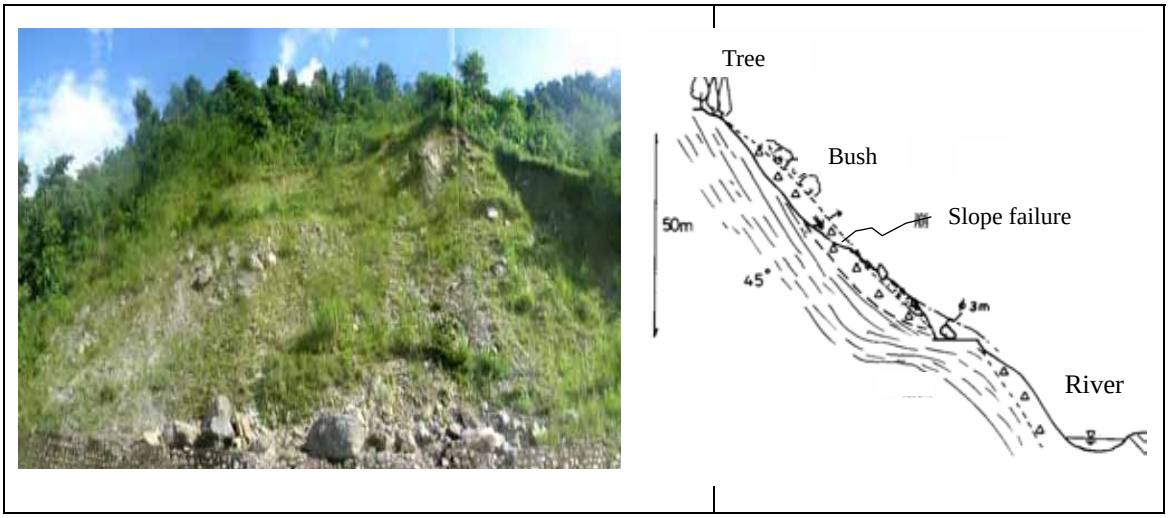


Figure 2.2.5 Cross Section and Photograph of Slope Failure

- A slope failure is a very rapid soil slope failure in high cut or natural slopes,
- It generally occur with gradients of over 45 degrees,
- It is triggered mostly by heavy rain infiltration and saturation,
- The slope failure is divided into a shallow failure and a deep failure.
- Material of shallow failures is generally residual soil produced by weathering of rocks or detritus soils hanging in steep slopes. Generally,
- The volume involved in shallow failure is rather small, ranging from dozens to several hundreds of cubic meters.
- The characteristics of deep failure resemble that of large slide, and the scale is comparatively large to moderate.
- Many shallow failures in the 2003 disaster are distributed in the Study area.

(d) Slide

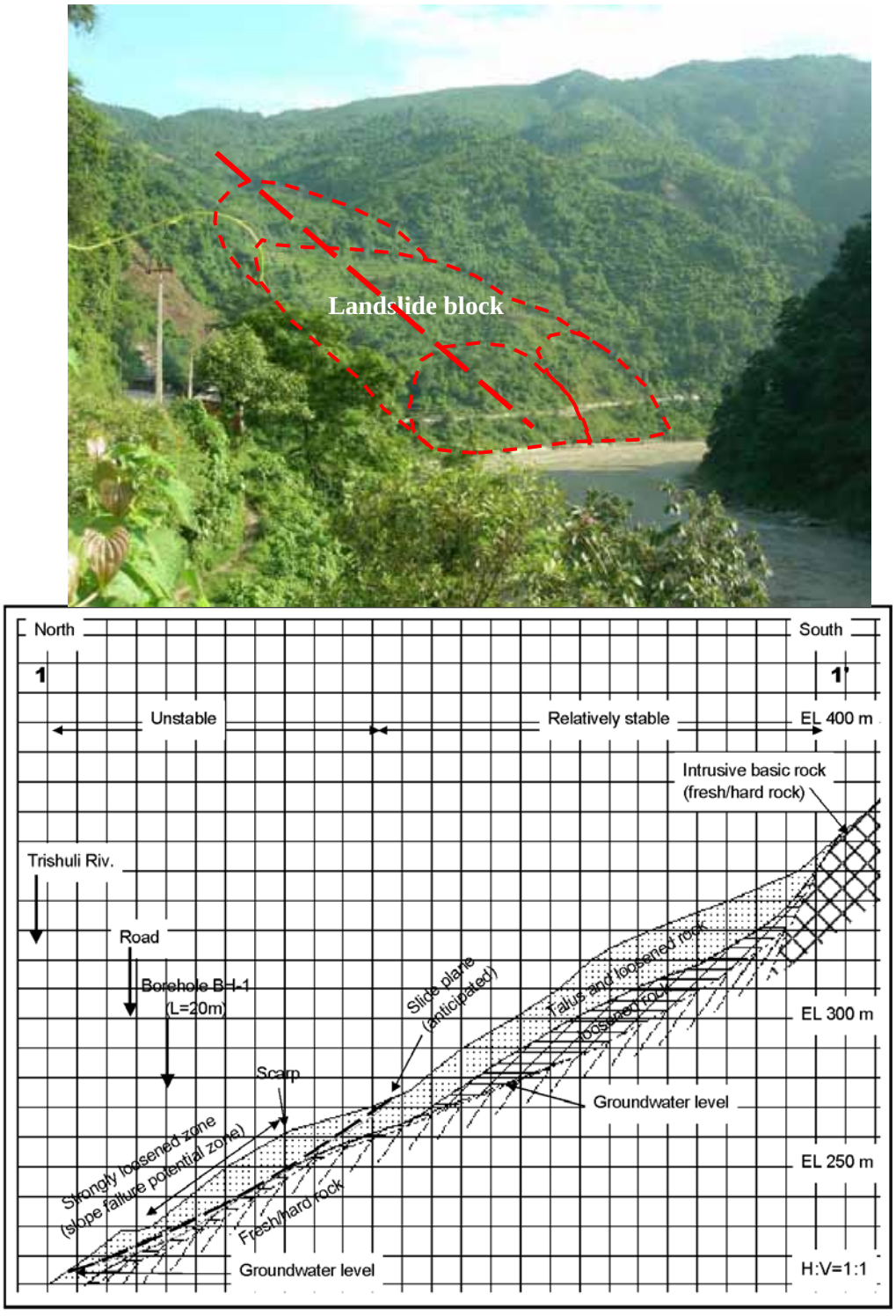


Figure 2.2.6 Photograph and Cross Section of Landslide.

(LS-1 St. 21km+610)

- A slide is a mass movement with slow rate of the movement,
- Including soil mass slide, rock wedge block slide, and rock slope toppling or spreading,
- Slides are activated not only on an upper slope above the road but also on a lower slope below the road,
- Some upheaval or subsidence of part of the road might occur due to the sliding
- The slides are divided into three groups: 1) a slide that clearly has sliding features with gentle slopes, 2) a slide that clearly has no sliding feature, and 3) a deep slide whose characteristics resemble that of deep failures with steep slopes. Group 2) is predominantly distributed in the Study area during the 2003 disaster.
- The slide is prone to occur on slopes of earth and highly weathered rocks, and is activated mostly by rainfall infiltration.
- The movement is slow to extremely slow. Many people live on a gentle slope in the upper part of “huge slide” in the Study area.

(e) Road foundation failure

Figure 2.2.7
Condition of Road Foundation Failure

- Road foundation failures are a failure, slide, erosion and settlement mainly on the road foundation or some parts of the valley-side slope,
- Cause of road foundation failures are;
  Scouring by surface water, river erosion that erodes or scours the river-side slope of the road, this is caused by flooding, earthquakes or artificial constructions,
- The rate of movement is very rapid, and its scale is small to moderate
- Many road foundation failures in the 2003 disaster are distributed in the Study area.

(f) Debris flow

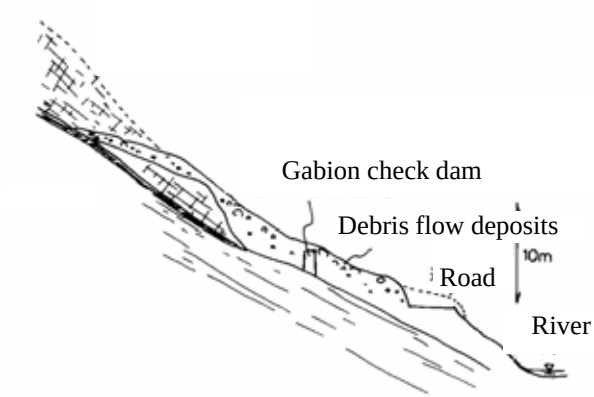


Figure 2.2.8 Cross Section and Photograph of Debris Flow

Figure 2.2.9 Buried Mohore Khola Bridge at km 21+500

- Mostly caused by heavy rainfall as a trigger,
- A debris flow is the rapid flow of boulders, sand, silt and tree mixed with a large quantity of water,
- It flows rapidly down to the riverbed with slope of over 20 degrees, and stops to deposit the debris in the riverbed where the gradient is less than 10 degrees,
- The scale is moderate to large,
- Debris flows are mainly generated by 1) slope failure of riversides, 2) abrupt re-movement of deposits in torrents and 3) failure of nature-made dams,
- Group 1) is predominantly distributed in the Study area during the 2003 disaster.

