

DISASTER REVIEW 2011

July 2012

Series XIX

Annual

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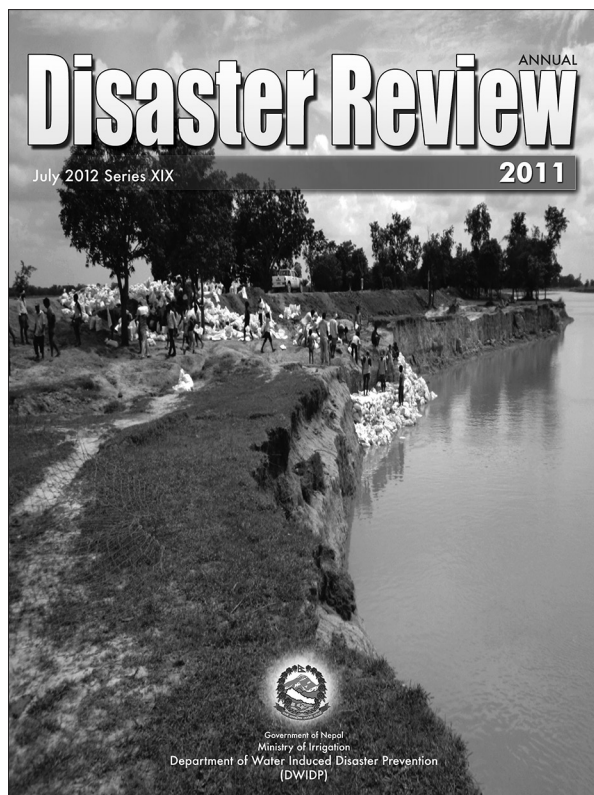
Department of Water Induced Disaster Prevention
(DWIDP)

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**Photographs of Cover Picture**

Banganga, Khoriya, Kapilbastu

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Layout Design: Krishna Trade Concern**EDITORIAL**

Nepal is one of the disaster prone countries like of water induced disasters- soil erosion, landslides, flood, debris flow, river bank erosion etc. In addition to these, other disasters caused due to fire, windstorms, earthquake, hailstorms, thunderbolt, avalanche, epidemic etc are also common in Nepal. The causes of such disasters are largely contributed due to rugged and fragile topography, weak geological formation, active seismic condition, occasional glacier lake outburst, heavy monsoon rain, unscientific land utilization pattern, rapid growth in population and the degradation of natural environment. Not only lives and private properties are lost, but also important national infrastructures like roads, hydro power projects, irrigation structures, drinking water structures etc are damaged mainly due to the flood, landslides and earthquake in Nepal.

The Department of Water Induced Disaster Prevention is mainly concerned on the prevention and mitigation of water induced disasters, so the departmental activities are focused on river control and landslide management. This office was established and functioned as the Disaster Prevention Technical Center from October 1991 to February 2000 with technical assistance from JICA and now it has been converted to the Department of Water Induced Disaster Prevention. The department is the main line/focal agency of government of Nepal for water induced disaster control, mitigation and management activities.

Although the Government of Nepal has introduced the Water Resources Strategy and the National Water Plan 2005 laying out the short, medium and long term strategies and plans and Water Induced Disaster Management Policy 2006 for the effective prevention, mitigation and management of water induced disasters in the country. But still the major question remains of sustainability of mitigation and management of water induced disaster measures adopted in order to save the lives and property of the people. This issue always has been a concern during the monsoon season when there is an excessive rainfall which brings flood, landslides, erosion, inundation etc.

Establishment of better information system and awareness programs about flood and landslide for the concerning target group is the crucial thing. For this, formation of authentic Community Based Organization (CBOs), awareness programs for them and empowering them by providing technical knowhow and pre-flood preparedness is necessary. Consultation with CBOs before and during construction of various structures at the sites of flood and landslide affected areas for the necessary information and knowledge sharing is also important. Establishment of active coordination mechanisms among local, district and national level government organizations, civil society organizations, private sector and vulnerable groups is another important issue. Ongoing, systemic, participatory and multi-disciplinary monitoring and evaluation system, quality assurance and preparation and implementation of Disaster Risk Reduction/ Management Plan should be mandatory. Only then, the goal of sustainability of flood and landslide disaster mitigation and management can be achieved by the Department of Water Induced Disaster Prevention.

- The Editorial Board

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DWIDP Concerns : Water Induced Disaster Prevention

Background

Nepal suffers from various types of water-induced disasters such as soil erosion, landslides, debris flow, flood, bank erosion etc. due to its rugged topography, weak geological formations, active seismic conditions, occasional glacier lake outburst, floods and concentrated monsoon rains associated with unscientific land utilizations. These phenomena induce severe impacts on the vital infrastructures of the nation such as roads, hydropower, irrigation and drinking water facilities causing loss of agricultural lands, properties and human lives posing a severe threat to the sustainable development of the country. In order to mitigate these disasters in Nepal, Water Induced Disaster Prevention Technical Centre (DPTC) was established under the then Ministry of Water Resources as per an agreement between the then His Majesty's Government of Nepal and the Government of Japan on 7th October 1991. The programs of DPTC were continued for seven and half years with the technical co-operation/assistance from Japan International Co-operation Agency (JICA). To institutionalize the objectives and achievements of the DPTC, the Department of Water Induced Disaster Prevention (DWIDP) was established on 7th February 2000 under the then Ministry of Water Resources along with seven divisions and five sub-division offices to mitigate the water-induced disasters throughout the country. The department is a focal agency for all water induced disasters mitigation works. To facilitate the activities of the water induced disaster mitigation in the country the activities and responsibility of the River Training Division of the Department of Irrigation has been transferred to this department in 2002.

Guidelines for addressing the issues on water induced disaster mitigations have been adopted from the Water Resources Strategy - 2002 and the National Water Plan - 2005, the government's main documents which have laid out the short term, medium term and long term strategies, plans, activities and resources for mitigation and management of water induced disasters

These documents have given DWIDP the leading role to implement the mitigation and risk reduction measures and coordinate with other related agencies. Based on these strategic visions, Water Induced Disaster Management Policy - 2006 has been formulated with policy provisions: (a) to mitigate water induced disasters and reduce loss of lives and property, (b) to enhance institutional strengthening of DWIDP and (c) establish network with the associated institutions and agencies to cope with potential disasters.

Water Resources Strategy - 2002 (WRS 2002) has defined ten strategic outputs to contribute the overall national goal as "living conditions of Nepali people are significantly improved in a sustainable manner" by achieving short term, medium term

and long term purposes. "Effective measures to manage and mitigate water induced disasters are functional"- is one of those ten outputs, concerned of DWIDP.

WRS-2002 also identified the indicators (specific targets and dates) that can be used to achieve the above strategic output related to disaster as following.

Water Induced Disaster Targets

- By 2007, potential disaster zones are identified by type and are located on district maps;
- By 2007, emergency relief materials are available in all five regions;
- By 2017, infrastructures for mitigating predictable disaster are put into place in twenty districts;
- By 2017, warning systems are established and functioning, encompassing the country; and
- By 2027, social and economic losses reduced to the levels experienced in other developed countries.

WRS-2002 puts forward the following activities to carryout the strategy to achieve the targets :

- Prepare and implement a water-induced disaster management policy and plan.
- Conduct risk/vulnerability mapping and zoning.
- Strengthen the disaster networking and information system.
- Establish disaster relief and rehabilitation systems.
- Carry out community awareness/education on disaster management.
- Activate Inundation Committee (s) with respect to neighboring countries.
- Prepare and implement floodplain action plans.
- Implement disaster reduction/mitigation measures.
- Strengthen institutional set-up and capacity.

Prepare and implement a water-induced disaster management policy and plan

So far Government of Nepal has already approved and enforced Water Induced Disaster Management Policy 2006 to carry out water induced disaster management activities with 5-points objectives. The policy covers up 3-points for "Emergency Operation", 4-points for "Reduction of Water Induced Disaster", 5-points for "Conservation of Natural Resources", 6-points for "Use of River Bank and Flood Affected Areas" and 3-points for "Intuitional Provision and Development". Risks should be identified and priorities be set for different areas and for areas at similar levels of risks. Additional considerations during development of the management plan should include a full range of protection and mitigation options, such as structural and non-structural protection works and use restrictions

and warning systems. It should be noted that different areas may require different types of emergency preparedness and response.

DWIDP has been designated as the lead agency to coordinate the various key stakeholders related to water induced disaster including Ministry of Home Affairs (MoHA), Department of Hydrology and Meteorology (DHM), Department of Irrigation, Department of Soil Conservation and Watershed Management (DSCWM). A directive of necessary technical standards relating to river training and reclaim/development work for both private and public sectors as mentioned in the policy, need to be prepared and enacted as early as possible.

Conduct Risk / Vulnerability Mapping and Zoning

Water induced disaster include floods, inundation, landslides, drought, debris flood GLOF and epidemics of water borne disease. The first step in preparedness for future disaster is to analyze the disaster mechanisms and evaluate risks. DWIDP, in conjunction with other departments, is preparing flood risk maps for all high priority areas and define and enforce land use restrictions to prevent increasing risk due to inappropriate use of flood zone lands. Floods are possible in all river catchments but the danger to property and human welfare varies greatly from the mountain, valleys to the Terai. Some rivers are associated with additional risk due to the potential for glacial lake outburst floods. Although, significant progress has already been made towards an inventory of existing GLOFs, other areas at potential risk have not been inventoried. Flood risk evaluations should be centered on an assessment of potential damage and danger. Very little work so far has been done in flood risk maps and an inventory identifying the locations at risk. Landslides are often caused by soil erosion or saturation of the ground during rainstorms and, in turn can cause flooding and mud flow into takes and rivers. Based on field investigations, very little work on preparing inventories of potentially dangerous landslides based on the risk of harm could be done, so far. DWIDP has already commenced significant studies on landslides. In each category of disaster, the locations identified in the inventories will be ranked in order of importance the basis for setting priorities includes:

- Magnitude of the risk, consequences, expected level of mitigation or disaster reduction
- Feasibility of the alternative actions and cost of the actions

Various considerations that to be given weightage in the ranking include:

- Potential for injury or loss of life, economic value of lost property or infrastructure
- Loss of cultural resources, potential environment impacts, extent of disruption to transportation, communication or flood supply and potential for water borne epidemics.

Strengthen Disaster Networking and Information System

The information will be disseminated to relevant agencies, local authorities and communities so that they are aware of

the risks and prepare for action in the most serious high – risk areas, decisions will be made regarding necessary action.

Although as mentioned in the policy, as a lead agency DWIDP is lagging behind to carryout activities for the management, total information system, early warning system, determination of jurisdiction of control of local body as per the size and type of river, procedure of issuing license for reclaimed land, etc.

Nepal Electricity Authority and private hydropower develops have installed warning systems at their weir/dams and in area situated immediately downstream. These systems will be integrated with the DHM flood warning system. DHN seems active in installing various systems for floods.

Establish Disaster Relief and Rehabilitation System

DWIDP, in collaboration with MoHA, Nepal Red Cross Society, local government and non-governmental organizations, will prepare and implement a disaster relief plan for each priority area. These plans will include:

- Preparations for emergency response, rescues and relief,
- Procurement and storage of relief supplies,
- Planning for emergency shelter and feeding of victims and
- Provision for disaster response rehearsals and drills.

Carryout Community Awareness / Education on Disaster Management

In parallel with the disaster relief / rehabilitation system, local authorities with guidance and technical assistance from DWIDP and other agencies will carry out a community awareness and education campaign. This will be linked with the disaster networking and information system.

Activate Inundation Committees with respect to Neighboring Countries

Inundation caused by barrages constructed by India just downstream of Nepal represents a special and unique area of concern. Despite the ongoing nature of these concerns, the existing committees under the jurisdiction of Ministry of Irrigation (Mol), have not been effective in resolving outstanding problems. They will be strengthened and activated and will receive support at the highest level to facilitate bilateral dialogue and actions. DWIDP is acting as the lead agency under Mol to carry out this work.

Prepare and Implement Flood Plain Management Plans

As mentioned in this activity, during the first years of strategy implementation efforts will focus on identifying and prioritizing high – risk areas and developing disaster management plans. In the medium term, efforts will be turned to better ways of managing the floodplains in harmony with nature. In certain river reaches where the flood plain could be developed for seasonal agricultural use, these management measures will be implemented at the community level. Adequate regularly compliance will be kept in place for the agricultural use in such flood plains. Other actions could include fisheries enhancement,

recreation or aggregate extraction. In this manner, natural flooding and erosion and deposition processes could be turned into economic opportunities rather than disasters.

Implement Disaster Reduction/Mitigation Measures

A number of studies of potential flood reduction/mitigation measures have been conducted, particularly those capable of reducing flood damages from rivers as they enter the Terai. These studies have indicated that structures are expensive and may have limited impact in the event of serious floods. None the less, there are some areas where a significant number of people face annual flood risks and relocation is out of the question. In these critical areas, some selected civil engineering and or bio-engineering actions will be identified and studied to determine their technical, environmental and economic viability. Only economically viable schemes will be considered for implementation.

Strengthen institutional set-up and capacity

Water-induced disaster present regular threats to many people. However, at present there seems no coordinating agency to reduce these risks or mitigate damages. In order to put on effective disaster warning and prevention system in place, the relevant institutions must be strengthened and coordinated. The following changes are proposed to be carried out as early as possible:

- DWIDP is designated as a lead coordinating agency, its mandate and authority broadened to facilitate its planning and coordination role and adequate staff and budget provided to carry out these duties,
- DHM is to be provided with the mandate and resources to be the lead agency for implementing and managing a flood warning system,
- DoI's responsibility for border inundation problems is to be transferred to DWIDP, and
- MoHA is to be provided specific resources for planning and implementing disaster relief/rehabilitation measures.

Goal of DWIDP

The main goal of the DWIDP is to minimize the human casualties and damages of infrastructures caused by water induced disasters by appropriate water induced disaster management and mitigation.

Objective of DWIDP

To implement the programs of river and river basins conservation and to develop related appropriate technology research, information systems, human resource and institutional development activities and to raise awareness of communities so as to mitigate water-induced disasters.