2.3 Climate of Chitwan District

2.3.1 Climate of Nepal

(1) Climate in General

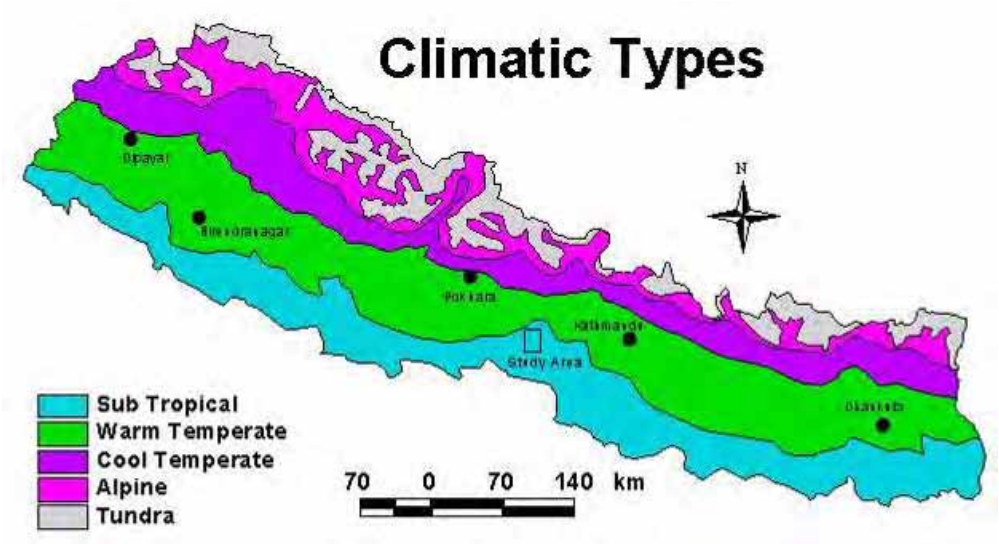


Figure 2.3.1 Climatic Types in Nepal

The climate of Nepal differs drastically in different places and seasons, it has cosmopolitan climates. Nepal has mainly five types of climates which are determined based on altitude ranges (Figure 2.3.1).

- ✧ Sub Tropical Climate
- ✧ Warm Temperate Climate
- ✧ Cool Temperate Climate
- ✧ Alpine Climate
- ✧ Tundra Climate

In general, Nepal has cold and dry winter, hot and dry summer, and heavy monsoon periods. Globally most of the countries have four seasons, however, Nepal has six seasons:

- ✧ Spring or Vasant (Mid-March to Mid-May),
- ✧ Summer or Grishma (Mid-May to Mid-July),

- ✧ Monsoon or Varsa (Mid-July to Mid-September),
- ✧ Autumn or Sharad (Mid-September to Mid-November),
- ✧ Hemant (Mid-November to Mid- January) and,
- ✧ Shishir (Mid-January to Mid-March).

(2) Annual Rainfall

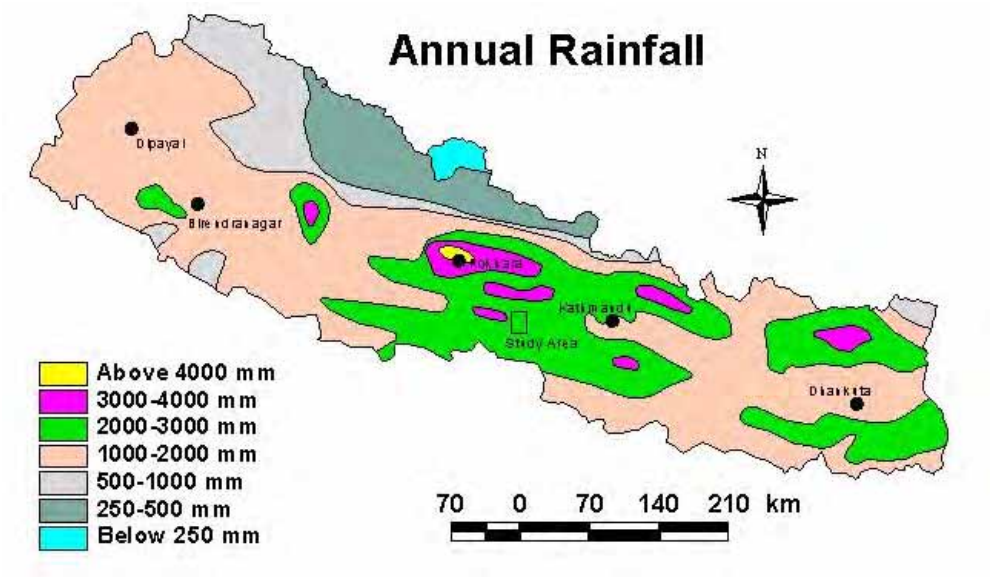


Figure 2.2.2 Annual Rainfall in Nepal

(a) Orographical Rain

In Nepal, rainfall has wide temporal and spatial variability. Several pocket areas in Nepal receive high rainfall more than 3000 mm in a year. Such high annual rainfall receiving areas lies close to Num in eastern Nepal, Gumthang in Central Nepal and Pokhara in western Nepal. The highest rainfall receiving area is Pokhara with more than 4000 mm rainfall in a year (orographical rain).

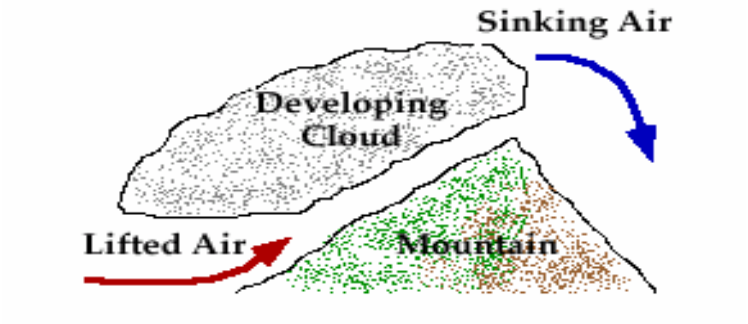


Figure 2.3.2 Schematic Illustration of Orographical Rain

(b) Monsoon Rain

Rainfall in Nepal is primarily affected by the summer monsoon developed over the Bengal Bay. Therefore, high rainfall, about 80% of total annual rainfall, receives during the summer monsoon period between June and September. The remaining period receives about 20% of total annual rainfall.

(c) Conventional Rain

This rain occurs heavily but briefly with thunder and lightning. When warm air rises and reaches upper layer of atmosphere, it cools and condenses. The condensed air forms cumulous clouds and cause rainfall. This type of rain is common during summer and hotter part of the day (noon).

2.3.2 Climate in Chitwan District

(1) Temperature

The elevation of Chitwan district ranges from 200-900m from the MSL, so climate is sub-tropical type. In winter, temperature ranges from 6-25° C in this district. Moreover, in summer, the southernmost and depressed part of this district becomes quite hot, but areas lying on elevated places on the northernmost part of this district have comfortable climate. In summer, temperature ranges from 25-40 °C in Chitwan district. Evergreen forests are prevailed throughout the highway in Chitwan. The maximum temperature of Bharatpur station during 2002-06 is shown in Figure 2.3.3

This hot climate promotes weathering (degradation of rocks and soils).

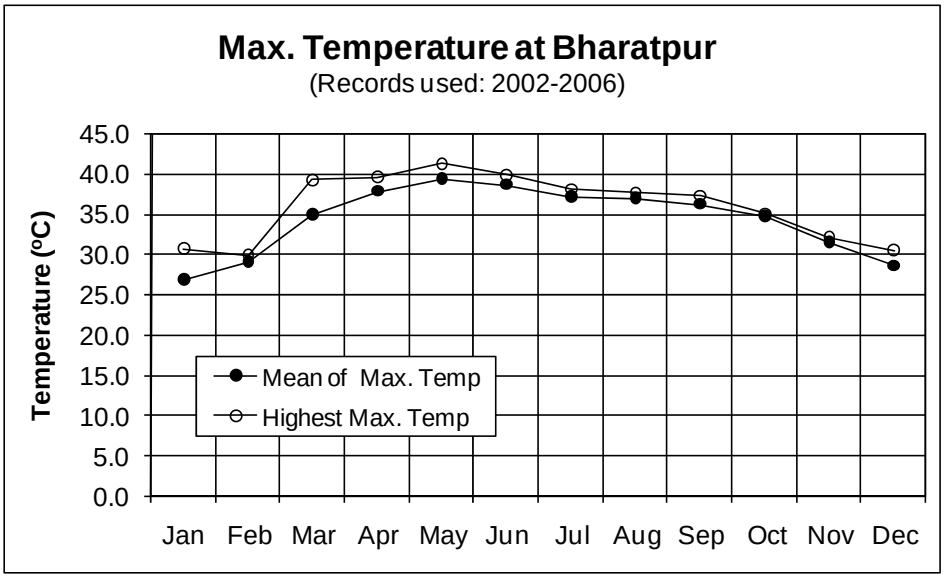


Figure 2.3.3 Maximum Air Temperature of Bharatpur Station

(2) Average Rainfall

The mean annual rainfall in Chitwan district is about 2650 mm which is big present from nature to sustain human lives. But, it some time causes sediment-related disasters.

2.3.3 Rainfall Monitoring in and Around N-M Highway

Rainfall monitoring is being carried out by DHM(Department of Hydrology and Meteorology).

Rainfall monitoring data is basic information to plan various project.

- Disaster management project,
- Agricultural development project,
- Power Development & etc.

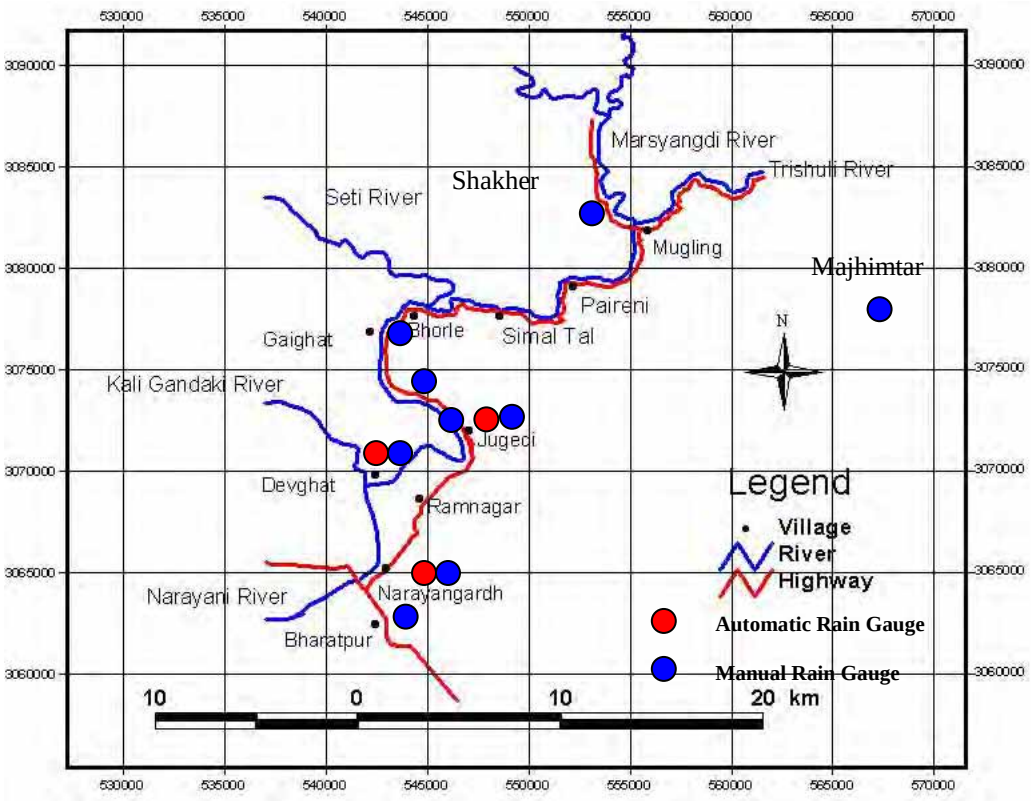


Figure 2.3.4 Rainfall Stations in around Narayangharh-Mugling Highway

The spatial distribution of rainfall stations in and around study area is shown in Figure 2.3.4.

- Kahale Khola (manual rain gauge at 11 km from Narayangharh on the highway) ;monitored by Division Road Office Bharatpur from 2004,
- Devghat (manual/automatic rain gauges at downstream of confluence of Kali Gandaki) ; monitored by DHM
- Bharatpur (manual at Bharatpur Municipality compound), monitored by DHM
- Shakher and Majhimtar stations(manual rain gauge). monitored by DHM

In addition to above monitoring sites, following rainfall monitoring are started from June 2008.

- Jugedi (manual/automatic rain gauge at health post in Kabilash Village) ; monitored by Kabilash Village
- Bharatpur (manual/automatic rain gauges at Bharatpur Municipality compound), monitored by Division Road Office, Bharatpur
- 21 km and 31 km from Bharatpur along Narayangharh-Mugling Highway (manual rain gauges), monitored by Division Road Office, Bharatpur

Khola Station: This station was established after 2003 disaster by the Divisional Road Office, Bharatpur at 11 km on Narayangharh-Mugling highway. Non-recording rain gauge was installed and daily rainfalls are being measured since 2004.

Devghat Station: This station is located at downstream of confluence of Kali Gandaki. At this station, both non-recording and recording types of rain gauges are installed by the Department of Hydrology and Meteorology (DHM). The hourly and daily rainfalls are being recorded at this station since 1998. Operational condition of the station at present is satisfactory. Daily rainfalls data of 1998-2006 of this station were made available.

Bharatpur Station: The station has non-recording rain gauge and is located in Bharatpur Municipality compound. This station is managed by Department of Hydrology and Meteorology (DHM). Discontinuous daily rainfall records of 2002-06 were made available, however, operational condition of the station seems satisfactory.

Figure 2.3.5 Rain gauges at Devigaht Station

Figure 2.3.6 Rain gauge station at Kahare Kohola

2.3.4 Rainfall related to Sediment-Related Disasters

Devghat station is the only nearby station from the highway with long time-series daily rainfall records (1998-2006). Therefore, daily rainfall records of Devghat station were use for analyzing the maximum annual 1-day, 2-day and 3-day rainfalls and their return period analysis.

(1) Maximum 1-day, 2-day & 3-day Rainfalls

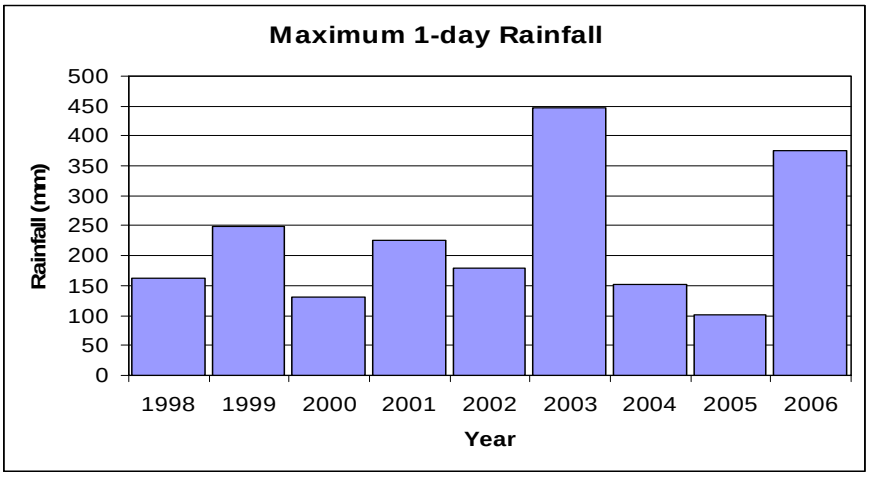


Figure 2.3.7 Maximum 1-day Rainfall (Devghat Station)

Table 2.3.1 Return Period of 1-day Rainfall

S. N.	Daily Rainfall (mm)	Return Period (Year)
1	200	2
2	250	3
3	300	5
4	350	7
5	400	10
6	450	16

- Daily rainfall: amount of daily accumulative rainfall
- Return period：Technical term of statistic;
  Frequency analysis result of rainfall amount (such as one day rainfall) by rainfall monitoring data. ‘Rain fall amount of return period T year’ means rain fall will occur once in every T year.

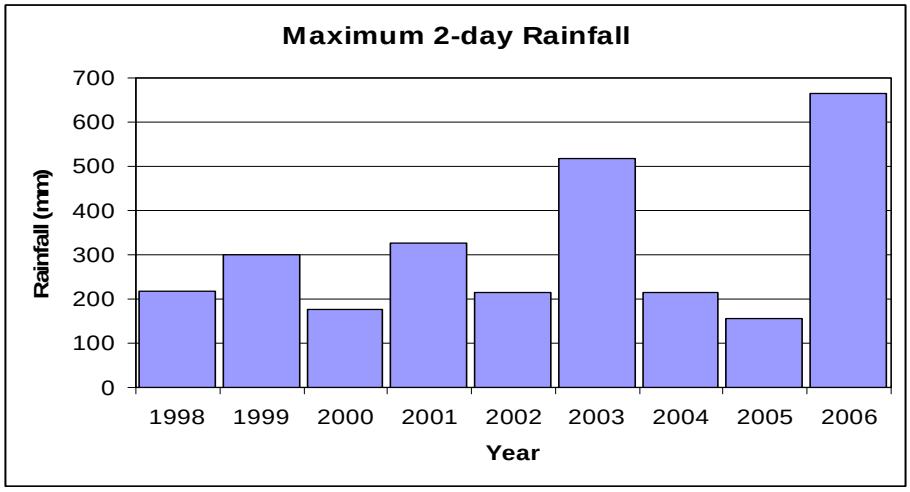


Figure 2.3.8 Maximum 2-day Rainfall (Devghat Station)

Table 2.3.2 Return Period of 2-day Rainfall

S. N.	2-day Rainfall (mm)	Return Period (Year)
1	240	2
2	305	3
3	350	4
4	390	5
5	430	6
6	465	7
7	480	8
8	520	9
9	550	10
10	600	12
11	650	15

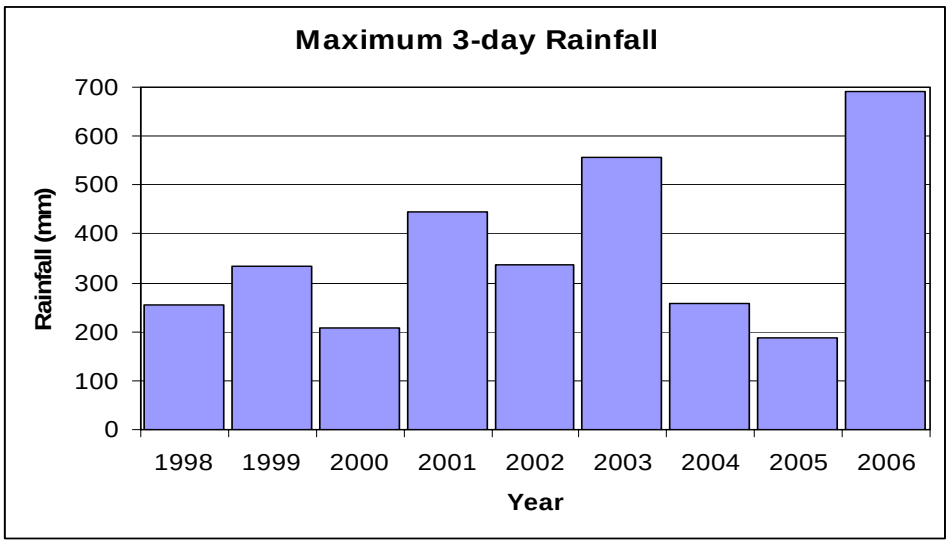


Figure 2.3.9 Maximum 3-day Rainfall (Devghat Station)

Table 2.3.3 Return Period of 3-day Rainfall

S. N.	3-day Rainfall (mm)	Return Period (Year)
1	305	2
2	385	3
3	440	4
4	490	5
5	520	6
6	550	7
7	570	8
8	600	9
9	620	10
10	640	11
11	680	16

- Maximum 1day rainfall ranges from 100mm(2005) to 450mm(2003),
- Big scale debris flow occurred in 2003 and 2006, under 450mm and 380mm 1 day rainfall respectively
- Small scale debris flow occurred in 2007 at 11km+200 when 300mm 1 day rainfall came down.
- It is supposed that over 400mm 1 day rainfall will induce big scale