Different Programs and projects under DWIDP

A. Disaster Prevention Program (Prakop Niyantaran Karyakram)

This program has been initiated to cope with the water induced disaster and probable short and long term remedies

in mitigation measures. Under this program following activities are carried out:

- i. River Training Project (Nadi Niyantaran Yojana)

The mitigate the water induced disasters such as bank erosions and inundation caused by the medium and small size rivers and others water induced disasters emergency works throughout the country is carried out by River Training Project. In the fiscal year 2068/69 a budget of Rs. 7.30 crore had been allocated.
- ii. Study based, Disaster Prevention (Adhyayan Gari Garine Prakop Niyantaran Karyaharu)

For the continuation of the ongoing projects that have already been studied, Rs. 39.15 crore had been allocated in the fiscal year 2068/69. These works are being by conducted division and sub division offices throughout the country.
- iii. Preparation Master Plan

Master plan for various smaller and bigger rivers is prepared by division and sub division offices throughout the country to carry out disaster prevention work systematically. At present master plan is being prepared in 18 rivers. In fiscal year 2068/69, Rs. 7.05 crore had been allocated.
- iv. People's Embankment Program (Janata koTatabandha Karyakram)

Government of Nepal has realized the importance of river training works in terai region in order to reduce the flood and inundation problems in low lying areas. Since fiscal year 2066/067 a new river training program known as "Janata ko Tatabandha" has been commenced. Janta Ko Tatbandha Karyakram has got following specific objectives:

- Land reclamation in the flood plain
- Employment generation during project period
- Reduction of loss of life and property

This program targeted to implement phase-wise in accordance with the master plan prepared for the particular river basin. Engineering structures with the bio-engineering applications are being used in order to provide sustainable and effective combination as potential counter- measures. Concerned people in this program are expected to participate with great enthusiasm. Janata ko Tatabandh is the river training project based on peoples' participation. Kankai and Ratuwa rivers in Jhapa district, Rato river in Mahotari district, Lakahandei and Jhim rivers in Sarlahi district, Narayani river in Chitwan and Nawalparasi districts, Danav Tinau in Rupendehi district, West Rapti river in Dang and Banke districts and Dhoda and Mahakli river in Kanchanpur district are ten rivers implemented under this program in the fiscal year 2066/067. In the fiscal year (2067/68), 2 rivers East Rapti river in Chitwan district and Karnali river in Bardiya and Kailali districts were added in the program. Similarly, in fiscal year (2068/69), 2 more rivers Jalad and Auorahi rivers in Dhanusa district

were included in the program. Now in total this program is being implemented in 14 rivers. Total budget allocated for the program in the fiscal year 2068/69 is Rs. 73 crore and by the end of the fiscal year in total about 90 km embankment has been constructed.

v. Landslide Management

About 83% of Nepal is cover by the hills and mountains so the country is prone to landslides. These landslides are activated due to natural phenomena or due to human factor. If these landslides are not controlled in time it will have an adverse effect in the teria belt. So, for the management of these landslides to be done by the division and sub division offices throughout the country in the fiscal year 2068/69 Rs. 3.20 crore had been allocated.

vi. Institutional Infrastructure Development

The activities under this program are the construction of the office buildings and maintenance of the infrastructures in different districts. In the fiscal year 2068/69 Rs. 0.75 crore had been allocated.

B. Disaster Mitigation Support Program (DMSP)

DMSP is a model program for comprehensive sediment management. Following major concerns are related with the DMSP program:

- Education and public awareness campaign
- Development of appropriate and cost effective technology
- People's participation in disaster mitigation
- Preparation of hazard maps of the watersheds
- Rehabilitation program
- Institutional development
- Survey and loss estimation
- Emergency rehabilitation – model site development
- Development of information technology and its dissemination
- Organizing seminars and trainings
- Preparation and amendment of policies and regulations
- Management of water induced disaster in the watershed and sub-watershed
- Watershed/sub-watershed water induced disaster mitigation management

In order to implement above stated themes, local and improved technologies is to be adopted in such a way that it is less expensive and it supports to resolve the problems like landslide, soil erosion, debris flow and sedimentation. Recently, Lother watershed has been selected to develop it as a model site. Rs. 4 crore was allocated in the fiscal year 2068/69. Similarly, for the maintenance of projects constructed by Japanese Aid Rs. 0.95 crore had been allocated. Moreover, for various seminars being conducted to raise mass awareness about the consequences of water induced disasters, preparation of the hazard maps of the watershed and for landslide control and settlement protection measures Rs. 3.55 crore had been allocated. In total, Rs. 8.50 crore had been allocated for DMSP.

Various programs have been conducted annually by DWIDP for the disaster mitigation to the safety and security of human life and property. For this, various structural and non structural methods have been applied which provides employment and income generating opportunities to the local people. Along with this, the department is also involved in the protection of existing infrastructure like transportation, hydroelectric plant, and archeological sites of the country. Moreover, the department is constantly involved in assuring better traffic management. In this regard, regular maintenance programs along Muglin-Narayanghat road section and Sindhuli-Bardibas road section are being carried out in order to reduce debris flow and landslides that cause harm to human life and property by means of structural and non-structural (bio-engineering) measures. For the sustainability of the water induced mitigation and control measures along these road sections and smooth flow of the traffic the department has made a policy to allocate sufficient budget for regular maintenance. Similarly, protection of Marsyangdi Hydroelectric Project power house, Ruwa River Management Program and conservation of the archeological site – Mankamana temple has already been implemented in the fiscal year 2065/066.

C. India Supported River Training Program (Bharatiya Sahayogma Sanchalit Nadi Niyantaran Yojana)

The big to small sized rivers that flow through the Terai to India occurring floods and inundation problems during monsoon season are considered major disasters - destroying human life and property. Embankments have been constructed in some of the river based on agreement and understanding between Nepal and India. Joint Committee of Inundation and Flood Management (JCIFM) plays an important role to initiate the program in particular river. JCIFM is being steered by a high level team from DWIDP (Nepal) and Ganga Flood Control Commission (India) and along with the representatives from Ministry of Finance and Ministry of Foreign Affairs from both the countries. Ongoing projects are Sunsari, Gagan, Kamala, Lal Bakaiya, Bagmati and Banganga having total budgets for the fiscal year 2068/69 is Rs. 69.46 crore and by the end of the fiscal year the total length of the embankment constructed in the above rivers is about 185 km.

D. River Terrace, Settlement/Bazaar Protection Program (Basti Ra Tar Bazar Samrakhsan)

This program is focused to implement in hills and mountains where there lies tars and bazaars vulnerable to floods, landslide and debris flow. This program is being implemented by the division and sub division offices and in the fiscal year (2068/69), Rs. 3.75 crore had been allocated.

E. Brief on Water Induced Disaster Management Policy and DWIDP

i. The Water Induced Disaster Management Policy 2062

Government of Nepal has approved "Water Induced Disaster Management Policy 2062" on 15 Chaitra 2062. In this policy following subjects are highlighted.

- (a) Emergency protection
- (b) Water Induced Disaster Mitigation
- (c) Natural Resource Conservation
- (d) Utilization of flood plains
- (e) Institutional Management and Development

ii. Organization of DWIDP

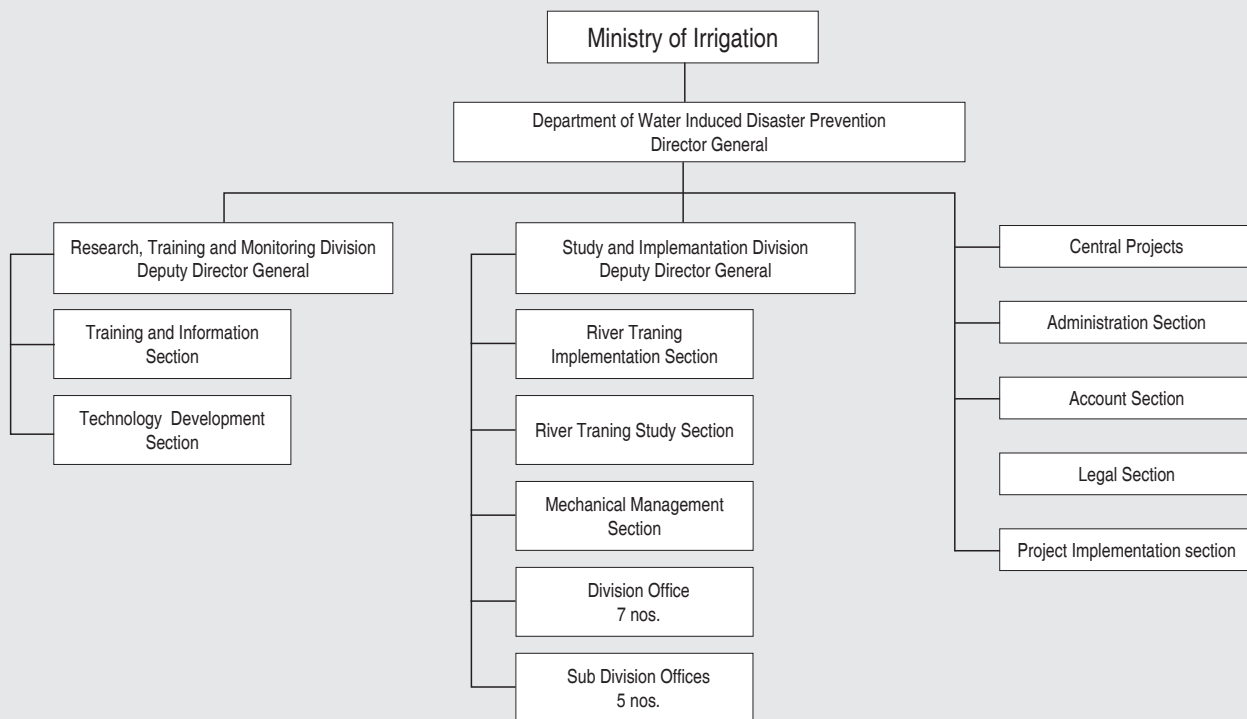
For the smooth functioning of the departmental activities the department consists of multi-disciplinary professions of different levels. These professionals have been mobilized in different offices within the department; the general overview is as follows: Organization and management (O&M) survey has been conducted for the proposed of new organization structure as per the need assessed.

S.N.	Description	Department		Division	Sub-division	Total
		Pool	Regular			
1	Gazetted (Tech.)		3	-	-	3
2	Gazetted II (Tech.)		7	7	-	14
3	Gazetted III (Tech.)	2	19	22	5	48
4	Gazetted III		3	-	-	3
5	Non-Gazetted (Tech.)	8	15	44	10	77
6	Non-Gazetted I		6	14	-	20
7	Non-Gazetted II (Tech.)		-	2	-	2
8	Non-Gazetted II		2	7	10	19
9	Non-classified		5	30	10	45
	Total	10	60	126	35	231

iii. Physical Facilities of the DWIDP

1. Central office at Pulchowk
2. Hydraulic Laboratory at Godawari, having the following facilities,
 - River simulation model facility
 - Debris flow simulation model facility
 - Soil testing facility
 - Concrete testing facility
3. Heavy equipment workshop at Baneshwor. It will be shifted to Division No. 5, Bhairahawa in the near future.
4. Seven division offices, five sub-division offices and four unit offices at different districts all over the country.
5. Gabion net weaving machines in Biratnagar, Parwnipur, Pokhara, Nepalgunj and Dhangadhi.

Organization Structure



Loss of Lives by Different Types of Disasters in Nepal

As records mentioned in the following table, the total loss of lives by different types of disasters from 1983 up to 2011 is 22811. Amongst the different types of disasters, the epidemic caused the highest death as of 11490 in between 1983 to 2011. The second position comes of flood and land slide that caused the total death of 8052 in the period of 1983 to 2011. The table 1 reveals the fact that the loss of lives by the flood and landslide is the most and the death rate is constantly fluctuating in the higher range where as the death rate by the epidemic is decreasing per year during this period. The reason may be of increasing awareness and various facilities in the health sector. The table even shows the fact that the condition of losing lives by the flood and landslide is severe. The reason may be of lower awareness of people on flood and landslide damage and poor mitigation measures applied by the affected community and the government of Nepal.

The number of 252 persons lost their lives by landslide and flood in 2011 which is of 49.50 percent of the total number. The second position comes up of Wind storm, Hail storm and Thunderbolt causing the death rate of 20.62 percent of the total loss of lives in 2011. Then the third position is of Cold wave causing the death rate of 14.63 percent. Then comes the fourth rank of fire which caused the death of 9 percent of the total death of lives in 2011.

In this way, the death causing disaster factors in 2011 are mainly flood and land slide, wind storm, hail storm and thunderbolt in Nepal. Thus, we can conclude that the government of Nepal needs to undertake the mitigation measures to cope these factors immediately than others in order to save the lives and property of the people.