(2) Daily Rainfall Pattern

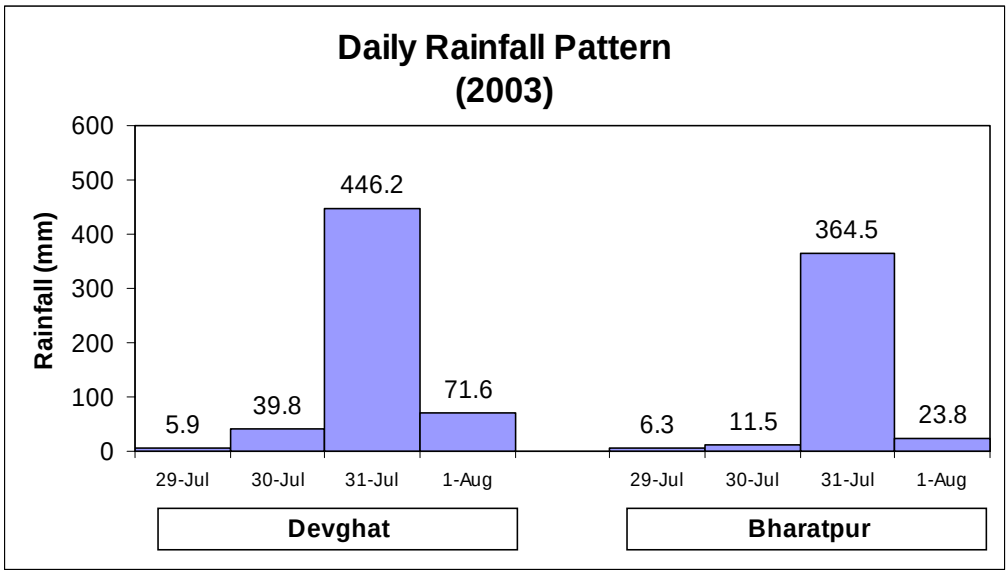


Figure 2.3.10 Daily Rainfall Pattern during 2003 Disaster

a) Daily Rainfall Pattern during 2003 Disaster

The daily rainfall patterns of Devghat and Bharatpur stations are shown as Figure 2.2.6. With daily rainfall pattern of Devghat station during 2003 disaster, it can be concluded that landslides and debris flow occur on the highway if rainfall continued for 2 days with considerable amount of rainfall on the first day and heavy rainfall of more than 300 mm on the second day.

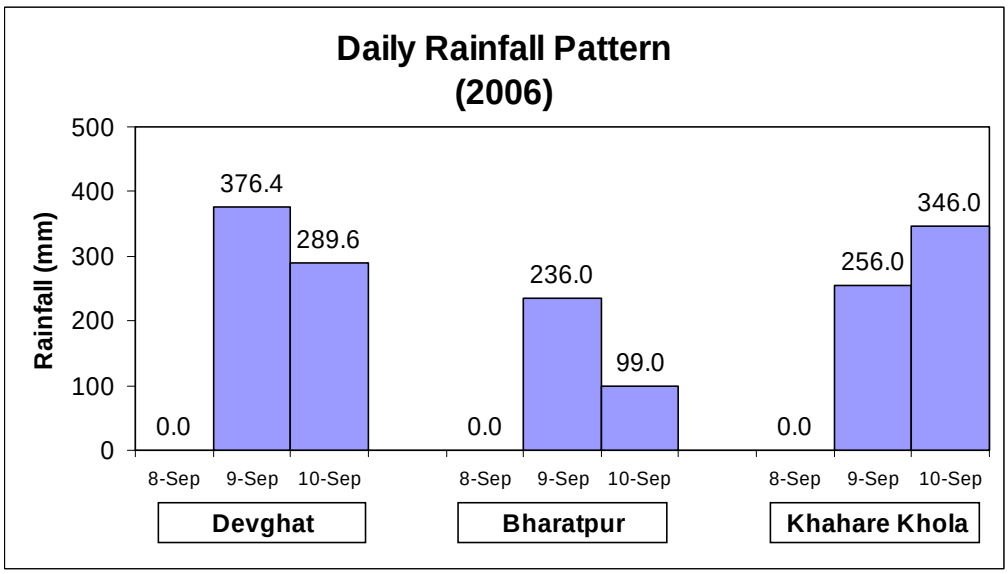


Figure 2.3.11 Daily Rainfall Pattern during 2003 Disaster

b) Daily Rainfall Pattern during 2006 Disaster

The daily rainfall patterns of Devghat, Bhratpur and Khahare Khola stations are shown as Figure 2.2.7. With daily rainfall pattern of Devghat and Khahare Khola stations during 2006 disaster, it can be concluded that landslides and debris flow occur on the highway if rainfall continued for 2 days with considerable amount of rainfall on the first day and heavy rainfall of more than 300 mm on the second day as concluded earlier.

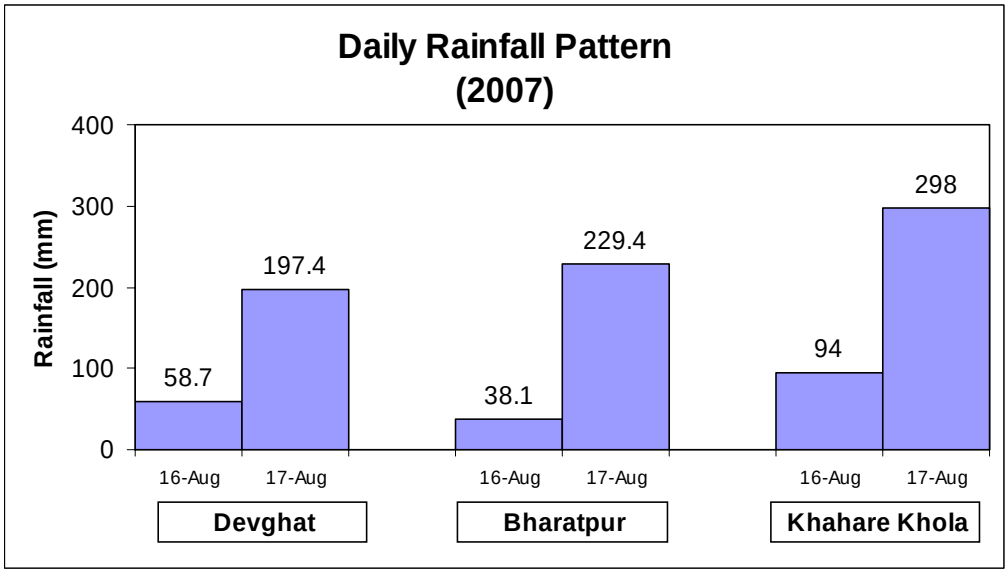


Figure 2.3.12 Daily Rainfall Pattern in 2007

c) Daily Rainfall Pattern during Recent Rainfall Days

The daily rainfall patterns of Devghat, Bharatpur and Khahare Khola stations for recent heavy rainfall days on 16-17 August 2007 were analyzed (Figure 2.5.3). At Devghat station, daily rainfalls were 58.7 mm and 197.4 mm on 16th and 17th August, respectively. The maximum 1-hour rain intensity was 39.5 mm/hr during rainfall at Devghat. At Bharatpur station, daily rainfalls were 38.1 mm and 229.4 mm on 16th and 17th August, respectively. Further, at Khahare Khola station, daily rainfalls were 94.0 mm and 298.0 mm 16th and 17th August, respectively. The rainfall pattern shows, the 2-day rainfall were 256.1 mm, 267.5 mm and 392.0 mm at Devghat, Bharatpur and Khahare Khola stations, respectively. The highway condition was inspected by the JICA Study Team on 17 August after heavy rainfall. During inspection it has been observed that landslides were occurred at several places on the highway, and length workers were busy on clearing the landslides for easy movement of vehicles on the highway.

Conclusion: From the inspection of the highway, it can be concluded that highway is vulnerable to landslides when rainfall continues for 2 days with considerable amount of rainfall on the first day and heavy rainfall of more than 200 mm on the second day.

(3) Hourly Rainfall

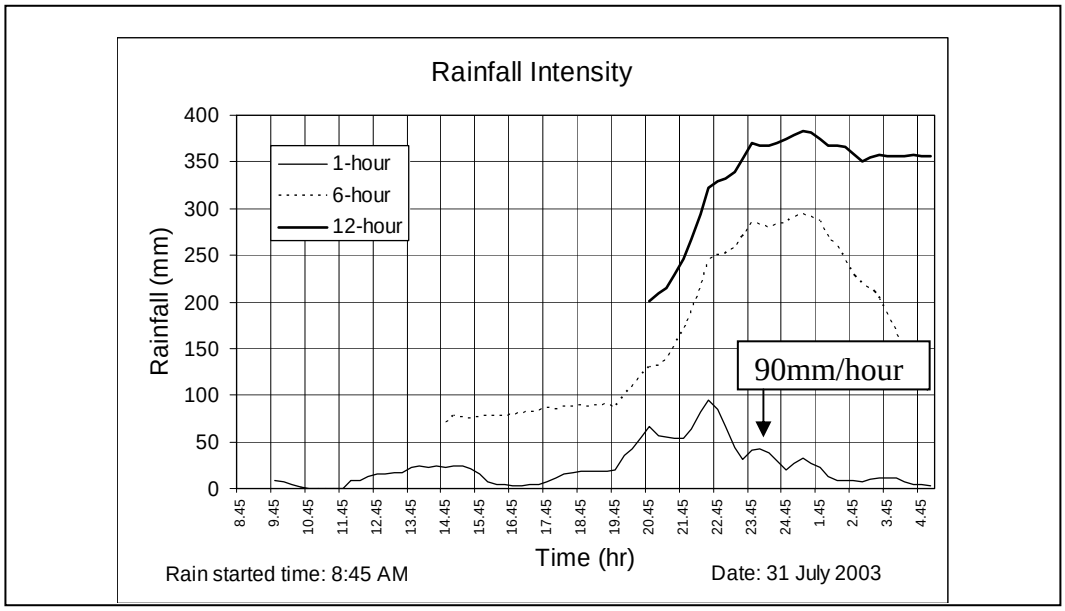


Figure 2.3.13 Rainfall Intensity on 31 July 2003 at Devghat Station

- Most strongest hourly rainfall was 90mm/hour

The 90mm/houer rainfall on 31 July 2003 at Devghat Station was most teribble level of rainfall!!

(4) Rainfall Isohyets

The rainfall isohyets of 20 mm intervals were prepared for the day of 2003 disaster (Figure 2.4.1). The rainfall isohyets were prepared using daily rainfall of 11 stations in and around the study area.

- The isohyets show 280 - 446 mm/day rainfall occurred on the stretch of the highway,
- The rainfall isohyets showed 446.2 mm of rainfall was occurred at Devghat and its surrounding,
- Rainfall isohyets shows rainfall amount is different in each monitoring station
- The isohyets could be developed more precisely if there were more rainfall stations along the highway.

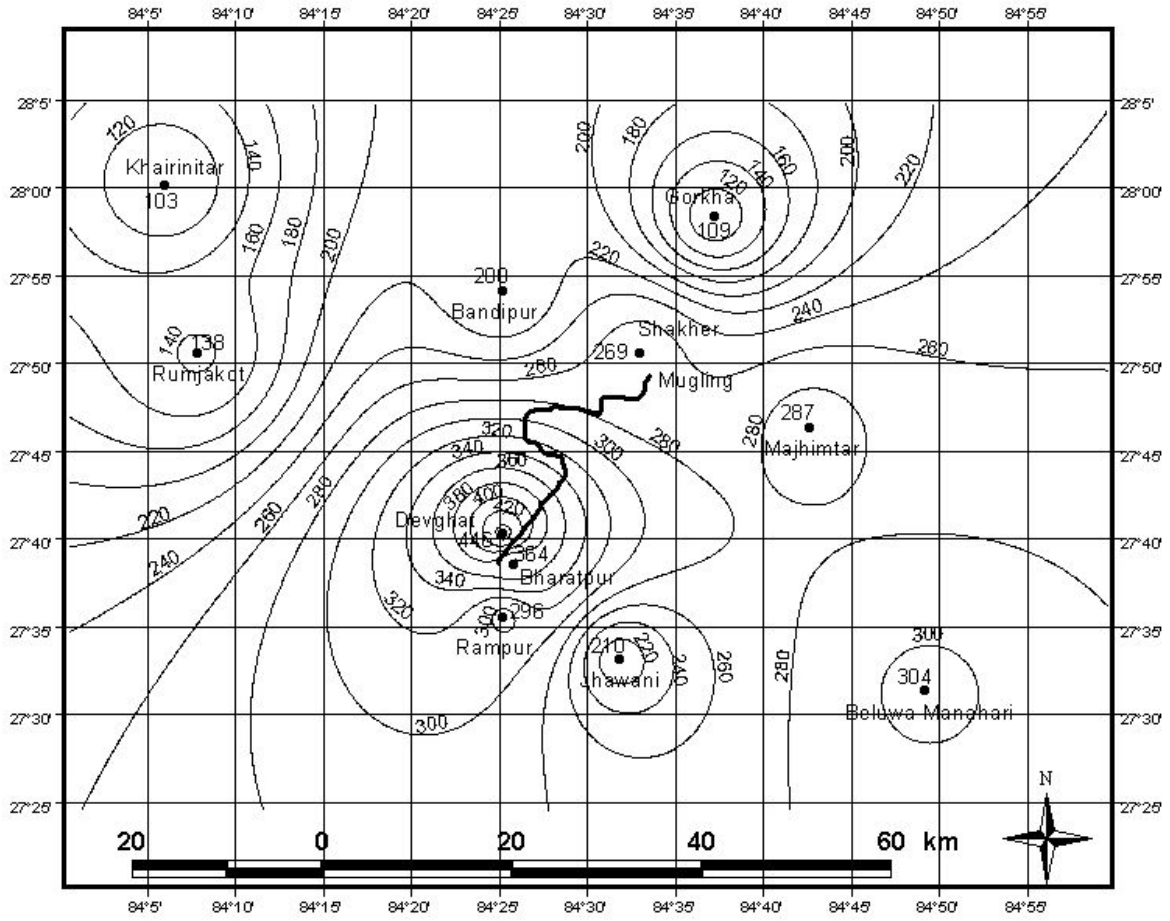


Figure 2.3.14 Daily Rainfall Isohyets (31 July 2003)

(5) Early Warning Criteria

Early warning criteria was made using "Modified rainfall amount of 12 hour-half value" as shown in Figure 2.3.15.

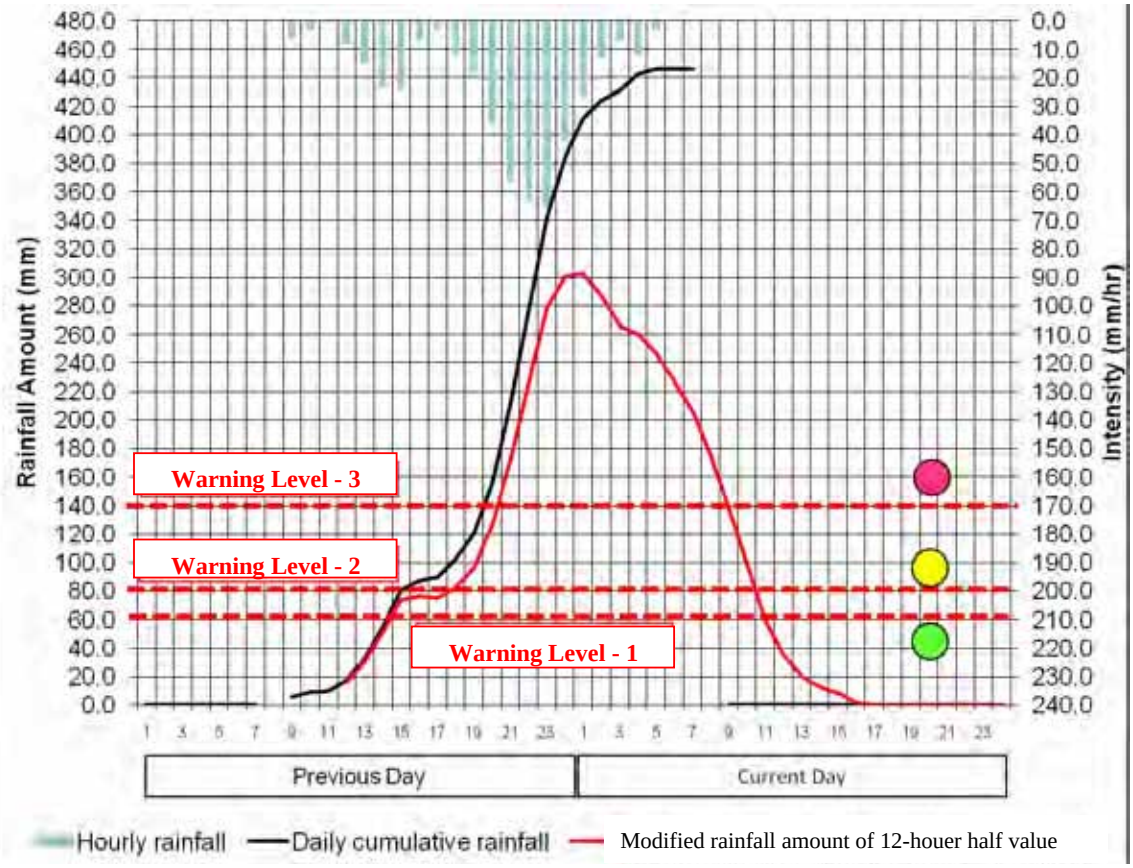


Figure 2.3.15 Warning Levels for Village Residents Evacuation

- Modified rainfall amount of 12 hour-half value ;

  At a certain time, the stability of ground is affected by rainfall. It is not influenced by only rainfall in a certain time, but antecedent rainfall before a certain time also has an influence on stability of ground. As one of the methods, there is a concept that half-amount of antecedent rainfall has effect on land stability. On this concept, rainfall amount is modified another amount.

  Even if the rain water at a certain time becomes a running water, part of rain water permeates into ground. Then a part of permeated rain water stores in ground, and another runs off to ground surface as seepage.

  For example, after 12 hours of rainfall time, we assume that half-amount of rain water have an influence on stability of ground. If rainfall amount at a certain time is α mm, amount affected after 12 hours is $1/2\alpha$ mm. If it is rain at amount of β mm after 12 hours, at this time, rainfall amount influenced on stability of ground is $(1/2\alpha+\beta)$ mm. According to this concept, rainfall amount is modified. It is called “Modified rainfall amount of 12 hour-half value”. And Figure 2.3.16 shows the concept of modified rainfall amount.

  If we measure rainfall per one hour, hourly rainfall amount is drawn up bar graph as shown at lowest graph of Figure 2.3.17. Hourly rainfall amount is also called the rainfall intensity. When rainfall amount is accumulated from the beginning of the falling rain to the end of it, middle graph of Figure 2.3.17 shows the cumulative rainfall amount. In this cumulative rainfall, it is also called the continuous rainfall. Cumulative rainfall amount at second rainfall set of Figure 2.3.17 is different from its first rainfall set because of one set of rainfall. At the viewpoint of the stability of ground, this continuous rainfall is not considered about the influence of permeated rain water. At second rainfall, amount of first rainfall set would have an influence on stability of ground, so correlation between disaster occurrence and 'the modified rainfall amount of 12 hour-half value' is often better than continuous rainfall amount as shown in Figure 2.3.17. We would assume that occurrence of disaster is influenced by storage water. Therefore ‘the modified rainfall amount indicator’ should be applied for early warning criteria.