Table: 1
Loss of Lives by Different Disasters in Nepal
(1983-2011)

Types of Disasters	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	
Flood & Landslides	293	363	420	315	391	328	680	307	93	71	1336	49	203	258	83	273	193	173	196	441	232	131	141	114	216	134	135	240	252	8061	
Earthquake	0	0	0	0	0	721	0	0	0	2	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6	733	
Wind storm, Hailstorm & Thunderbolt	NA	NA	NA	NA	2	NA	28	57	63	20	45	47	34	75	49	23	22	26	38	6	62	10	18	15	40	16	7	70	105	878	
Avalanche	0	0	0	0	0	14	20	0	0	0	0	0	43	4	12	0	5	0	0	0	0	0	21	NA	6	0	2	NA	-	127	
Fire	69	57	52	96	62	23	109	46	90	97	43	43	73	61	65	54	39	37	26	11	16	10	28	3	9	11	35	69	46	1380	
Epidemic	217	521	915	1101	426	427	879	503	725	128	100	626	520	494	951	840	1207	141	154	0	0	41	34	0	3	10	462	36	9	11470	
Stampede	0	0	0	0	0	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NA	NA	0	0	NA	-	71	
Rainfall	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	11
Boat Capsize	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6
Bridge Collapse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Cold Wave	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72	72
Total	579	941	1387	1512	881	1584	1716	913	971	318	1524	765	873	895	1160	1190	1466	377	415	458	310	192	242	132	274	171	641	415	509	22811	

NA: Not Available

Source: Ministry of Home Affairs

Table 3: Water Induced Disasters: Flood in 2011

District	VDC / Municipality & Ward No.	Date	People		Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (In Rs.)	Remarks
			Death	Missing			Injured	Comp.		Partly	No.			
Baglung	Naraethati-3	12-Feb-11		1										Sunil Gairae
Sindhupalchowk	Mankha-6	8-Mar-11	2											Bir Bdr. Lama, Chandra Bdr. Tamang
Nuwakot	Tarukaghat-1	5-Jun-11		1										Bharat Pimal
Gorkha	Tawalung Fewatar	14-Jun-11	1											Umesh Sunar
Khotang	Bakachol-4	23-Jun-11											40000	Ram Bdr. Rai
Okhaldhunga	Ghurmi	26-Jun-11		3	1									Jantiko Dunga Paltera Sumitra Lutel Ra Ganes Dhamala Sahit..
Sunsari	Duhabi-9	26-Jun-11												Budhi Khola Pul najik Rai Ra Dum Jatiko Basti ma Katan
Udayapur	Tribeni-4	26-Jun-11												Janti ko Bas Beisot Kholama badhile bagayeko
Nawalparasi	Ratnapur-2	30-Jun-11												Som Bdr. Sonari
Baglung	Hugdri Sir-6	1-Jul-11			1			2						Bharat B. Ale
Bhaktapur	Bhaktapur-5	1-Jul-11			1									Surag Basuk
Chitawan	Mangalpur-5,9	1-Jul-11			70									Narayani River
Chitawan	Meghauli-1,2	1-Jul-11			250									Narayani River
Lalitpur	Saibu	1-Jul-11			1									Name Unknown
Palpa	Madanpokhara-6	1-Jul-11		1										Raju Kanauli
Pyuthan	Khabang-1	1-Jul-11		1										Khagi Pun
Rupandehi	Sankarnagar-3	1-Jul-11	1											Samir Buchar
Sunsari	Itahari	1-Jul-11												Sathi Petrol Pump
Sunsari	Bhokra-7	1-Jul-11			25									
Tanahau	Ringbingrani	1-Jul-11		3										Name Unknown
Achham	Matatikot-7	2-Jul-11	3		1									Dhruba B.K., Ramesh B.K., Ishara B.K., Joginidevi B.K.
Juma	Lama-4	2-Jul-11		1										Chahre Damai
Serlahi	Nokelwa-1	3-Jul-11	1											35yrs Nagina Mahato
Tanahau	Rising-4	3-Jul-11	2	1										Hari Kumar Shrestha and His Daughter Gita Shrestha are death and Dipendra Shrestha missing
Bardiya	Gaughat	4-Jul-11		1										Parse Kami
Bardiya	Pachaha-8	4-Jul-11		1										Ram Shankar Tharu
Bardiya	Jamuni-4	4-Jul-11		1										Mankhola tarda 25 yrs ko Parse Kami
Kailali	Chamauli-7	5-Jul-11					1						50000	Khadga Nepali
Rautahat	Pipra Ranjaha-7	5-Jul-11	1											Rabin Pandit
Bardiya	Neulepur-4	6-Jul-11	1											8 yrs Nisha Chaudhari
Kailali	Kailashmandu-4	6-Jul-11	1											Hanta Bahadur Atri
Kapilbastu	Parasa-1	6-Jul-11		1										10 yrs Birkha Bdr. Rawl
Morang	Biratnatar-8	6-Jul-11	1											5 yrs Dhananjaya Kamat

NA= Not available

Source: Ministry of Home Affairs

District	VDC / Municipality & Ward No.	Date	People		Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing			Injured	Comp.		Partly	No.			
Morang	Lelang-3	6-Jul-11	1										3 yrs Jenish Magar	
Morang	Govindapur-1	6-Jul-11	1										60 yrs Jhameli Rishidev	
Serlahi	Chhatauna-1	6-Jul-11	1										Jangi Mandai	
Kailali	Baliya-9	7-Jul-11		1	2								60 yrs Singha Bdr. Shahi	
Kailali	Udasipur-2	7-Jul-11	1										5 yrs Krishna Bdr. Chaudhari	
Parsa	Bigunj-1	7-Jul-11	1		1								Saad Aalam	
Surkhet	Rakam-7	8-Jul-11	1										13 yrs Urmila Khatri	
Banke	Tilahariya-5	9-Jul-11	1										Sangam Chaudhary	
Jhapa	Khudunabari-8	10-Jul-11		1									45 yrs. Prem Bdr Rai	
Kailali	Khairala-4	10-Jul-11		1									Tek Bahadur Baraee	
Parsa	Negardaha-1	10-Jul-11	1										Rahul Kumar Saha	
Sindhuli	Lagavir-2	10-Jul-11	1										Dhabala Sada	
Surkhet	Birendranagar-1	11-Jul-11		1									Jeevan Adhikari	
Tanahau	Rishipani-4	11-Jul-11		1									Dipendra Shrestha	
Rautahat	Dumariya-4	12-Jul-11		2									Sakuntala Saha, Sima Kumari Saha	
Sankhuwasabha	Deurali-9	12-Jul-11		1									Hikmat Rasaili	
Sarlahi	Hajariyapur-5	12-Jul-11	1										Dipak Saha	
Jhapa	Satashidham-8	14-Jul-11	1										Birkha Bdr. Newbang	
Nawalparasi	Haripur-7	14-Jul-11		1									Shivnath Yadav	
Sarlahi	Netragunj-7	14-Jul-11	1										Salina Lama	
Dang	Gowadiya-8	15-Jul-11	1										Gharchwoj Chaudhari	
Kavrepalanchowk	Panauli	15-Jul-11	1										Ramlal Shrestha	
Mustang	Kowang-8	15-Jul-11											Lake Khola Pool Bagayeko	
Saptari	Phaitapur-5	15-Jul-11	1										Dev Sharma	
Kaski	Lamachaur-2	17-Jul-11		1									Tek Bdr. Magar	
Sindhuli	Jhapatae-4	17-Jul-11	1										Govinda Nayak	
Ilam	Chulachuli-3	18-Jul-11	1										Pratik Magar	
Jhapa	Shivagunj-6	18-Jul-11									9 kattha		Kul Prasad Rajbansi, Shyam Ghimire, Kajiman Budhathoki	
Morang	Bhabigunj-4	18-Jul-11		1									Bishwaji Sardar	
Udayapur	Rampur-2	18-Jul-11	1										Gita B.K	
Jhapa	Anarmani-1	19-Jul-11	1										Sandip Chaudhari	
Jhapa	Ajundhara-5	19-Jul-11					1						Chandra Bdr. Katuwal	
Morang	Sanischare-4	19-Jul-11									6 Biga	500000	17 people's land	
Surkhet	Gumi-2	19-Jul-11	1										Birendra Regmi	
Ilam	Chulachuli-3,4,5	20-Jul-11												
Jhapa	Garamuni	20-Jul-11									5 Kattha		Ayan Khabung, Tej Bdr. Karki, Parasmani Dhakal	
Kaski	Pokhara-5	20-Jul-11									5 Ghar Duban		Sukumbasi Tole	
Kathmandu	Kathmandu-9	20-Jul-11		1									Kailash Pariyar	

NA= Not available

Source: Ministry of Home Affairs

District	VDC / Municipality & Ward No.	Date	People			Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing	Injured			Comp.	Partly		No.	Unit			
Mahottari	Serpallo-2	20-Jul-11		1										Ram Chhabila Kurmi	
Mustang	Charang-6	20-Jul-11											989000		
Nawalparasi	Narayani-3	20-Jul-11		1										Shikha Ram Mahato	
Rautahat	BaluwaMadanpur-4	20-Jul-11		1										Ganesh Thapa	
Jumla	Mahabai Patar-1	21-Jul-11		1										Bijaya Shahi	
Sindhupalchowk	Bhimtar-2,3,4,5	21-Jul-11									500 Ropani				
Sarlahi	Agaruwa-2	22-Jul-11	1											Ranjit Raya	
Syangja	Waling-3	22-Jul-11	1											Ram Bdr.BK.	
Banke	Bankatuwa-7	23-Jul-11	1			6								Punam Tharu	
Bara	Parsauni-5	23-Jul-11	1											Narsingh P. Dalwar	
Kailali	Fulbari-4	23-Jul-11	2											Devaki Joshi, Kalpani Aairai	
Kanchanpur	Shankharpur-7	23-Jul-11												18 Ghar Pariwar ko jagga katan	
Arghakhanchi	Thulopokhara-8	24-Jul-11	3											Rekha B.K., Usha B.K., Rita B.K.	
Bara	Prasauna-5	24-Jul-11	1											Bishnu Yadav	
Achham	Siddheshwor-7	25-Jul-11		1										Dilli Lohar	
Bajura	Kailashmandu-6	25-Jul-11	1											Keshab Raj Giri	
Bardiya	Patabhara-1	25-Jul-11	1											Hari Bdr.Chaudhari	
Pyuthan	Sari-1	25-Jul-11		1										Tek Bdr. Pun	
Jhapa	Khudunabari-3	26-Jul-11	1											Muna Damal	
Kailot	Dhaulagata-5	27-Jul-11		1										Ujwal Neupane	
Jajarkot	Karkigaun-4	28-Jul-11	1											Devi Adhikari	
Jhapa	Ajunchhara-5	28-Jul-11	1											Gopi Sherma Limbu	
Lalitpur	Sainbu	28-Jul-11	1											Nakhu Khola Swept an unknown woman	
Makawanpur	Hadikholia-6	28-Jul-11	1											Rapti River Swept unknown	
Rukum	Aatbiskot-2	28-Jul-11	1											Amar Bdr. Khola	
Baitadi	Maladevi	29-Jul-11		1										Sabina Bam	
Rautahat	Dharampur-4	29-Jul-11	1											Keshari Mahara	
Rupandehi	Dayanagar-4	29-Jul-11		1										Nirajan Subedi	
Jhapa	Satashicham	30-Jul-11						1					2500000	Biring Khola ko katan	
Kailali	Trineagar	30-Jul-11			1										
Bardiya	Kalka-2	31-Jul-11											145000	Pashupati Pra.Bi., Kaushila Sunar	
Rautahat	Saktuhawa-9	31-Jul-11	1											Dilip Paswan	
Sindhuli	Kalpabrishtya-6	31-Jul-11	1											Marin Khola swept unknown	
Sindhuli	Hatpatae-4	31-Jul-11		1										Kamala Nadi swept an unknow Indian	
Baglung	Adhikarichaur-5	1-Aug-11							3					Jit Bdr. B.K. Nal Bdr. B.K., Ram Bdr. Thapa	
Bejhang	Chainpur-6	1-Aug-11	1		1									Sujha Devi Karki	
Bejhang	Kadelich-8	1-Aug-11	1		1									Kanjadi Mandela and his son	
Bardiya	Rejapur-5,7	1-Aug-11				30									
Bardiya	Gulariya-4	1-Aug-11						1					400000		

NA= Not available

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District	VDC / Municipality & Ward No.	Date	People		Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing			Injured	Comp.		Partly	No.			
Beridya	Gulariya-13	1-Aug-11			1			1				90000		
Panchthar	Ranitar-9	1-Aug-11		1									Subarna Rai	
Rautahat	Basantapatti-6	1-Aug-11	1										Hari Narayan Sahani	
Rupandehi	Manmatoriya-9	1-Aug-11	1										Sunil Kewat	
Udayapur	Premitol-	1-Aug-11		2									Kram chand Chaudhari, Shyam BK	
Kapilbasu	Kopaba-6	2-Aug-11		1									Aparichit Male Person	
Solukhumbu	Baku-9	2-Aug-11					1						Pemba Sherpa	
Baitadi	Dasharathchand-2	3-Aug-11		1									Ramsingh Karki	
Dang	Durwa-3	3-Aug-11			1								Karna Bdr. Pariyar	
Palpa	Phek-3	3-Aug-11		2	1								Hum Kumari Rana Ridi Kholama Ham Phaleko	
Parsa	Supauliya-8,9	3-Aug-11										600000	10 Families ko	
Rolpa	Inwang-7	3-Aug-11	2										Pal Bdr. Dangi	
Rukum	Gotamkot-3,4,5	4-Aug-11					30						Naghari Khola swept houses	
Rupandehi	Butwal-13	4-Aug-11		1									Lila Thapa	
Dang	Tulsipur-6	5-Aug-11	1		1								Khopiram Adhikari	
Nuwakot	Dhijurae	5-Aug-11	1										Rishiraj Paudel	
Sindhupalchowk	Sundarjal-8	6-Aug-11		1									Kumar Lama	
Jajarkot	Khageikot-1	7-Aug-11		1									Tikaram Aagri	
Siraha	Siraha-7	7-Aug-11	1										Gulab Mohammad	
Sunsari	Bharaul-2	7-Aug-11		1	1								Baburam Majhi, Paras Neupane	
Bhojpur	Khatamma-8	8-Aug-11										500000	Gajendra Rai	
Dang	Urabi-3	8-Aug-11	1										Jugal Chaudhari	
Kailali	Ransikharihaire-2	9-Aug-11	1										Khadga Bdr. Bohora	
Kailali	Dharsinghpur-5	9-Aug-11		1									Tapasya Bohora	
Nawalparasi	Dumkibas-5	9-Aug-11	1										Itali Husen (Indian)	
Rupandehi	Shivapur-4	9-Aug-11		1									Vijaya Yadav	
Tanahun	Bhanu	10-Aug-11	3										Dhiraj Nepali, Raju Nepali, Aarati Nepali	
Nawalparasi	Senahi-9	11-Aug-11	2										Khobarudin Divan, Gujthe Teli	
Bejhang	Chainpur-3	12-Aug-11		1									Suresh Darmaee	
Bara	Nijgadh-8	12-Aug-11	1										Purna Maya Tamang	
Dhading	Trishuli	12-Aug-11		1									Ajun Bhujel	
Sarlahi	Shankhapur-2	12-Aug-11	1										Birendra Sahani	
Arghakhanchi	Thada-8	13-Aug-11		1									Tulasa G.C	
Bara	Nijgadh-8	13-Aug-11	1										Sakuntala Pariyar	
Dolekha	Lamabagar-2	13-Aug-11					2						Dil Bdr. Tamang, Nimachiring Tamang	
Mahottari	Laxminiya-3	13-Aug-11	1										Radu Devi	
Sarlahi	Bharnapuri-5	13-Aug-11	1										Manisha Paswan	
Udayapur	Triveni-4	13-Aug-11	1										Kumar Thapa (Janamukti Platoon CDR)	