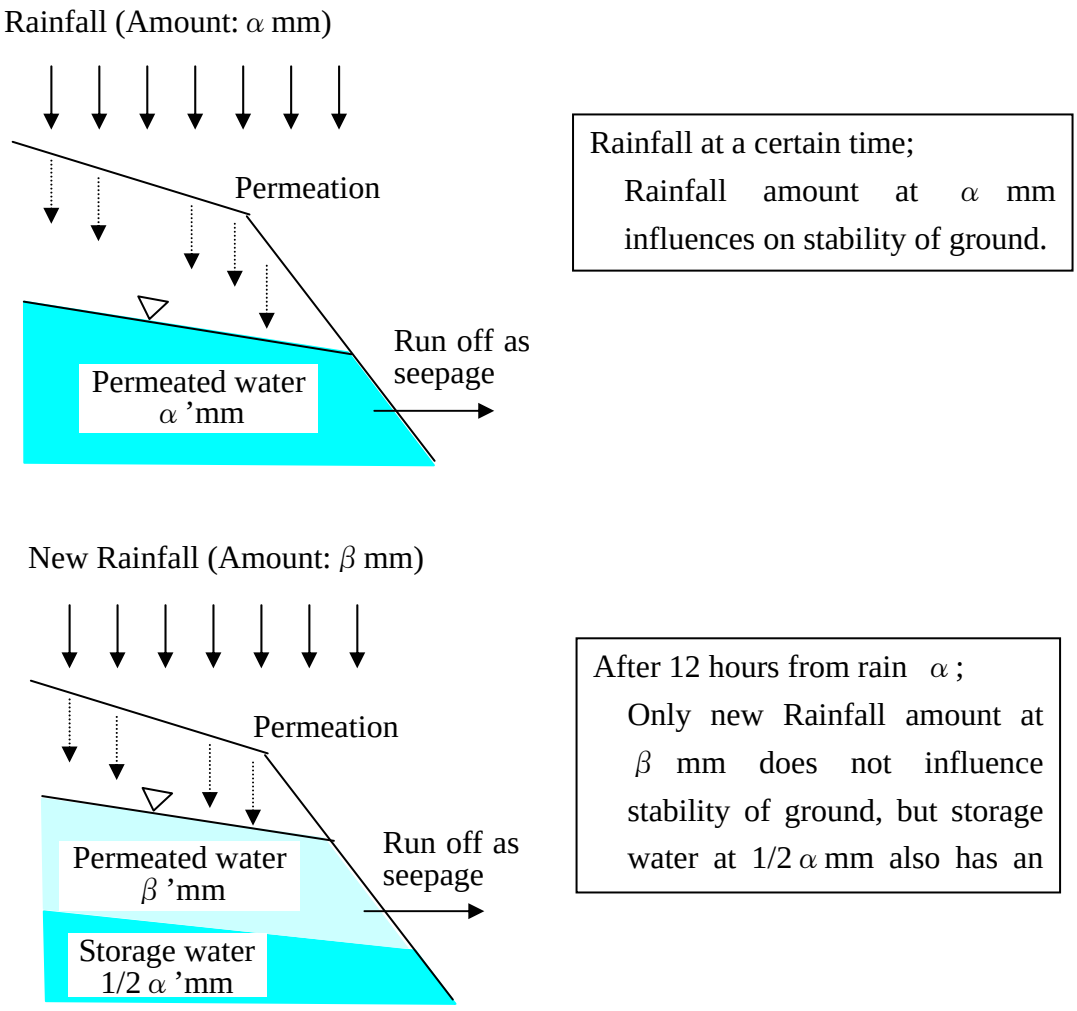


Figure 2.3.16 Concept of Modified Rainfall Amount

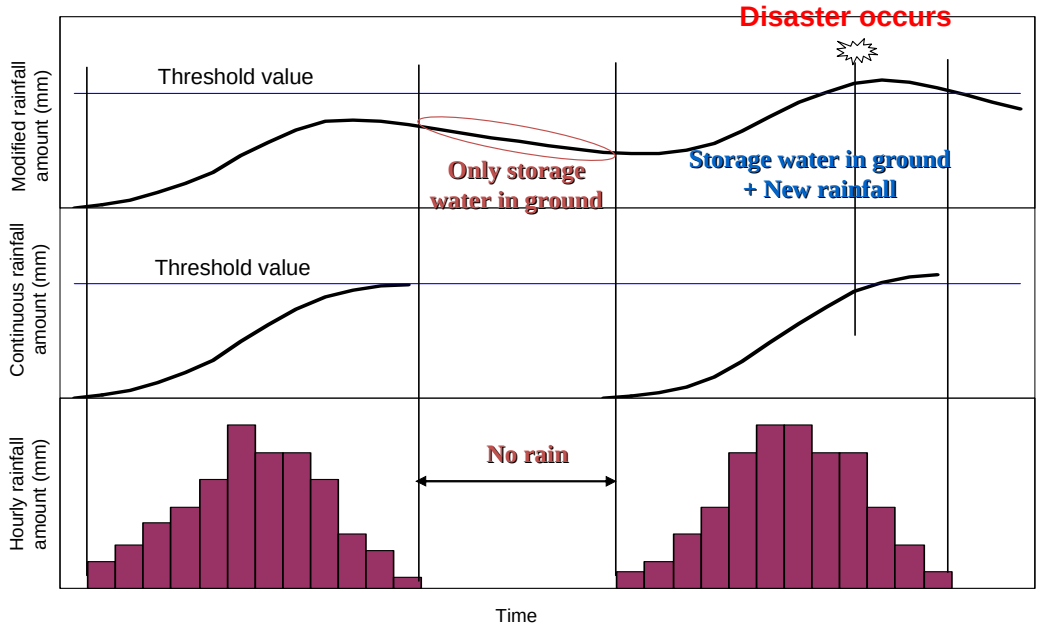


Figure 2.3.17 Advantage of Modified Rainfall Amount Procedure

Early Warning Criteria

Level I – Care:

If 12-hour half-value rainfall amount becomes more than 60 mm (1-year return period) then this level-care will be issued.

Level I care will be announced to early warning/evacuation team and ward representatives; and to start monitoring of the rainfall hourly by the assigned persons.

Level II – Caution:

If 12-hour half-value rainfall amount becomes more than 80 mm (2-year return period) then this level-caution will be issued.

Level II Caution Notice will be issued to prepare of evacuation of specific inhabitants of dangerous area for water-induced disasters, to avoid transference in village of all villagers (students should wait home or school).

Level III– Warning:

If 12-hour half-value modified rainfall amount becomes more than 140 mm (5-year return period) then this warning level will be issued.

This level will be issued to evacuate of specific inhabitants of dangerous area for water-induced disasters until 'Modified rainfall of 12 hour half-value' is under Level I (60 mm).

Term for Rainfall intensity classification and necessity of care stance (villager should be check warning information by Kalika FM radio) for villagers is shown in Table 2.3.4.

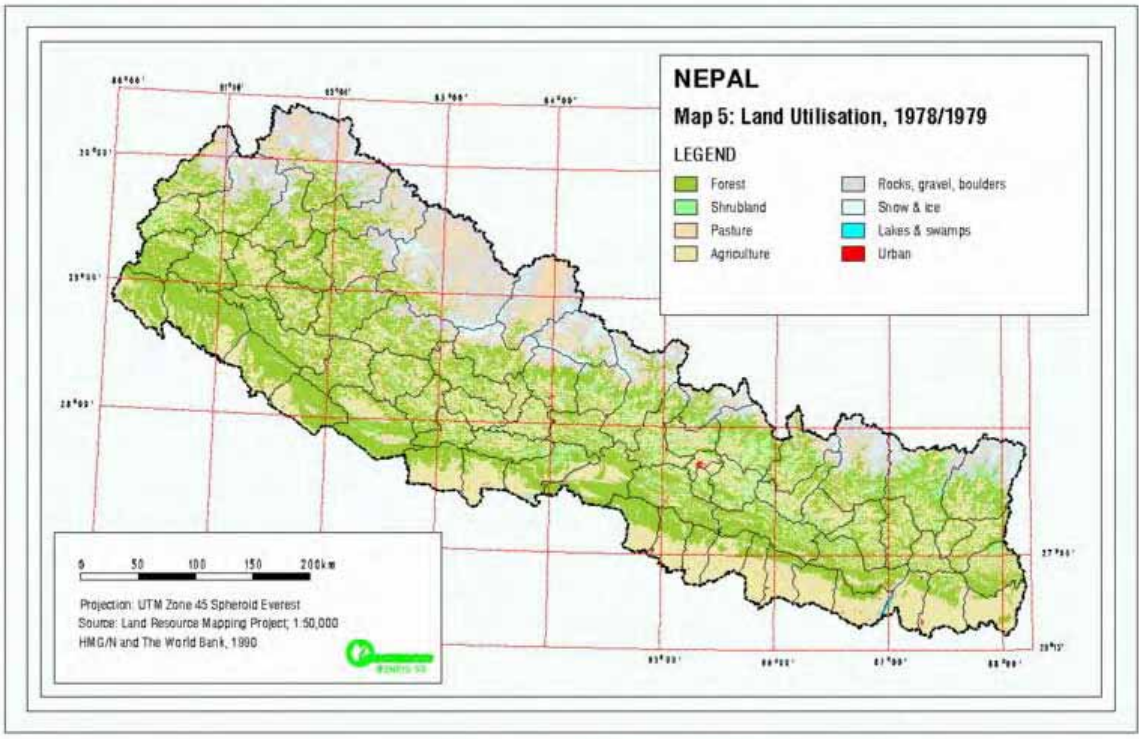
Table 2.3.4 Rainfall Intensity and Necessity of Care Stance
(Modified from the Table provided by Japan Metrological Agency)