NA= Not available

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District	VDC / Municipality & Ward No.	Date	People		Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing			Injured	Comp.		Party	No.			
Bera	Amelekhgunj-7	15-Aug-11	1											Dolma Lama
Bhojpur	Bhojpur-2	15-Aug-11										10500		Thir Bdr Pariyar
Kathmandu	Thankot-9	15-Aug-11	1											Rishib B.K.
Banke	Nepaljung-8	16-Aug-11	1											Imaran Hasin
Ilam	Pashupatinagar-5	16-Aug-11	1											Niraj Ghimire
Jhapa	Gauradaha-4	16-Aug-11		1										Ujwal Shrestha
Kailali	Bhajani-3	17-Aug-11	1											Tika Chaudhary
Kanchanpur	Dajai-2	17-Aug-11					4							Tulae Kunwar
Okhaldhunga	Jyamerai-5	17-Aug-11	1											Tika Bdr. Khadka
Seplari	Fakira-1,2,3,4	18-Aug-11					13					150000		Bhulani Khola Flood
Tanahau	Devghat-2	18-Aug-11	1											
Lamjung	Barundada-3	19-Aug-11		1										Gopal Pokharel
Okhaldhunga	Tokshela-9	19-Aug-11		1										Jamuna Tamang
Jhapa	Gauradaha-7	20-Aug-11	1											Jalapa Devi Timilsina
Kaski	Pokhara-17	20-Aug-11		1										Bir Bdr. Tamang
Mugu	Seti-4	20-Aug-11						6						Khade Khola Flood
Jhapa	Buchabarae-3	21-Aug-11	1											Bhavana Darji
Sankhuwasabha	Khandbari-13	21-Aug-11		1										Ming Ming (Chinese Tourist)
Sindhuli	Bhimeswor-1	21-Aug-11		2										Chomor Majhi, Jiwan Rana
Bara	Golgunj-9	22-Aug-11	1											Rajendra Pandit
Sindhuli	Bhimsthan, Belghari	22-Aug-11									6 Biga land			Kumar Karki & 6 others
Surkhet	Birendranagar-10	22-Aug-11			2									Man Bdr. Buda, Anil Buda
Surkhet	Thahachaur-1	22-Aug-11	1											Musug Sunar
Bhojpur	Kot-7	23-Aug-11												Bhinkumar Bharati
Dang	Purandhara-2	23-Aug-11	1											
Jhapa	Kerabari-8	24-Aug-11			12		12							
Jhapa	Kohabara-2	24-Aug-11	1											Rishi Dev
Parbat	Kankari	24-Aug-11									30 ropani		3000000	1 pool samet
Udayapur	Rampurhokshila-1	24-Aug-11		1										Sujan Rai
Jhapa	Jalathala-4	25-Aug-11	1											Rahul Mechee
Kanchanpur	Bhimdutta-12	25-Aug-11		1										Umesh Bhatta
Rukum	Pipal-4	26-Aug-11		1										Dipa B.K.
Rupandehi	Somalar-8	26-Aug-11	1											Mina Pun
Sunsari	Dharan	26-Aug-11	1											Yamaraj Shrestha
Sunsari	Dharan-17	26-Aug-11	1											Isha Pasali
Jhapa	Bhadrapur	27-Aug-11		1										Dhiru Mahato
Makawanpur	Manahari-1	27-Aug-11	1											Santosh Nepal
Morang	Mahogantale-1	27-Aug-11	1											Bikram Magar
Dadeldhura	Aalit-3	29-Aug-11	1		1									Chovi Ram Joshi

NA= Not available

Source: Ministry of Home Affairs

District	VDC / Municipality & Ward No.	Date	People			Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing	Injured			Comp.	Party		No.	Unit			
Siraha	Bedaharamal-1	29-Aug-11	1			1								Gadudhowji Chauhan	
Nawalparasi	Swathi-6	30-Aug-11		1		1								Bidur Gaire	
Palpa	Dovan-5	30-Aug-11		1		1								Sachin Magar	
Nuwakot	Naraja-3	31-Aug-11		1		1								Gokarna Sunar	
Dolakha	Suspa-2	3-Sep-11						2					700000	Bal Bdr. Thami, Nar Bdr. Kami	
Dang	Satbariya-6	5-Sep-11	1											Sangita Gharti	
Makawanpur	Chhatiwani-4	5-Sep-11	2												
Doti	Ladagada-5	6-Sep-11		1										Khari Devi Malli	
Mahottari	Khayasmara-8	6-Sep-11	1											Indu Devi Yadav	
Dang	Manpur-1	7-Sep-11	1											Ashish Bhandari	
Lamjung	Bholaeadar	7-Sep-11		1										Suvash Pariyar	
Rautahat	Pipariya-7	7-Sep-11	1											Dhermandra P. Sah	
Rupandehi	Semlar-2	7-Sep-11		1										Govinda Parita	
Dang	Laxmipur-6	8-Sep-11		1										Sunil Pariyar	
Jhapa	Shivajung-4	8-Sep-11	1											Biku Rai	
Kavrepalanchowk	Banepa-10	9-Sep-11	1												
Banka	Nepaljung-5	10-Sep-11		1										Safiya Nuwaf	
Ilam	Ilam-3	10-Sep-11	1											Manish Rai	
Ilam	Danabari-9	10-Sep-11	1											Bal Bdr. Rai	
Lamjung	ishanaeshowr-2	11-Sep-11	1											Bin Kumari Gurung	
Morang	Jhurakiya-1	11-Sep-11	1											Kailash Yadav	
Parsa	Lagadi-1	11-Sep-11	1											Pravesh Kurmi	
Kanchanpur	Krishnapur-2	12-Sep-11	1											Satyadevi Roka	
Banka	Kanchanpur-6	13-Sep-11	1											Kalpana Buda	
Morang	Sauramang-5	13-Sep-11	1											Samud Mandal	
Rukum	Pipal-1,4	16-Sep-11	1	1											
Siraha	Bacharamala-5	16-Sep-11	1											Sarada Sing Danuwar	
Bajhang	Malichaur-4	17-Sep-11		1										Naman Bohara	
Bajura	Martaadi-3	17-Sep-11		1										Nanda B. Bista	
Bajura	Jugada-7	17-Sep-11	1											Khina Thapa	
Khotang	Sawakataharae-8	17-Sep-11	1		1									Kabita Rai, Dikshya Rai	
Rupandehi	Chihya-1	17-Sep-11	1											Anil Chaudhary	
Dalekh	Naumulae	20-Sep-11		1										Kabiram Parajuli	
Nawalparasi	Dumkibas-1	20-Sep-11		1										Sanu Regmi	
Humla	Gothi-5	21-Sep-11		1										Yakendra Shahi	
Morang	Biratnagar-11	22-Sep-11	1											Bishal Sah	
Udayapur	Rampurthokshila-1	23-Sep-11		1										Ganesh Rai	
Bera	Kalaya-12	24-Sep-11	1											Murni Khatur	
Dadeldhura	Ajymeth-7	24-Sep-11		1										Tanka Awasthi	

NA= Not available

Source: Ministry of Home Affairs

District	VDC / Municipality & Ward No.	Date	People		Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing			Injured	Comp.		Partly	No.			
Ilam	Mahamai-8	24-Sep-11	1											Namkha Tamang
Rasuwa	Septhubeshi-3	24-Sep-11		1										Chhiring Tamang
Bejura	Martaadi-3	25-Sep-11	2											Nir Bista, Dhani Bista
Dhanusha	Bahedabela-7	26-Sep-11					5							Ram Kumar Yadav, Rambirish Yadav
Dhanusha	Bindhi-4	26-Sep-11					25					1166000		Shrawan Mandal
Kathmandu	Kathmandu-10	26-Sep-11		1										Sundar Regmi
Mahottari	Gaidabhetpur-3	26-Sep-11					5							
Mahottari	Pokharavinda-4	26-Sep-11					15							
Mahottari	Barnaula-2,7	26-Sep-11				6	7							Indra Kumar Jha and others
Rautahat	Dhamapur-1,2	26-Sep-11					35							
Siraha	Inaruwa-3	26-Sep-11						40						Sabita Bohara
Dadeldhura	Jogbudha-5	27-Sep-11		1										
Dhanusha	Naktajhi-2,3	27-Sep-11					3							
Dhanusha	Naktajhi-1	27-Sep-11					2							
Mahottari	32 VDC	27-Sep-11					520	381					496714000	
Sarlahi	Kabilasi-4,5,6	27-Sep-11					4							
Sarlahi	Simara-1,6,7	27-Sep-11					4							
Sarlahi	Sangrampur-6	27-Sep-11					1						50000	Bacri Mandal
Sarlahi	Sundarpur-4,6,7,8	27-Sep-11						6						
Siraha	Nabarajpur-5	27-Sep-11						6						
Siraha	Sarsor-1,8	27-Sep-11						10						
Siraha	Majhaura-2	27-Sep-11					6							
Taplejung	Liwang-4	27-Sep-11					1							Dilli Maya Nedembo
Mahottari	Halkhori-2,5,9	28-Sep-11						15						Rehana Devan
Nawalparasi	Narsingh-7	28-Sep-11		1										Shiva B.K.
Mugu	Pina-2	1-Oct-11		1										Mahamad Samir
Kavrepalanchowk	Bhumlutar-6	3-Oct-11		1										Netra Bdr. Magar
Dhading	Pida-3	6-Oct-11		1										Sarita Oli
Rukum	Chaukhabang-5	7-Oct-11		1										Barma Yadav
Bardiya	Gulariya-9	9-Oct-11	1											Dinesh Kharel
Salyan	Maikagade-1	12-Oct-11		1										Niraj Harijan
Rupandehi	Pakadasakraun-9	13-Oct-11	1											
Syangja	Deurali-7	13-Oct-11	2											
Palpa	Khaliwang-1	19-Nov-11	1											Santa Bahadur Kumal
Lamjung	Taghing-2	10-Dec-11	1											Chhepe Lama
Kaski	Sardikhola-7	5-May-12	31	38	5	31	31			120	Ropani	11000000		Archan Shrestha, Gopal Tamrakar and others

NA= Not available

Source: Ministry of Home Affairs

Table 4: Water Induced Disasters: Landslides in 2011

District	VDC / Municipality & Ward No.	Date	People			Affected Family No.	Animal Loss	House Destroyed Comp.	Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing	Injured					No.	Unit			
Bardiya	Khairapur-4	5-Feb-11	1										Paturam Chaudhary	
Tanahau	Manapang-8	5-Feb-11	3										Dau Bdr. Ale, Jag Bdr. Ale, Bir Bdr. Khamcha	
Kailkot	Fukot-9	14-Feb-11	1		3								Sawanae B.K.	
Kailkot	Fukot-9	14-Feb-11					1					458000	Devisara Neupane	
Kailkot	Fukot-9	14-Feb-11					1					310000	Ram Bdr. Atri	
Kailkot	Fukot-9	14-Feb-11					1					300000	Dan Singh Bogati	
Rolpa	Khumel-3	19-Feb-11	1		1								Humraj Nepal	
Lalitpur	Badaegaun	20-Feb-11	3		2								Sandip Ghelan, Kancha Lama, Bhatu Buda	
Gorkha	Chhekampar-6	28-Mar-11	5										Dorje Lama, Syange Dorje Lama, mwang Londup Lama, Chhewang Dundup Lama, Yangjen Lama	
Syangja	Tamsar-4	14-May-11										1600000	Seshkant Sapkota	
Parsa	Jipur-7	23-May-11	4										Dipmala Chaudhary, Dipnarayan Chaudhary, Rajkumar Das, Anita Das	
Baglung	Righa-6	27-May-11				1	1					1500000	Dhansara Sapkota	
Tanahau	Rojidanda-2	3-Jun-11			2								Purn Bahadur Thapa	
Syangja	Fedikhola-4	6-Jun-11										80000	Taradevi Khaadka	
Syangja	Putalbazar-2	11-Jun-11										100000	Moti Prasad Sharma	
Khotang	Aiselukharika-7	26-Jun-11				12	12					2637000	88 Ropani Land too	
Humla	Limi-4	30-Jun-11					2						Chhiring Ueetup Tamang, Sonam Gyaljan Tamang	
Syangja	Chimnebas-8	30-Jun-11					1						Til Bahadur Manandhar	
Kaski	Salyan-5	1-Jul-11			2		1					150000	Unita BK, Nisha BK	
Lalitpur	Chapagaun-6	1-Jul-11			3								Rajendra Thapa Magar, Sushila Thapa Magar, Sunita Thapa Magar	
Makawanpur	Faratei-5	1-Jul-11	1										Dambar Sing Thing	
Syangja	Shaligram-9	1-Jul-11					2					4000000	Laxmi Paudel, Sunil Pathak	
Syangja	Setidovan-3	1-Jul-11										60000	Bhawishwor Dhakal	
Syangja	Dasinghalsum-7	1-Jul-11										413000	Baburam Basnet	
Tanahau	Bhanumati-1	1-Jul-11			1		1						Nar Bdr. Malla	
Tanahau	Reesing-7	1-Jul-11	2										Goma Thapa & her daughter	
Tanahau	Bandipur-8	1-Jul-11	1										Chetmaya Bhattarai	
Tanahau	Manaskot-8	1-Jul-11				5			1				Devilal Paudel	
Tanahau	Arunodaya-5	1-Jul-11				10							Tulsiram Timisina	
Tanahau	Bhanumati-8	1-Jul-11	1		2								Pitmaya Thapa	
Tanahau	Bhimad-8	1-Jul-11											Tilak Nepali, Pom Bdr. Shrestha, Sita Rani	
Achham	Kalagaon-7	2-Jul-11	3										Rup BK, Ramesh BK, Ishara BK	

NA= Not available

Source: Ministry of Home Affairs

District	VDC / Municipality & Ward No.	Date	People			Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing	Injured			Comp.	Partly		No.	Unit			
Sarlahi	Lamatar-9	2-Jul-11					2		1	1			200000	Bhim Bahadur Tamang	
Syangja	Panchamul-8	2-Jul-11											1000000	Amar Bdr. Bishwa	
Syangja	Ramkot-3	3-Jul-11									15 Ropani		170000		
Syangja	Rapakot-3	3-Jul-11											300000	Gupta Prasad Kafle	
Syangja	Rapakot-3	3-Jul-11									1 hal ko melo		200000	Bhesha Raj Kafle	
Syangja	Aarukharika-9	3-Jul-11											150000	Humnath Jaisy	
Syangja	Kichnas-3	3-Jul-11											50000	Radhika B.K.	
Tanahau	Sabubhagawipur	3-Jul-11	1		1									Jyoti Thapa	
Tanahau	Jamune-6	3-Jul-11	1		2		3							Gita Shrestha	
Baglung	Righa-2	4-Jul-11	6		1		3		1					Rana Bahadur Shreesh	
Kaski	Thumki-7	4-Jul-11					2							Mamata Pariyar, Shanti Pariyar, Dhani Pariyar, Narayana Pariyar are Death and Sejan Pariyar, Dhana Meya pariya are missing	
Syangja	Putali Bazar-1	4-Jul-11											138000	Huti Kami	
Syangja	Kichnas-3	4-Jul-11											100000	Chitra Bdr. B.K.	
Dolpa	Tripurkot-2	5-Jul-11						1						Dharma Singh Rokaya	
Humla	Simikot-2	5-Jul-11			1			1						Dabal Rokaya & Gore Rokaya	
Mugu	Sukadhiki	5-Jul-11			1									Jayananda Karki	
Syangja	Yeladi-8	5-Jul-11					4		2				682000	Sita Paudel	
Tanahau	Bandipur-4	5-Jul-11	1		1			1						Dhurba Kumari Pradhan, Dinesh Pradhan	
Mustang	Lete-4 Meshi	6-Jul-11												Jomsom Sadak Khauda Bato Banda	
Syangja	Waling-4	6-Jul-11						1					300000	Dala Bahadur Gurung	
Syangja	Waling-4	6-Jul-11						1					300000	Thal Bahadur Gurung	
Myagdi	Ghatan-8	7-Jul-11						1						Dil Bahadur Darji	
Palpa	Madanpokhari-4	8-Jul-11												Siddhartha Rajmarga Bato Abarudha	
Sindhuli	Bastipur-7	8-Jul-11	1											50 yrs Phul Kumari Khaadka	
Humla	Syada-3	9-Jul-11	1											Tul Bdr. Malla	
Sindhupalchowk	10 kilo	9-Jul-11												Bato Abarodh	
Bhojpur	Boya-4	13-Jul-11					2	1					42000	Prem Kumar Tamang	
Sankhuwasabha	Khandbari-	13-Jul-11						1						Jilla Police Jawan Mesh Ghar	
Taplejung	Khamling-7	13-Jul-11			2			1						Dala Bdr. Nambu	
Dolpa	Juphal-1	15-Jul-11							1					Krishti Bikash ko Ghar	
Jajarkot	Ragda-5	15-Jul-11	3		2									Lal Kumari B.K., Hirakumari Chamar, Langka Bdr. B.K.	
Nuwakot	Thansingh-9	15-Jul-11	3		5		1	2		1				Sanae Mijar, Nirmala Mijar, Susma Mijar, Ram Bdr. Mijar	
Nuwakot	Okharpaawa-1	15-Jul-11						10					2100000	Balkrishna Nepal	
Rukum	Purtimkade-1	15-Jul-11	3					8						Ramesh Gharti, Amrita Gharti, Sabina Gharti	

NA= Not available

Source: Ministry of Home Affairs

District	VDC / Municipality & Ward No.	Date	People			Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing	Injured			Comp.	Partly		No.	Unit			
Rukum	Purimkada-3	15-Jul-11	10											Udiram Buda, Kali Buda, Khadag B. Buda, Rudra Budhatoki, Gita Budhatoki,	
Sindhupalchowk	Simpalkavre-4	16-Jul-11				1		1					617000	Ramkrishna Kami	
Manang	Dharapani-1	17-Jul-11			2									Kumar Singh Tamang	
Nuwakot	Narjmandap-5	19-Jul-11	4			5			1					Ajun Tamang, Thulikanohi Tamang, Santosh Tamang, Jhliake Tamang	
Solukhumbu	Salleri-9	19-Jul-11	1	1									600000	Lakpa lama	
Humla	Simkot-3	20-Jul-11						1					40000	Dodhe Rawal	
Khotang	Bahauhidada-2	20-Jul-11	1											Khadak Bdr. Bhujel	
Lalitpur	Godavari-2	20-Jul-11	1					1						Srijana Ale Magar	
Rasuwa	Saphru-7	20-Jul-11	1											Chris Van Ravesteyn	
Dadeidhura	Amarpatti-4	21-Jul-11											300000	Hotel	
Dolpa	Narku	23-Jul-11						1					169300		
Mustang	Ghusang-5	23-Jul-11	1											Nima Gurung	
Tanahau	Kahaushivatu-8	24-Jul-11			2									Krishna Thapa, Khem Karki	
Kavrepalanchowk	Devitar-1	26-Jul-11						1					350000	Morali Kami	
Baitadi	Nwani-1	27-Jul-11			1			1						Dhan Chand	
Kalikot	Siuna-5	27-Jul-11			2			1						Pratik Shahi	
Gorkha	Prok-4	28-Jul-11			10									Police Station Larke Bhanjyang	
Baitadi	Shivalinga-3	31-Jul-11	1					1						Bahadur Bohara	
Rukum	Chaukhabang	31-Jul-11									School				
Baglung	Malika-9	1-Aug-11				1		1					200000	Dil Bdr. Damai	
Baglung	Ajewa-7	2-Aug-11				1		1					200000	Farsa Bdr. Nayak Chhetri	
Baglung	Paiyaupata-7	3-Aug-11				1		1					180000	Tek Bdr. Rana	
Doti	Khatiwada-1	3-Aug-11			3			1						Tule Saud	
Rolpa	Liwang Tobang-1	3-Aug-11	3		2			1						Balaram Thapa and his 1 son and 2 daughter	
Taplejung	Pedang-2	3-Aug-11						1						Rasriya Ma. Vi., Santosh Gautam	
Taplejung	Pedang-2	4-Aug-11												6 family displayed	
Gorkha	Palungtar-1	5-Aug-11						1						Shree Prasad Paneru	
Rupandehi	Butwal-4	6-Aug-11	1											Rupa Paudel	
Pyuthan	Maranthana-4	7-Aug-11				1	2		1				200000	Santos Rana Magar	
Dalekh	Chamunda-5	11-Aug-11						3						Deusee B.K.	
Dolpa	Liku	11-Aug-11						1					1193500		
Dalekh	Bansi-8	13-Aug-11			1			1						Dilli Bishta	
Dolakha	Gaurishankar-4	13-Aug-11				2		3			40 Ropani land			Birman Tamang	
Solukhumbu	Chaurikharke-8	13-Aug-11	6					3						Ek Bdr. Basnet and his 3 family and 3 guest	
Baglung	Amalachaure-7	14-Aug-11							1				80000	Sashidhar Paudel	
Dhading	Jogimara-5	17-Aug-11	1											Chinimaya Chepang	
Baglung	Dudliabhati-1	18-Aug-11				1		1					1200000	Mana Bdr. B.K.	

NA= Not available

Source: Ministry of Home Affairs

District	VDC / Municipality & Ward No.	Date	People			Affected Family No.	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)	Remarks
			Death	Missing	Injured			Comp.	Partly		No.	Unit			
Dalekh	Toil-5	18-Aug-11			1									Mankumari Malla	
Rasuwa	Bidim-1	18-Aug-11			1									Ranachandra Chaudhary	
Baglung	Palakot-6	19-Aug-11				1		1					171000	Hemanta Hamal	
Baglung	Chhisi-7	22-Aug-11				1		1					250000	Dilae Damai	
Jajarkot	Dhinae-8	22-Aug-11			2		3		1					Karna Bdr. Sarki	
Parbat	Deupur-9	22-Aug-11						3					3000000		
Rukum	Khara-2	23-Aug-11	5		3			2						Yagya Oli, Setae Oli, Mina Oli, Tika Oli	
Salyan	Kotbada-7	23-Aug-11	2											Nandaram Oli, Nokhiram Oli	
Salyan	Sivarath-2	23-Aug-11	1		2			1						Udiram Oli	
Sindhuli	Kamalamat-2	23-Aug-11	1											Bimanta Khadka	
Baglung	Singana-6	24-Aug-11				1		1					154000	Hasta Bdr. Thapa	
Jajarkot	Bhagawati-3	24-Aug-11	3		1								150000	Jayram B.K.	
Baglung	Bhingithae-1	25-Aug-11				1		1					100000	Govinda Dhital	
Dhading	Bairani-8	25-Aug-11				1		1					300000	Bhakta Bdr. Thapa, Krishna Bdr. Sinjali	
Sindhuli	Jhagajholi	1-Sep-11	7			2		2						Jakmari Buda, Chahana Buda, Sunita Gharti, Himanshu Gharti, Pujani Buda, Sarita Buda	
Rukum	Hukam-7	5-Sep-11												Khagenora Gautam	
Kavrepalanchowk		8-Sep-11	1												
Jajarkot	Dhurkhola	9-Sep-11			4		1							Karna Bdr. Gharti	
Dalekh	Kalika-9	10-Sep-11	2	5										Kamal Magar	
Morang	Yangshila-9	11-Sep-11	1		2									Bhajanee Thapa,	
Achham	Budarkot-2	14-Sep-11	1		2									Gauri B.K.	
Rolpa	Gram-8	14-Sep-11	1		1		5							Rewati Acharya, Sunita Acharya	
Khotang	Diktel-3	17-Sep-11	1		1									Kalpana, Alina, Sangita Sarki	
Ramechhap	Rasnaluu-6	17-Sep-11	3		1									Nal Budhathoki, Kali Pariyar and others	
Rolpa	Mijhing-1	17-Sep-11	7	17			9	8	1				20000000	Gyan Batae Chongbang	
Taplejung	Thukimba-4	19-Sep-11	1											Deepak Rai	
Baglung	Resha-3	22-Sep-11	5		9									Isada Mandal	
Panchthar	Falaya-8	23-Sep-11			1									Suman Thami, Susan Thami	
Kavrepalanchowk	Jamdi-6	26-Sep-11	1											Yemuna Tiwari	
Lalitpur	Lalitpur-8	27-Sep-11	1		1			1						Batuli Pun & Husband	
Surkhet	Satakhani-8	27-Sep-11		1										Aini Kotari, Amrita Dhama, Manu Ojha	
Rukum	Jhula-7	14-Oct-11	2											Escavator	
Darchula	Khalanga-4	17-Mar-12	3			0								Jhamak Yakha, Anil Gurung, Tikaram Gurung, Abhisekh Rai	
Mustang	Chussang-7	16-May-12	4			0								Man Nath Limbu	
Dhankuta	Telya-3	22-May-12	4			0									
Terathum	Morahang-1	27-May-12											700000		

NA= Not available

Source: Ministry of Home Affairs

Comparative Disaster Scenario of Nepal Since 1983 to 2011

In the year between 1983 to 2011 A.D., the total number of 22811 people lost their lives by different types of disasters. In the first 11 years only of 21st century, total number of 3759 people lost their lives from various disasters which is of 16.47 percent of the total number of lost lives from 1983 to 2011. In the previous 11 years from 1990 to 2000 A.D., the number of 10452 people lost their lives from different disasters which is of 46 percent of the total death of people since 1983 to 2011 A.D. This is 29.53 percent more than the death casualties of last 11 years (table: 2). In the first 11 years of 21st century, total 1888 people were injured consisting of 8.47 percent of the total injured since 1983 to 2011. In the previous 11 years since 1990 to 2000 A.D. 5666 people were injured consisting of 25.44 percent. This is 17 percent more than the injured number of people of last 11 years (Table: 2).

In the last 11 years, the total number of 46792 live stocks lost their lives by different disaster factors which is of 56.76 percent of the total loss of live stocks since 1983 to 2011 A.D. In the previous 11 years since 1983 to 2000 A.D. 12994 number of live stocks lost their lives by different disaster factors consisting 15.76 percent. In this way, the figure in the table 2 shows that the loss of live stocks in the last 11 years is higher than the previous 11 years. Thus, the facts in this table show that the condition is severe in livestock raising in the last 11 years. Comparing to all the years 1983 to 2011, the highest number of live stocks lost was 21881 in the year of 2007 which is of 25.69 percent of the total as shown in the table:2.

In the last 11 years of period, the number of houses destroyed by the different disasters is 130442 consisting the percentage of 30.57 of the total number of the period of 1983 up to 2011. In the period of previous 11 years 1990 up to 2000 A.D. the number of houses destroyed by the different disasters was of 122390 which is of 28.68 percent of the total of the period of 1983 to 2011. In this whole period, the highest number of houses destroyed was of 108801 in the year of 1988 as shown in the figure (Table:2) the major cause was the earthquake in 1988.

During the period of last 11 years, 281182 numbers of families were affected by the different disaster factors which is

of 31 percent of the total of 1983 to 2011. In the previous 11 years 1990 up to 2000, the number of 447363 families were affected by the different disasters which consists about 50 percent of the total affected families since 1983 to 2011. Thus, the facts show that the affected families were more in the previous 11 years than the period of last 11 years which is 19 percent more. The table 2 shows that in the last 11 years, 75965.98 ha of land was affected which consists 64 percent of the total land affected area since 1983 up to 2011. But in the previous 11 years since 1990 to 2000 the land area of 57334.25 ha was affected by the different disaster factors which is 48.55 of the total affected land since 1983 to 2011. In this way, the facts show that 15.45 percent more land is affected in the last 11 years than in the previous 11 years. Thus, we can come to the conclusion that more natural hazards (flood and landslide, wind storms) might have occurred in the last 11 years than in the period of previous 11 years. The reason might be population growth, higher rate of migration, forest area encroachment causing more natural hazards.

The figures in the table 2 show that in the last 11 years, the numbers of 225.46 public infrastructures were affected. In the previous 11 years since 1990 to 2000, the total number of 105 public infrastructures were affected by the different disasters since 1983 to 2011. In this way, the number of affected public infrastructures is higher in the last 11 years than in previous 11 years.

In the last 11 years as shown in the table 2, the estimated loss was of Rs. 8542.92 million by different kinds of disasters. In the previous 11 years since 1990 to 2000 A.D. the estimated loss was of Rs.12409.5 million. The total estimated amount since 1983 to 2011 is of Rs. 34180.319 million. Thus, the period of last 11 years, consists about 25 percent of the total estimated amount of loss. Previous 11 years' period consists about 37 percent of total estimated loss and the period of 1983 to 1989 (only 7 years in accordance of available data) consists about 38 percent of total estimated loss which is the highest of all. This concludes that the natural disasters were highly occurred in that period of 7 years only. The serious earthquake also was occurred in 1988 which caused the loss of higher level of lives and properties.