Rainfall Intensity (mm/hour)	Categories of Rainfall Intensity	Situation	Possibility of 'Level 2 Caution' or 'Level 3 Waning' Stance for Water-induced Disaster in Kabilash Village (Villager should turn on radio Kalika FM to get warning information)
Under 3	Small rain	➢ Wet road surface	-
3-10	Normal rain	➢ Rainy sound will be listened ➢ Water pond will be come out	Continuous 'normal rain' of 5 hour
10-20	A little strong rain	➢ Rains with rushing sound ➢ Feet be get wet by splashing from ground ➢ Water ponds come out in many places on the ground	Continuous 'a little strong rain' of 2 hour
20-30	Strong rain	➢ Rains as cat and dogs ➢ Umbrella lost function ➢ Difficult to look forward even quick wiper	Continuous 'strong rain' of 1 hour
30-50	Heavy rain	➢ Rains as turned out bucket ➢ Road becomes as river ➢ No break control on highs speed cars	Continuous 'Heavy rain/very heavy rain/terrible rain' of 0.5 hour
50-80	Very heavy rain	➢ Rain like water fall with strong rushing sound ➢ Bad visibility due to white out and splashing ➢ Driving is impossible	
Over 80	Terrible rain	➢ Feel breathless oppression and fear for strong rain	

2.4 Land Use of Nepal

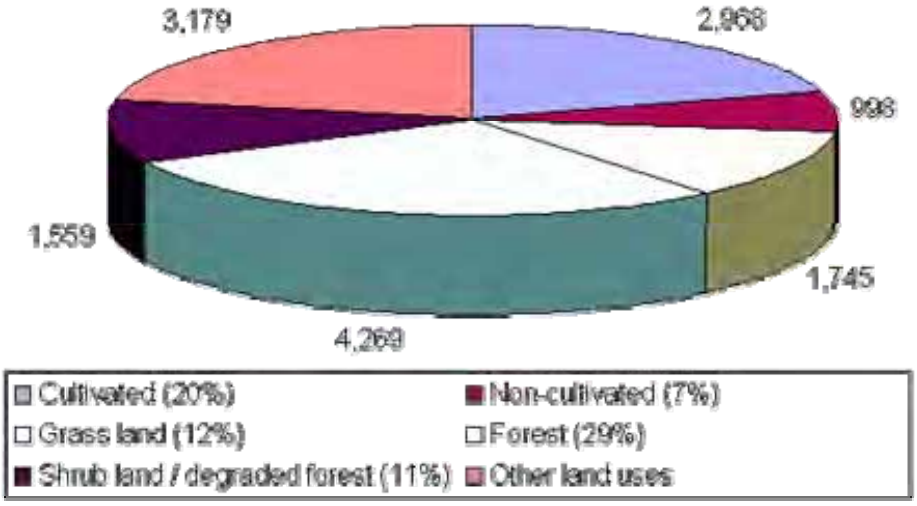
2.4.1 Land Use of Nepal

Land utilization map in Nepal is shown as Figure 2.4.1. And, land use pattern in Nepal is shown as Figure 2.4.2. The Land Resource Mapping Project (LRMP) categorized the major land uses of Nepal into agriculture, forest, grazing, and others. The extents of these major land uses by physiographic regions have been summarized in Table 2.4.1. The table shows nearly 27 percent of the total land area of the country as under agriculture, which includes about 7 percent non-cultivated inclusion within the agricultural land; about 12 percent under grazing; 43 percent under forest; and about 19 percent under other land uses which include snow, ice and rock outcrop. The non-cultivated inclusions in Table 2.3.1 indicate the areas under other land use categories mapped as agricultural land due to the limitations of map scale.



Source: http://www.fao.org/ag/AGL/swlwpnr/reports/y_sa/z_np/npmp281.htm

Figure 2.4.1 Land Utilization Map in Nepal



Source: FAO (2005), http://www.fao.org/ag/AGL/swlwpnr/reports/y_sa/z_np/npch281.htm

Figure 2.4.2 Land Use Pattern in Nepal (Area in '000 ha)

Table 2.4.1 Major Land Uses by Physiographic Regions (1986)

Physiographic Region	Agriculture			Grazing	Forest	Other	Total
	Cultivated	Non* Cultivated	Total				
High Himal	8	2	10	884	221	2234	3349
	(0.2)	(0.05)	(0.26)	(26.0)	(6.6)	(67.0)	
High Mountains	245	147	392	510	1813	245	2960
	(8.1)	(5.0)	(13.1)	(17.2)	(61.2)	(8.3)	
Middle Mountains	1222	665	1887	293	2202	61	4443
	(27.5)	(15.0)	(42.5)	(6.6)	(49.6)	(1.4)	
Siwaliks	259	55	314	21	1477	74	1886
	(13.7)	(2.9)	(16.6)	(1.1)	(78.3)	(3.9)	
Terai	1234	117	1351	50	593	116	2110
	(58.5)	(5.5)	(64.0)	(2.4)	(28.1)	(5.5)	
Total	2968	986	3854	1758	6306	2730	14748
	(20.1)	(6.7)	(26.8)	(11.9)	(42.8)	(18.5)	

Source: http://www.fao.org/ag/AGL/swlwpnr/reports/y_sa/z_np/nptb281.htm

2.4.2 Change of Land Uses

Available data suggest that agricultural land has remained constant since 1985, but that the area under forests has decreased considerably. The forest land use is reported to have declined from about 43 percent in 1978 to 29 percent of the land area of the country at present (UNEP, 2001). The decrease in forest land appears to be associated with the increase in shrub land. This gives an indication of the level of degradation of the forest in the country which is caused by increasing population pressure for fuel wood collection as well as overgrazing by the increasing livestock population. The annual rate of reduction in forest area between 1978/79 and 1994 was 1.7 percent; the annual reduction rate in forest and shrub combined was 0.5 percent (UNEP, 2001). Table 2.4.2 shows the changes in area under forest and shrub land uses from 1978 to 1994.

Table 2.4.2 Changes in area under forest and shrub land uses (1978 - 1994)

Type	Area occupied (percent of total land area)		
	1978 - 79[1]	1985 - 86[2]	1994[3]
Forest	38.0	37.4	29.0
Shrub	4.7	4.8	10.6
Total	42.7	42.2	39.36

Sources: 1. LRMP (1986); 2, 3. DFRS (1999)

According to "UNEP/(2001): Nepal: State of the Environment 2001", forest depletion and soil degradation are shown as follows;

Forest depletion:

- Forest area went down from 38% in 1978/79 to 29% in 1994. Rate of deforestation was 1.7% per year - 2.3% in the Hills and 1.3% in the Terai.
- Growing stock of forests decreased from 522 million m^3 in 1985/86 to 388 million m^3 in 1999.
- Local inhabitants must spend more time to collect fuel-wood
- Biodiversity has been threatened.

Soil degradation

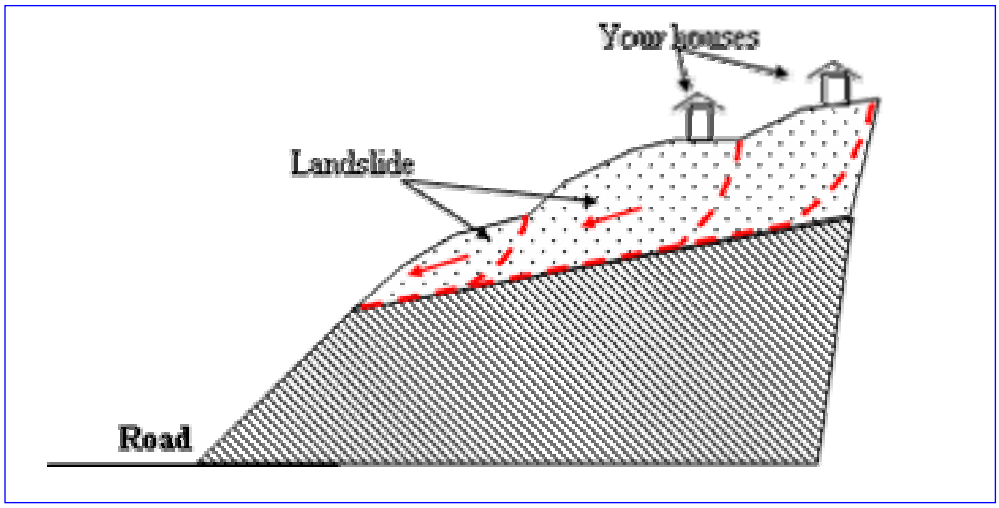
- Loss of topsoil due to erosion
- Depletion of organic matter and plant nutrients
- Landslides

3 Structural Measures for Sediment-related Disaster in Kbilash Village

3.1 Why Implement Structural Measures?

If the hazard maps prepared in Chapter 4, show potential areas at risk of sediment-related disasters around your house or your farm lands, or areas having a historical disaster, you should quickly implement some simple structural measures in order to reduce loss (farm lands, property, lives of your family) from the disasters such as debris flow, landslide, slope failure, etc.

For example, if your house is on the loose soil slope as shown in figure below, because the toe part of the slope is easily eroded by flowing water and becomes unstable, especially when the toe part slides down; the upper slope where your houses stand will become unstable. Consequently your houses may break down associated with the development of landslides.



In order to make your houses safe, the best cost-effective solution is to immediately implement some simple structural measures such as wattle, vegetation, drainage ditch, etc. when you find some toe collapse or instability around your lands and houses.

3.2 What Kinds of Structural Measures We Can Do?

As implemented in the Pilot Project, vegetation works, wattle works, gabion works (sabo dam and retaining wall) can be done. These works are very simple and cheaper but effective. The following is a brief description of these works

(1) Wattle Work

Figure 3.1 shows the photograph of wattle works implemented at 11km + 500 around the Kabilas Village. Wattle works mean wattled wood or bamboo fencing which is fixed by some piles on the ground surface. The work can be used to prevent small-scale soil slope collapses, especially on the

toe part of slope and is always good to plant grass on the upper side of the fence.

Figure 3.2.2 Wicker work implemented at 11km+500

The functions of the wattle work are as follows:

(a) To trap loose sediments on the slope
(b) To improve site condition to grow vegetation
(c) To prevent small soil collapses on the toe part of slope

Figure 3.2 shows a standard section of wattle work. The material is mainly rounded wood or bamboo and steel wire.