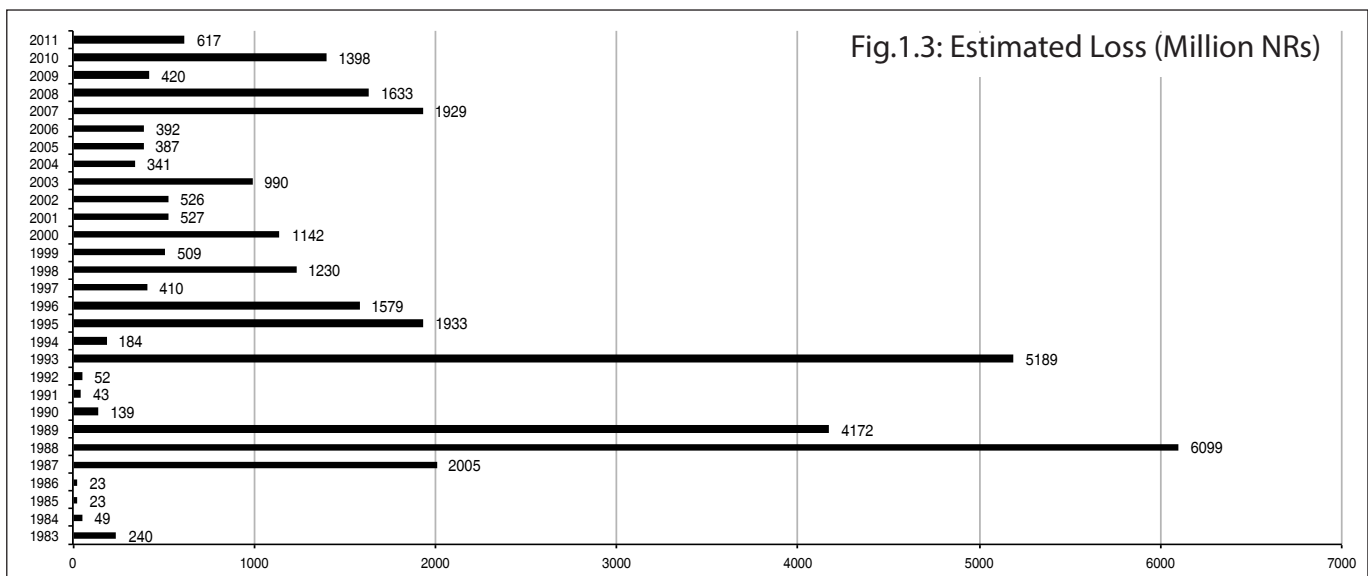
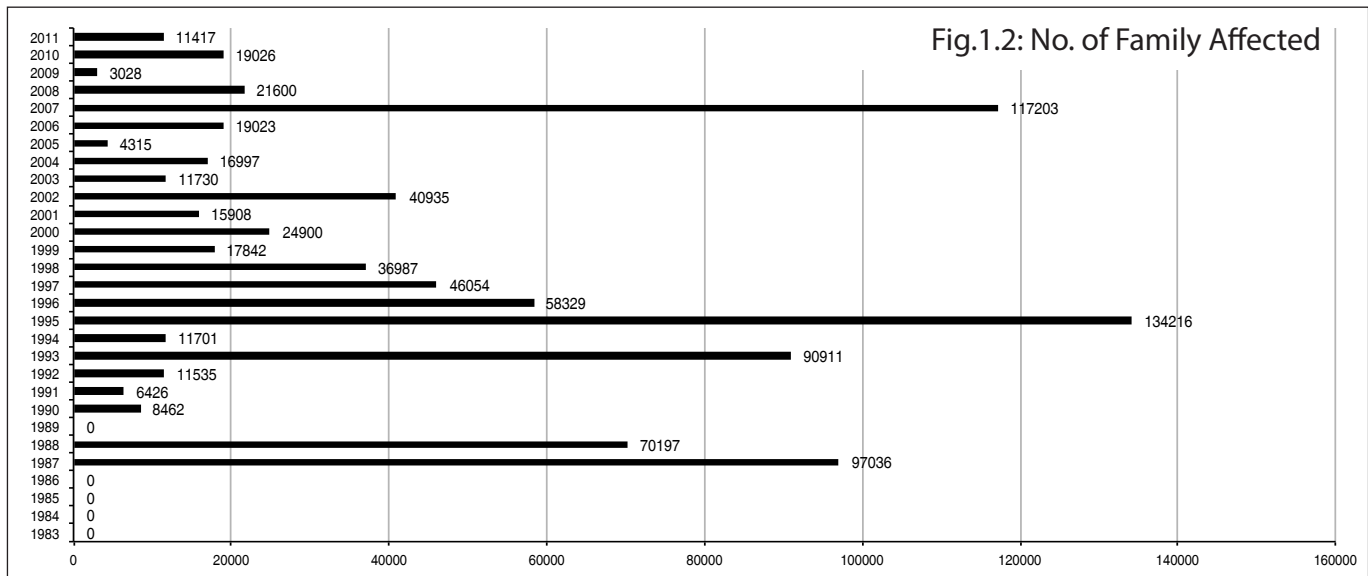
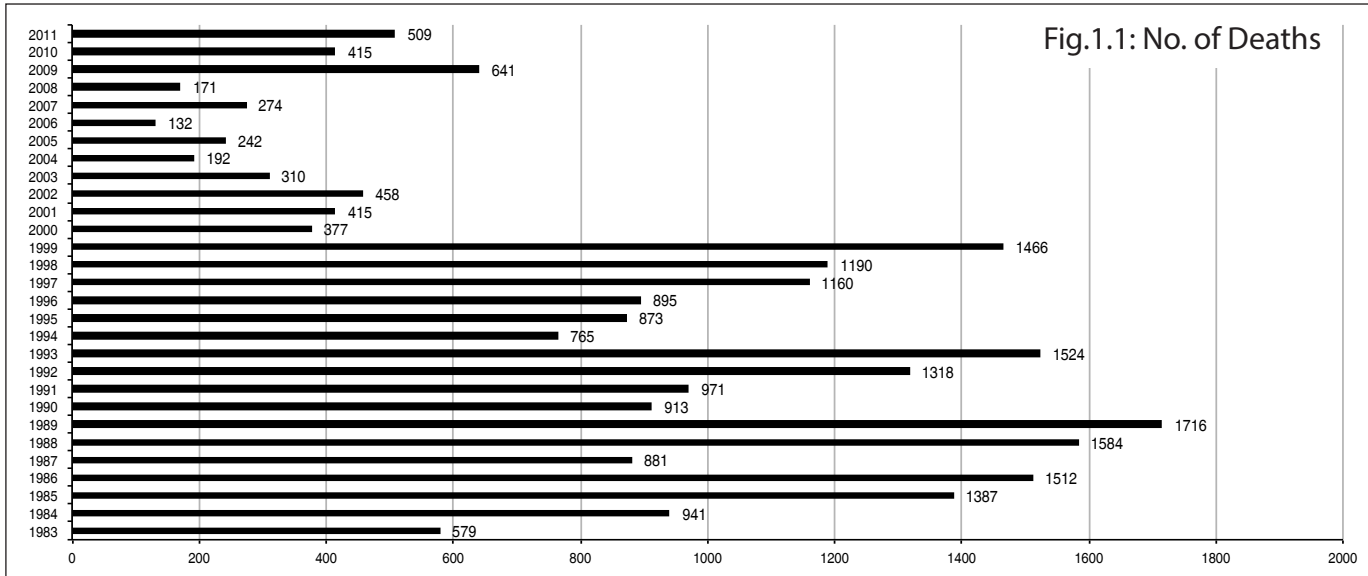
Table: 2
Comparative Disaster Scenario of Nepal since 1983 to 2011

Year	People		Livestock Loss (Nos.)	Houses Destroyed (Nos.)	Affected Family (Nos.)	Land Affected (Ha.)	Public Infrastructure	Estimated Loss (Million NRs.)	Remarks
	Death	Injured							
1983	579	NA	248	12	NA	NA	NA	240	
1984	941	NA	3547	10597	NA	1242	869	49	
1985	1387	NA	3399	7166	NA	1355	436	23	
1986	1512	NA	6566	3370	NA	1315	436	23	
1987	881	162	1852	36220	97036	18858	421	2005	
1988	1584	12538	2788	108801	70197	NA	4365	6099	
1989	1716	3014	4240	7648	NA	NA	NA	4172	
1990	913	196	867	6352	8462	1132	NA	139	
1991	971	43	642	5510	6426	283	39	43	
1992	318	17	1586	13997	11535	135	66	52	
1993	1524	246	NA	21911	90911	NA	NA	5189	
1994	765	155	1329	3234	11701	392	NA	184	
1995	873	1937	2053	10275	134216	41867.26	NA	1933	
1996	895	1527	2480	30014	58329	6063.4	NA	1579	
1997	1160	1120	1191	4825	46054	6063.4	NA	410	
1998	1190	117	1179	15082	36987	326.89	NA	1230	
1999	1466	146	650	4304	17842	182.4	NA	509	
2000	377	162	1017	6886	24900	888.9	NA	1141.5	
2001	415	132	665	6103	15908	NA	NA	526.55	
2002	458	287	2126	19856	40935	10077.5	NA	525.56	
2003	310	160	1125	6819	11730	2360	NA	989.93	
2004	192	220	888	4818	16997	0	NA	341.09	
2005	242	153	955	3169	4315	0	NA	387.21	
2006	132	88	10098	3765	19023	3396.84	NA	392.31	
2007	274	144	21861	37984	117203	513.650	NA	1928.55	
2008	171	55	7066	13864	21600	21315	NA	1633.28	
2009	641	117	228	1050	3028	NA	4.88	420.25	
2010	415	261	1526	23370	19026	200 no	2.85	1398.19	
2011	509	271	254	9644	11417	120	0	616.899	
Total	22811	22268	82426	426646	895778	118087.24	6639.73	34180.319	

Note: NA - Not Available

Source: Ministry of Home Affairs

Figure 1: All Types of Disasters, 1983-2011



East Rapti River Training with PEP Perspective

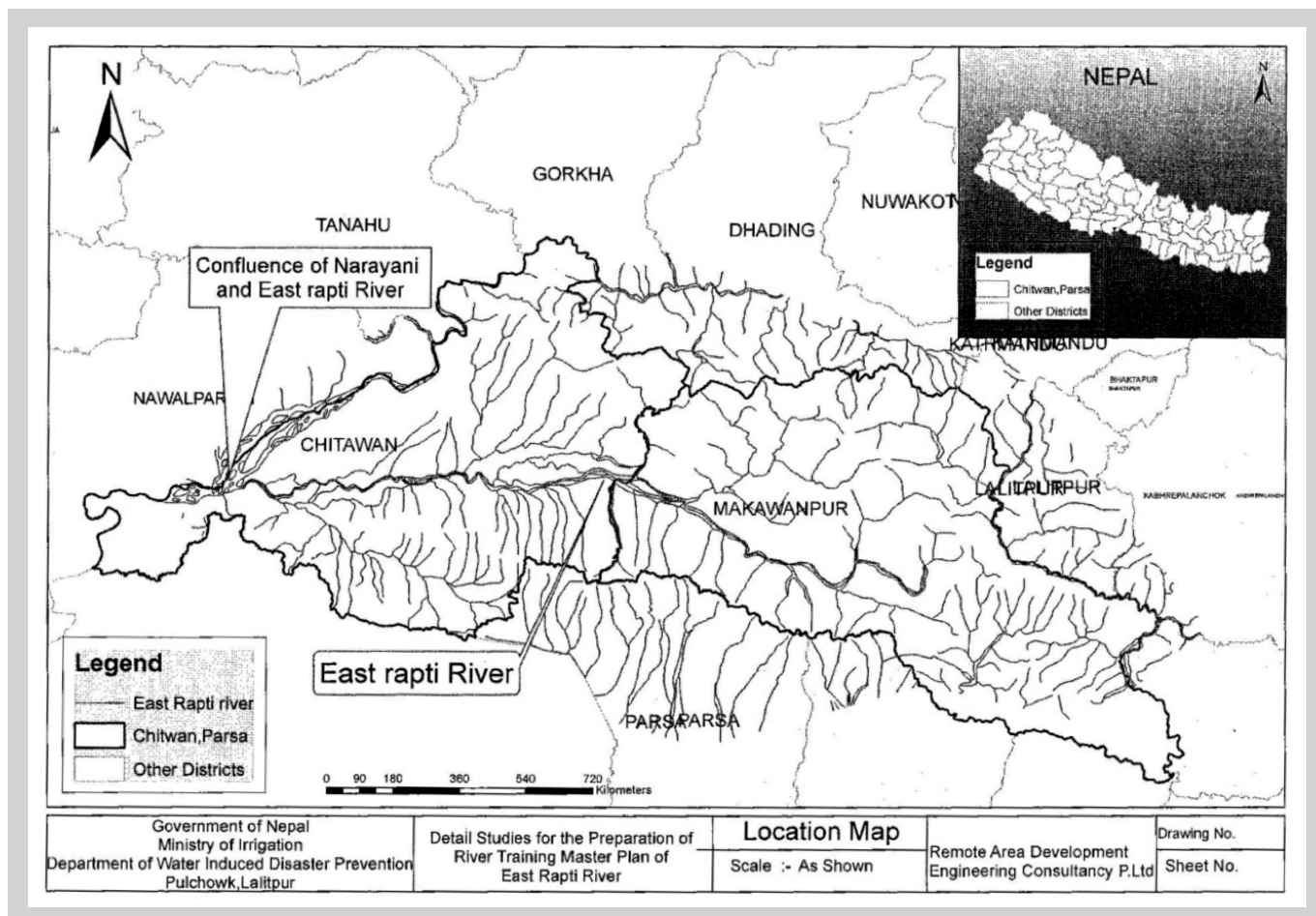


Krishna Prasad Rijal
Engineer, DWIDP

Introduction

East Rapti River, a tributary of Narayani River which is a major river system of Nepal, is situated at the central part of the country. It originates from Chisapanigadhi of Makawanpur district and merges with Narayani River at Khoriya, Meghauri VDC of Chitwan District. At the downstream from Hetauda municipality, this river is almost parallel to East West Highway and flowing towards the West. The total length of the river is about 117 km. Total catchment area of this river at the confluence point with Narayani is 2665 km². This river is steeper at its origin and the upstream part, while middle portion has moderate to flatter slope and the lower portion has flatter slope. It is a non snow fed river, however, perennial in nature. The major tributaries of this river are Samari, Karra, Lothar, Manahari, Pampha, Budhi Rapati, Ladra, Kayer, Khageri etc. The adjoining VDCs through which this river flows at Makawanpur are Bhimpheedi, Nibuwatar, Aambhanjyang, Padampokhari, Handikhola, Basamadi, Manahari and Hetauda municipality and adjoining VDCs at Chitwan are Piple, Bhandara, Pathar, Kumroj, Padampur, Patihani, Bachhauri, Jagatpur, Sukranagar, and Meghauri. The left part of the river at Chitwan district is covered by forest and the forest is reserved by Chitwan National Park.

Figure 1: Map of East Rapti River, Source: Master Plan, 2010



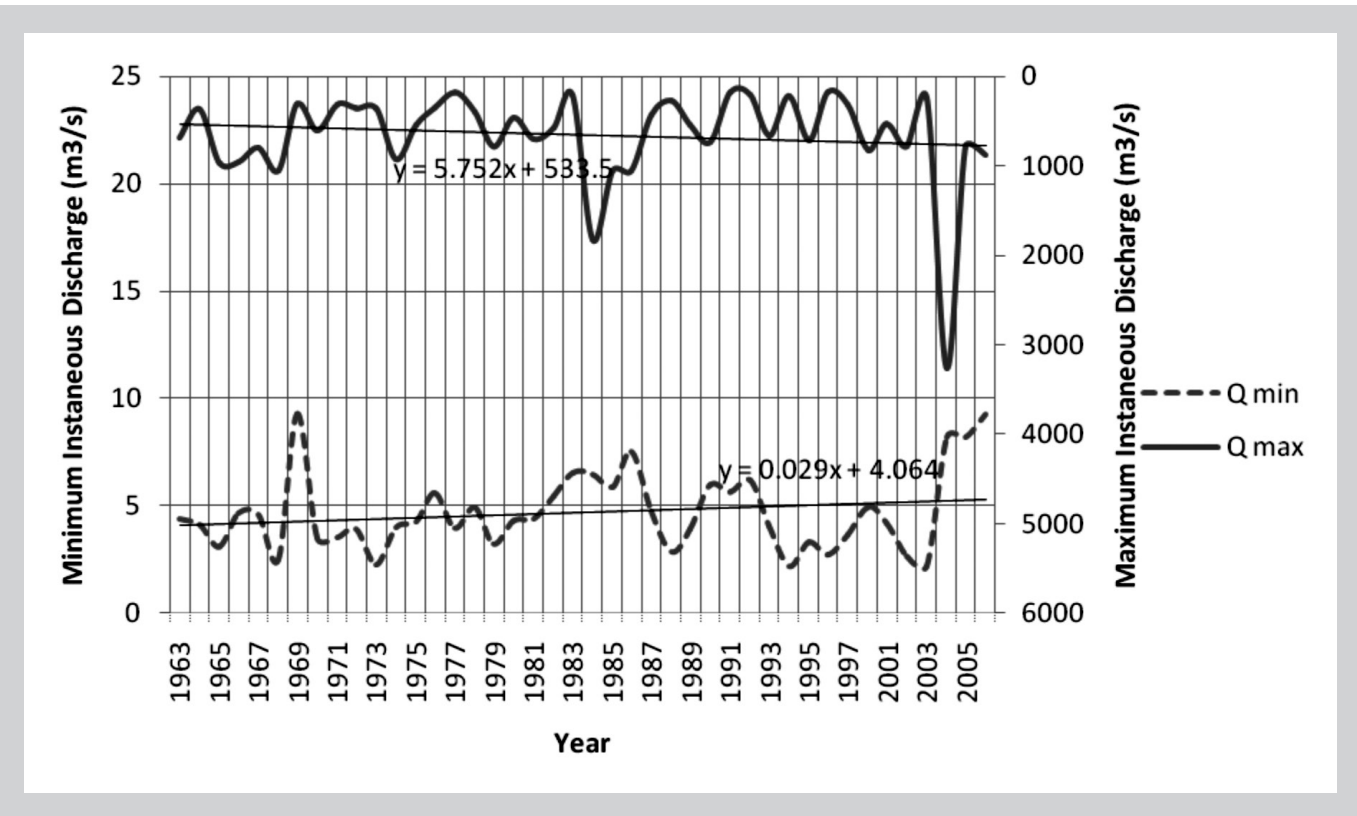


Figure 2: Min. and Max. Instantaneous discharges measured at Rajaiya, East Rapti, Data Source -DHM

The upper part of river bed is composed of sand and gravel bed material where as the lower part, at Chitwan district, consists of silt and sand bed. Most of the steep tributaries joining to this river carry heavy sediment through the debris flow. This has caused the river to be of the aggrading nature. The consequences are frequently changing nature of the river in plan and profile to cause increased water induced hazards.

The hydrological data measured at Rajaiya station of East Rapti River in Makawanpur district, figure 2, shows the yearly maximum and minimum instantaneous discharge. The minimum instantaneous discharge is nearly constant over the years where as the maximum instantaneous discharge has increasing trend with the peak value of 3260 m³/s occurred in the year 2004. The increased trend of maximum instantaneous discharge has become the notion of increasing trend of flood hazards.

Hazards Caused By East Rapti River

Water induced hazards are mainly caused by erratic rainfall, fragile geology and poor vegetation coverage. East Rapti River basin is also engrossed with such hazard causing characteristics. Also, at many places along the bank of the river, the flood plains and adjoining land are encroached by people for settlement and agricultural purpose. Slums have been made at various areas of Hetauda and Manahari near the highway. These encroached areas are most severely affected by the flood of East Rapti River. The torrential rainfall at monsoon season, nearly about eighty percent of the annual rainfall within the four months from June to September, causes very high peak discharge in this river. This causes flood events and inundation even at high lands at various parts of Chitwan district. Summary of water induced disasters occurred in Chitwan and Makawanpur district in the past two decades is depicted in table 1.

Table 1: Losses due to Water Induced Hazards in Chitwan and Makawanpur districts

Year	Losses due to landslides and Floods in Chitwan and Makawanpur districts									
	Chitwan					Makawanpur				
	Person Dead	Person Injured	Family Affected	House destroyed	Damage to Agr. land (ha)	Person Dead	Person Injured	Family Affected	House destroyed	Damage to Agr. land (ha)
1992						1		1		
1993	24		5293	2206	741.0	247		14748	3010	4112.0
1994										
1995			11	6	5.4		1	1	1	
1996			12		1.0	1		1		
1997	2	1	55					56	55	
1998			37		1.5	5	2	42	27	1.4
1999	20		890		0.1	5	2	78	20	
2000				7		3	2	9	5	677.3
2001	1		212	91	270.9			281	81	135.5
2002	30	146	1753	1375	3538.9	113	26	82	138	
2003	14	5	134	136		8	3	66	74	5.4
2004	1		1			24	2	1407	1446	
2005								2	1	
2006	4			209		3				
2007						4		11	150	2.7
2008			7	7						
2009				4		1				
2010	2		784		101.6	3	4	42	11	
Total	98	152	9189	4041	4660.4	418	42	16827	5019	4934.2

Source: Disaster Review (1992- 2010)

Some of the specific hazardous impacts caused by this river can be summarized as below:

Impact on road and bridge

East Rapti River flows along the road corridor at certain stretches in Makawanpur district. The road is at the left side of the river. At various locations the river has made toe cuttings to the road slope. The bridge at the East West highway at Hetauda Municipality is also vulnerable to flood hazard. The right bank of the river has disastrous effect to the bridge structure.

Impact on cultivated land and settlement

The morphology of river is braided at certain stretches at the upper part while it is meandered at the downstream reaches. The high rate of sediment yield from Chure area and from other parts of the catchment has caused the river bed raising. The aggrading nature of the river has made it unstable river. The geomorphological change in the river has made it more hazardous. The bank erosion and flooding has impacted on cultivated land and settlements. The river hazard affected VDCs in Makawanpur district are Bhimphedi, Nibuwater, Aambhanjyang, Padampokhari, Handikhola, Basamadi, Manahari and Hetauda municipality and in Chitwan district are Kumroj, Padampur, Patihani, Bachhauli, Jagatpur, Sukranagar, and Meghauli. As per East Rapti master plan study

report 2011, Makawanpur district can reclaim 2000 ha of land and Chitwan district can do 7200 ha.

Impact on tourism sector

Chitwan district is one of the important tourism destinations of Nepal. The Chitwan National Park, situated in this district, has been a place of attraction for natural beauty, Jungle Safari, elephant riding and wild life viewing and the like. The major places for tourism importance are Saurah, Patihani, Jagatpur, Sukranagar and Meghauri. Most right bank of this river at Chitwan district has been developed as tourism destination. About one half dozen of new and attractive tourist resorts are under construction. However, the bleak picture is that, the existing resorts and even those under construction are not risk free from flood hazards. The bank erosion has been regularly affecting the resort areas and the structures made thereof.

Impact on conservation area

The Chitwan National Park, an important conservation area of the country, is suffering from landslides and bank erosion due to the unstable nature of this river. The river frequently changes its course at the milder slope stretches and cause direct and indirect impacts to the existing flora and fauna residing over there. The unplanned and scattered interventions along the river course cause adverse effect to the ecosystem of the conservation area.

Existing River Training Works and Attempts

Most likely, considering the importance of this river and hazards caused to people and its economic value, various studies have been made in this basin and river training works have been initiated. As the major responsible agency for water induced hazards, Department of water Induced Disaster Prevention (DWIDP) has major contribution to the study and implementation of mitigation measures of these hazards.

A significant work was done by JICA/DPTC in this river in 1999. This project constructed 18 km long earthen dam at the downstream of Lother khola and spurs at various locations. In total 87 numbers of spurs are existed in the Chitwan district part of this river as reported in master plan, 2010.

Under DWIDP, Bara division is the responsible agency for study and implementation of water induced hazards in Chitwan and Makawanpur districts. This division has also conducted river training works in this river in both districts until People's Embankment Program started its interventions.

River Training Project, Pulchowk, Lalitpur also has worked in this river in FY 2067/68. This project has constructed embankment of 1305 m length and seven numbers of spurs at different places in this river. Beside these, various works have been done by Department of Roads, I/NGOs, Local bodies such as DDC and VDCs, and local land owners and hotel/ resort owners.

PEP Intervention

People's Embankment Program started since FY 2066/67 for river training of large rivers based on master plan approach. Initially, seven number of field offices under co-ordinator's office started river training works for ten rivers. Later on, thanks to the effectiveness of projects and popularity it gained, further extension of the program is being demanded for remaining major rivers. Till date, PEP has fourteen numbers of rivers and East Rapti River Training Project, under coordinator's office, is one of them started since FY 2067/68.

Table 2: Progress of East Rapti River Training Works

District	(%) Physical Progress	Financial progress (%)	(%) Time Progress
Makawanpur	13.0	7.32	40
Chitwan	5.1	4.23	40
(Overall (East Rapti	6.6	4.84	40

Source: East Rapti River Training Project, PEP, Pulchowk, Lalitpur.

East Rapti River Training Project, as per master plan, has set target of 5 years time to accomplish major river training works in this river. The plan consists of 40 km of river training works in Chitwan district and that of 10 km in Makawanpur district. Cost purposed for these works in Chitwan district is 1.65 billion and that in Makawanpur district is 0.409 billion. Taking about the progress of the project, in this fiscal year this project has completed 1416 m of embankment and 7 numbers of spurs. Till date, including the progress made by river training project, the total infrastructures constructed is: 2721 m of embankment, 14 numbers of spurs and 4 numbers of cross drainage structures and bioengineering works of 10,000 m² areas. Additional to physical infrastructures, detailed study of the river training works and water user association training works also have been undergoing. As compared to master plan, the progress of this project till date is presented in table 2.

The progress achieved till date shows that this project can't be completed within the planned period. The main cause of this is the allocation of insufficient yearly budget. If allocation of yearly budget is in the order of that in the last year and assuming the total project cost is constant, it needs total 34 years of time to complete the project. This project, additionally, faces a problem of free access in the national park area for the purpose of study and construction works and also, the royalty of riverbed material is so high that it will dramatically increase the cost of project if required to be paid.

Figure 2: Spur and Embankment constructed at Hetauda and Rajaiya by People's Embankment Program, Co-ordinator's Office, Pulchowk, Lalitpur.





*East Rapti Training
Participants and
Resource Persons*

Way Forward

Though East Rapti River has national importance due to its flowing through Chitwan National Park and Tourism area, it is not getting due importance and priority for river training works. From the past experiences, projects on ad-hoc basis and with uncoordinated manner couldn't yield expected results. Now, the People's Embankment Program has shown the silver linings. The government has to allocate required budget as per the master plan. Besides, appropriate policy and proper coordination should be made for use of riverbed materials and prompt action should be taken to the issues which potentially could hurdle the progress of the project.

Another important thing to be considered is the necessity of a concrete program and policy for using the reclaimed land. If this land is private there would be no problem, otherwise, there might be issue of ownership and use of the land. DWIDP's work till date is limited to river training works. So, an appropriate government agency shall be entrusted to ensure the proper use of the land. Also, the issue of land ownership and administration shall be addressed properly.

Conclusion

Even though East Rapti River is small in shape and size, it is not small in its importance. It's centrally located in the country and is also a tributary to Narayani River, a major river system of the country. It flows through Makawanpur and Chitwan districts. The latter is called the seventy-sixth district of the country and also one of the districts with attractive tourism destination.

In the contrary, this river is causing hazard to people, cultivated land, infrastructures and tourism areas. The economic value of the losses is very high and social and environmental losses too, probably not recoverable. Though various efforts have been made in the past, no significant progress has been observed in the result. Now, the People's Embankment Program, which works on participatory based master plan approach, is performing well and gaining popularity among the public. The government shall promote such type of projects and programs for the further benefits of public which could support economic development of the country as well.

Cause, Mechanism and Impacts of the Seti River Flood, 5th May 2012, Western Nepal



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Introduction

The southern slope of Annapurna range has been experiencing avalanche triggered high intensity floods also in the past. On August 15, 2003, the Madi River suddenly experienced an unprecedented flash flood, which destroyed the recently built rural road and triggered many landslides on it's course and killed 5 people (Dwivedi, 2005). A catastrophic flash flood has occurred in the Seti River in the morning of May 5 2012 and has killed 72 people and has caused tremendous damage to the lives and livelihood in Sadikhola and Machhapuchhre VDCs of Kaski district (Plate 1) Both of flood occurred in a clear day and no glacial lake of significant size were spotted in the satellite images captured before the flood event.

the event and suspended sediment sample collected during the flood event . The event has also been reported by NASA as a huge landslide (NASA, 2012).