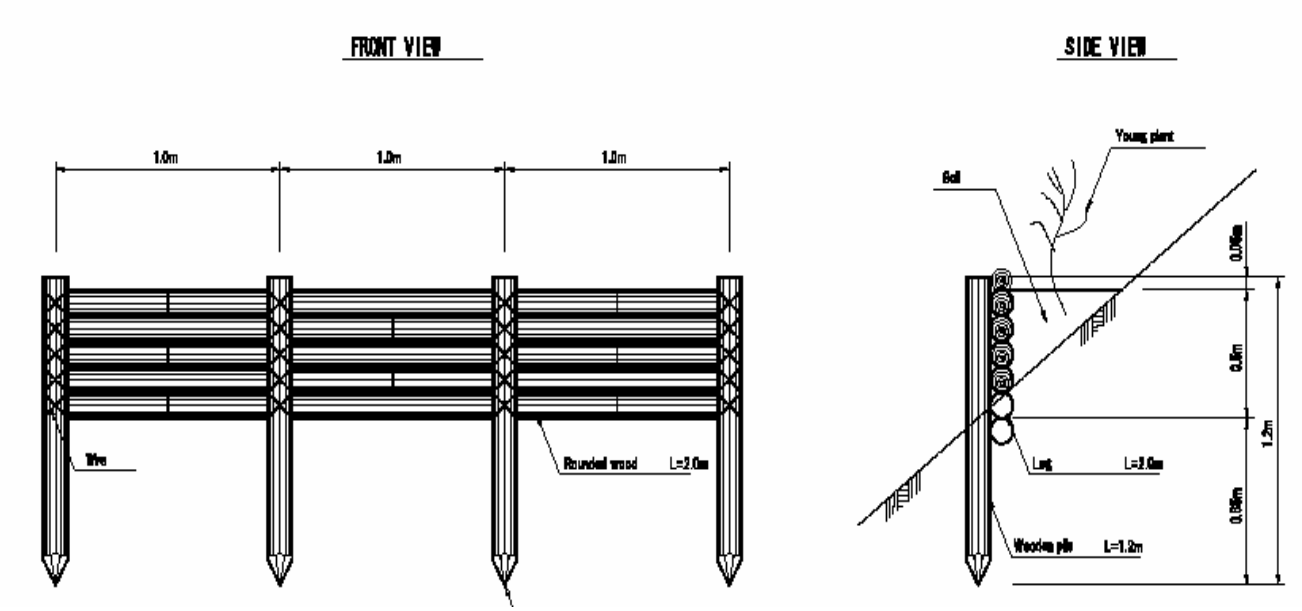


Figure 3.2 Layout of Wattle Works Implemented at 11km+500

(2) Bio-engineering Work

The bio-engineering works are in common use in Nepal. The main effects of bio-engineering work (vegetation) are as follows:

(a) To restrain some small collapses by woody taproots of trees or vegetation
(b) To prevent soil slope from surface erosion such as runoff and rainy splash
(c) To stop or trap the movement of eroded soils by the stems of vegetation
(d) To drain the surface water on the ground surface to avoid the slumping of saturated surface soils

Besides the above-mentioned effects, the bio-engineering works can provide social, economical and environmental benefits.

The main planted species in Nepal are given in table below.

Species	Nepali Name	Botanical Name
Tree	Tanki Uttis Chilaune Masure Katus	Bauhimia purpurea Aluns nepalensis Schima wallichi Castanopsis tribuloides Mulberry
Fruit	Naspati Lapsi Halwabed Alubakhada	Prunus communis Choerospondias axillaries Diospyros malabarica Prunus domestica
Bamboo	Bans	Dendrocalamus spp.
Grass	Amriso Napier Kagati Ghans Khar	Thysanoleana maxima

Source: Final Report on Dahachowk Sabo Model Site, DWIDP, Sabo Section, August 2004

The bio-engineering works are cost-effective, environmentally friendly, and easy to be implemented and maintained. However, they are prone to be damaged by small collapse and others, and therefore should be maintained on regular base.

Figure 3.3 shows the bio-engineering work implemented around the Kabilas Village, which is constructed to control soil erosion.

Figure 3.3 Bio-engineering work implemented around the Kabilas Village

According to "UNEP/(2001): Nepal: State of the Environment 2001", forest depletion and soil degradation are shown as follows:

Forest depletion:

- Forest area went down from 38% in 1978/79 to 29% in 1994. Rate of deforestation was 1.7% per year - 2.3% in the Hills and 1.3% in the Terai.
- Growing stock of forests decreased from 522 million m^3 in 1985/86 to 388 million m^3 in 1999.
- Local inhabitants must spend more time to collect fuel-wood
- Biodiversity has been threatened.

Soil degradation

- Loss of topsoil due to erosion
- Depletion of organic matter and plant nutrients
- Landslides

(3) Sandbag Work

Sandbag work, as a temporary work, functions as retaining walls. The work provides the retention effect of a wall by using a number of bags filled with granular soils. Because sandbag works consist of many sandbags, the resistance and stability of the method provides significant load-bearing capacity against static loads. The ease and speed of construction reduces overall cost and makes it ideal for the urgent treatment of sediment-related disasters.

Sandbag works are generally used to retain soil mass on steep slopes, especially when the soil erosion is active and during vegetations grow up.

The work involves construction of a number of sandbags, which are made of vinyl, synthetic fiber, plastic, etc. The dimension of a sandbag is generally 70 cm long and 40 cm wide. About 6-7 scoops of soil suffice to fill 70% to 80% of the bag and the resulting weight comes to 30 to 50 kg. Figure 3.4 shows image of sandbag work.

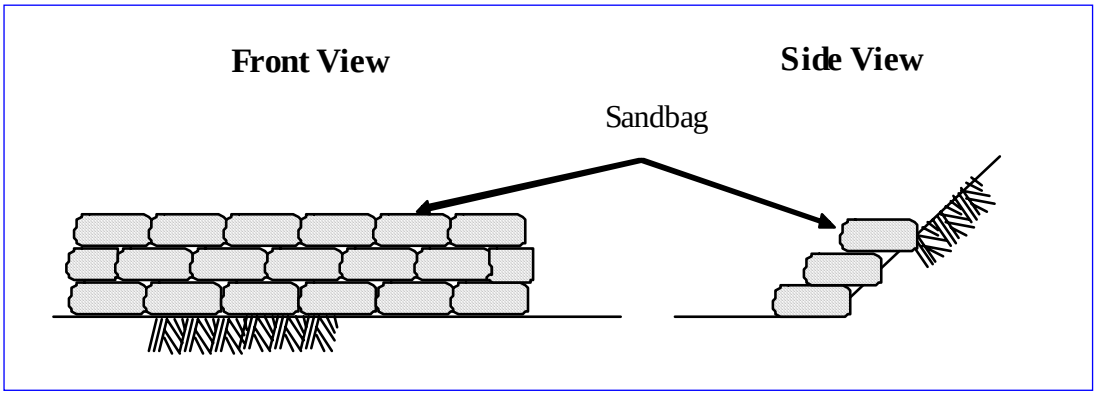


Figure 3.4 Image of Sandbag work

(4) Gabion Work

Gabion works including gabion walls and gabion sabo dams, are fabricated from gabion baskets that are typically 1 meter × 1 meter in cross-section and from 1 to 4 meters in length. The rock fill for the gabion is graded from a maximum of 250 mm diameter to 100 mm diameter in size.

The gabion works are flexible and the nature of the gabion fill provides good drainage conditions in the vicinity of the works. Filtration protection between the gabion and the wall backfill should be considered.

Gabion works, when constructed as retaining wall, are used to (a) prevent small-scale shallow collapse and toe collapse of large-scale slope failures, and (b) as a foundation for other slope protection works such as crib works. Where the toe of the slope has collapsed or the collapse is likely to enlarge upward along the slope, retaining walls are commonly recommended.

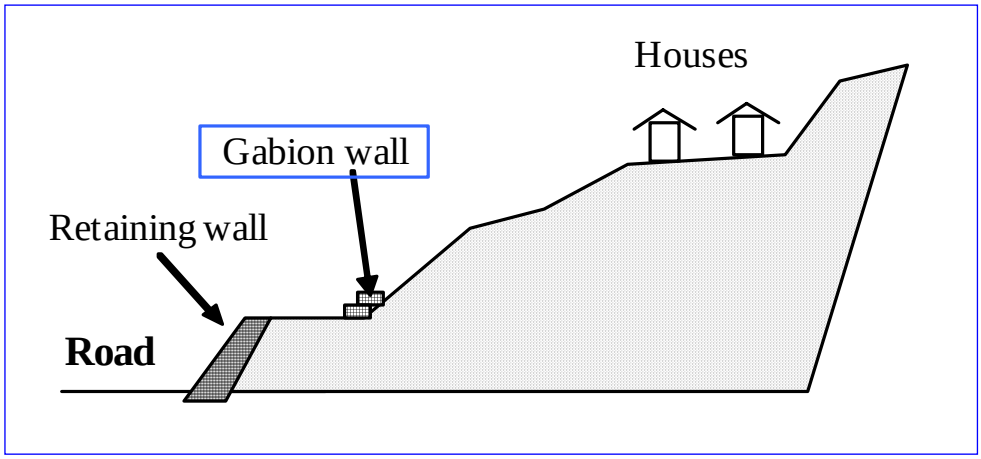


Figure 3.5 Example of Gabion Wall on the Foot of a Slope

Figure 3.6 Gabion walls implemented around the M-N highway

Figure 3.7 shows gabion sabo dams implemented along the M-N highways. Gabion sabo dams are generally implemented to as follows:

(a) Prevent erosion and toe failure of potentially unstable slopes along stream bank slopes;
(b) Prevent and eliminate damage from debris flow; and
(c) Improve the stability of a slope through sedimentation behind the dam.

Figure 3.7 Gabion Sabo/Check dam constructed along the M-N