The Avalanche area:

The Seti River originates from the bowl shaped valley surrounded by the mountain Machhapuchhre (The Fishtail Mountain) in the south , Annapurna III in the North west , Annapurna IV in the East direction. The circular valley is glaciated in the higher altitude. The close observation of the satellite images of the area reveals sloping glacial terrace and glaciers at about 5000 meters altitude on the western slope of the Annapurna IV (Plate 2). The terrace is facing south western direction

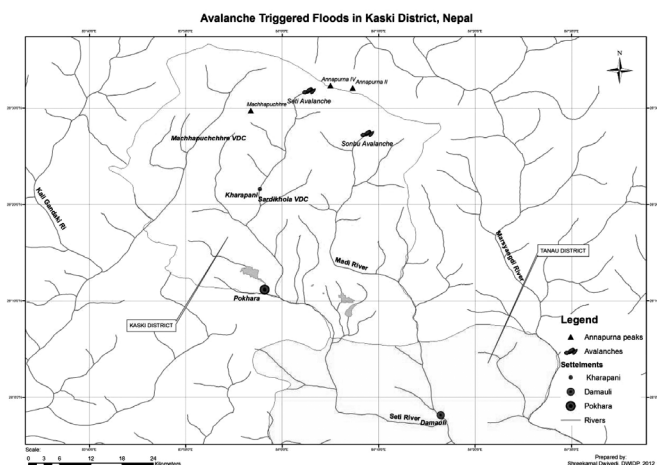


Plate 1: Avalanche triggered Floods in Kaski District

An attempt has been made here to find out the cause and mechanism of the initiation of the Seti Flood by analyzing the Landsat ETM satellite images captured before and after

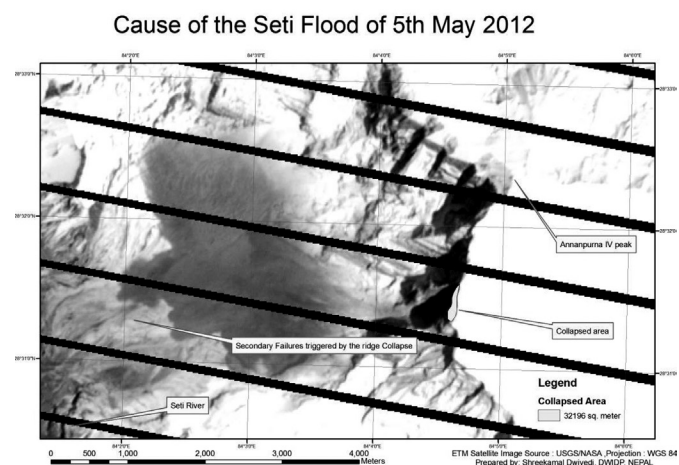


Plate:2, Collapsed portion of the ridge is about 32000 square meters.

Cause and Mechanism of the Failure:

The rainfall recorded in Pokhara (37 km. South from the avalanche area), Beni (50 km. South-west) and Jomsom (45

km. North-west) stations show no significant rainfall in the area. The maximum amount of rainfall 8.4 mm is recorded in Pokhara at 16:00 hrs on 3rd May 2012. The total rainfall from the period 21st April to 5th May 2012 in the three mentioned stations is given in the Table 1.

Table: 1 Rainfall recorded between April 21st to 5th May 2012 in Pokhara and nearby area (Source: DHM, realtime data)

Rainfall Station	Pokhara	Beni	Jomsom
Latitude	28° 13' 12''	28° 16' 12''	28° 46' 48''
Longitude	84° 00' 00''	83° 36' 00''	83° 43' 12''
21 April	0	0	5
22 April	2.6	4.06	2.28
23 April	0	0.25	0
24 April	2.2	3.3	0
25 April	0	0	0
26 April	0	0	0
27 April	0	0	7
28 April	0	2.29	0.26
29 April	0	0	0
30 April	0	0	0
1 May	0	0	0
2 May	0.2	0	0
3 May	11.8	0.76	0
4 May	0	1	8
5 May	0.4	2.54	0
Total	17.2	14.2	22.54

(Rainfall in mm.)

While comparing the Landsat ETM satellite images of April 2012 and 6th May 2012 revealed that the area of about 32000 square meter of the southern ridge 1.5 kilometre away from the Annapurna IV peak failed in the north western direction(Plate 3). The impact of descending mass of the failed mountain from 6850 meters to 4500 meters almost vertically pulverised the ice, sediment and rock forming depression at the major impact point (Plate 4). The pulverized mass formed dark brown cloud which was captured by the ultralight aircraft camera. The main direction of the failure was towards the North-West . The impact even triggered seismicity (at 9:09.56 a.m. local time) which was recorded all over the 21 stations of National Seismological Centre(Sapkota and Duvadi, 2012). The seismicity was equivalent to 3.8- 4 Richter Scale magnitude. The closest seismic station at Dansing which is 32 km. south west from the area recorded the high signals for 70 minutes which corresponds to the duration of the debris flow. The seismic signals were recorded even by the global seismological network located in Lahsa, Tibet. (Petley, D)

The huge vibration and the heat generated by the impact caused the glaciers on the slope to fail. This whole mass descended further down slope to 3300 meter south western direction from where the Seti River starts (Plate 3 and 4). The huge mass of debris along with Ice chunks rushed down the river as a debris flow for 20 kilometres downstream at Kharapani in just 28 minutes (almost 12 meters/second). The flood arrived at Kharapani where the most casualties occurred at 9:38 a.m. and reached the Dam of the Seti Irrigation system at 10:35 a.m..

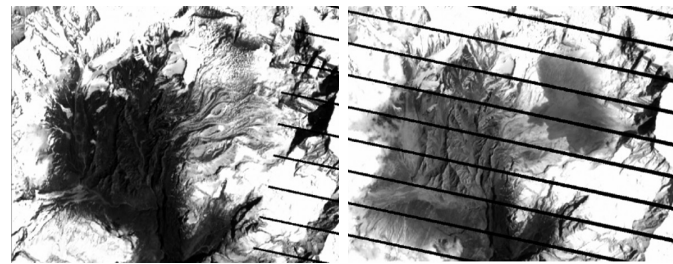


Plate 3 : a- (Left) Landsat Satellite Image of 20 April 2012, b-(Right) Landsat Satellite Image of 6 May 2012 which shows the dark patch (middle right position) of deposits of the ridge collapse and light brown colour of the whole area of mid-left part is due to the avalanche triggered there after. The glaciers located in between the two patches have vanished in the right image

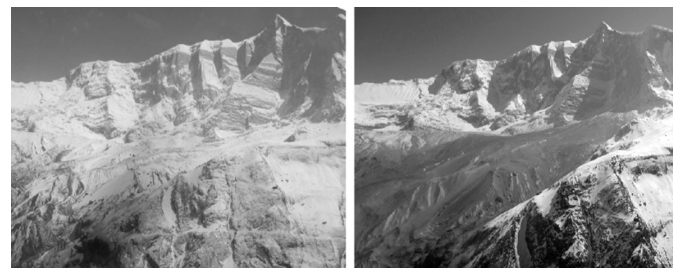


Plate 4 : Photos taken from Ultralight aircraft a- (Left) Before the collapse of the ridge seen on the upper right corner of the photograph 4th May 2012, b-(Right) After the collapse. The triangular peak is the Annapurna IV. Photo courtesy: Avia Club Nepal.

Flood water Sediment analysis :

The flood water sample collected 100 meter downstream of the Irrigation Dam in Pokhara was analyzed. Lab analysis of the flood water sample revealed the density of the flow as 1.88 gm/cc. The result of sieve analysis of the dried suspended sediment sample showed that it mostly contains fine sand and silt (Plate 5). Visual examination the coarse grains showed that it comprised of rock fragments of dolomite along with grains of quartz and micas. The rock fragments are angular to sub angular with medium sphericity. The sample also contains 27% of fine soil with grain size <0.075mm i.e. silt and clay sized material. In order to distinguish them further dry strength test and shaking test were performed. The oven

dried sample got easily powdered by rubbing it with fingers. During shaking water easily drained at the surface of the soil which confirmed that, the finer material in the soil is silt. Hence the flood water contained bimodal particles of fine sand and silt. Acid test done in the dried sediments indicated calcareous contents in the flood water. Dark grains showed effervescence when powdered.

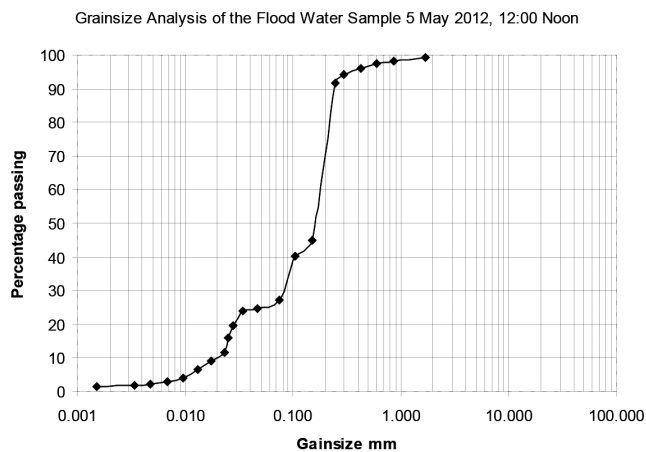


Plate: 5 The result of sieve analysis of the dried suspended sediment sample

Impacts of the Flood:

According to the eye-witnesses the flood lasted for about 5 hours with about 20 high surges different magnitudes. The high water level at the dam weir at Pokhara was 2.15 meters. The discharge estimation based on the water mark revealed the peak as 935 cumec. The eye-witnesses in Kharapani area saw huge ice blocks floating in the flood. They felt vibrating ground and heard very loud sound similar to flying of several helicopter together. The smell of the flood water was muddy. Eye witness account during Tampokhari and Dig Tsho Glacier Lake Outburst Flood (GLOF) events have shared similar experiences (Dwivedi et. al. 2000, Vuichard and Zimmerman, 1986, Yamada, 1998).

The flooding in Seti River has caused great damage to the life and properties. According to the Ministry of Home Affairs forty people lost their lives and thirty two are still missing (all presumed dead) and five are injured. Estimated economic loss is about eighty two million rupees including thirty three million private properties and remaining forty nine million public properties. Devastating flood damaged seven house and seven shops. One km blacked topped road two km gravel road, twenty five electric poles, four suspension bridges at different places were damaged by the flood which affected daily operation. Flooding also swept away twelve

vehicles including seven tractors, one van, two motorbikes and two trucks. About 9.5 hectares paddy field has been covered by sand. Flood also damaged two water mills and 45 meter drinking water supply lines resulting problem on water supply in Pokhara..

Kharapani was a popular spot for picnic and natural hot spring bath. There were people just arriving and some were already in the hot spring ponds. The ponds were located just below the terrace seen in the middle of the photograph (Plate 6). The springs were located just close to the river. The 6-8 meters high terrace above the river is now covered with debris of about 1.5 meters. The houses located on the terrace and below the terrace are all swept away. Now the area is covered with thick debris of about 9 meters. Most of the causalities occurred in this area as the early warning message could not reach this area.



Plate: 6 : Upstream view of the Kharapani Bazar, hot springs and parking area, now covered with thick debris.

Warning message of the Ultralight Pilot

Capt. Alexander Maximov, the pilot of Ultra Light plane of Avia Club Nepal was in his regular sightseeing flight close to the Mountain Machhapuchhre. He noticed the massive avalanche on the western slope of the Mt. Annapurna IV. A dark cloud evolved from the rock/ice slide (Plate 7). He sent the message quickly to the tower of Pokhara Airport. His quick understanding of the avalanche and timely response has saved hundreds of lives during the Seti flood of 5th May 2012. He informed the tower at 9:16 am and the message was broadcasted through FM radio and police force evacuated hundreds of people living and working in the bank of the Seti River.



Plate 7: The dark grey cloud indicated by the circle formed by the rock/ice slide. (Photo courtesy: Avia Club Nepal)

Conclusion:

After the analysis of the satellite images, photographs taken by the Ultra Light Aircraft and the eye-witness accounts, we conclude that the flood of 5th May 2012 in the Seti river was caused by the massive avalanche which occurred in the glaciated area located at 4500 meters a.m.s.l. on the South-Western slope of the Annapurna IV peak. The avalanche was triggered by the failure of the ridge at an altitude of 6850 meters and was located 1.5 km. south of the peak which even caused seismic activity equivalent to 3.8- 4 Richter Scale in magnitude. Avalanche triggered high intensity floods, (having density of 1.88 gm/cc in this event, have similar characteristics to Glacier Lake Outburst Flood (GLOF) are common in the Annapurna area.

Recommendation:

1. Experience during the Seti flood have shown that the large scale disaster of this intensity cannot be averted, hence a effective and functioning early warning system must be installed in human settlements and in the areas where people gather for recreation purposes.
2. Hazard Maps must be prepared in the vulnerable areas with evacuation routes clearly displayed in public places
3. The early warning message reached Pokhara within 10 minutes of the initiation of the disaster but due to lack of preparedness in warning dissemination, the warning could not reach touristic area of Kharapani, hence there is need of disaster preparedness in the authorities.
4. People are seen entering in the river to collect logs and dead fishes. Eyewitnesses reported that some people who were already in the safe place ran towards the river to see the flood and were swept away. Such practices

should be discouraged by conducting public awareness campaigns.

5. People should not be allowed to enter in the flood plain till the authorities announce end of the flooding as surges may occur with time intervals.
6. The vibration caused by the debris flow could be recorded by the seismic stations, the signals received at Dansing seismic station and other stations should be studied further to find out the possibility to develop early warning system for the debris flow of larger extent such as caused by GLOF.

Acknowledgements:

We are thankful to Mr. Steven Shrestha, Managing Director of Avia Club Nepal for the rare photographs which were very valuable to find out the cause of the flood. We are grateful to engineer Basanta Poudel for the rare water sample which he collected during the flood event. We are thankful to Chitra Raj Pandit for his help during labwork.

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