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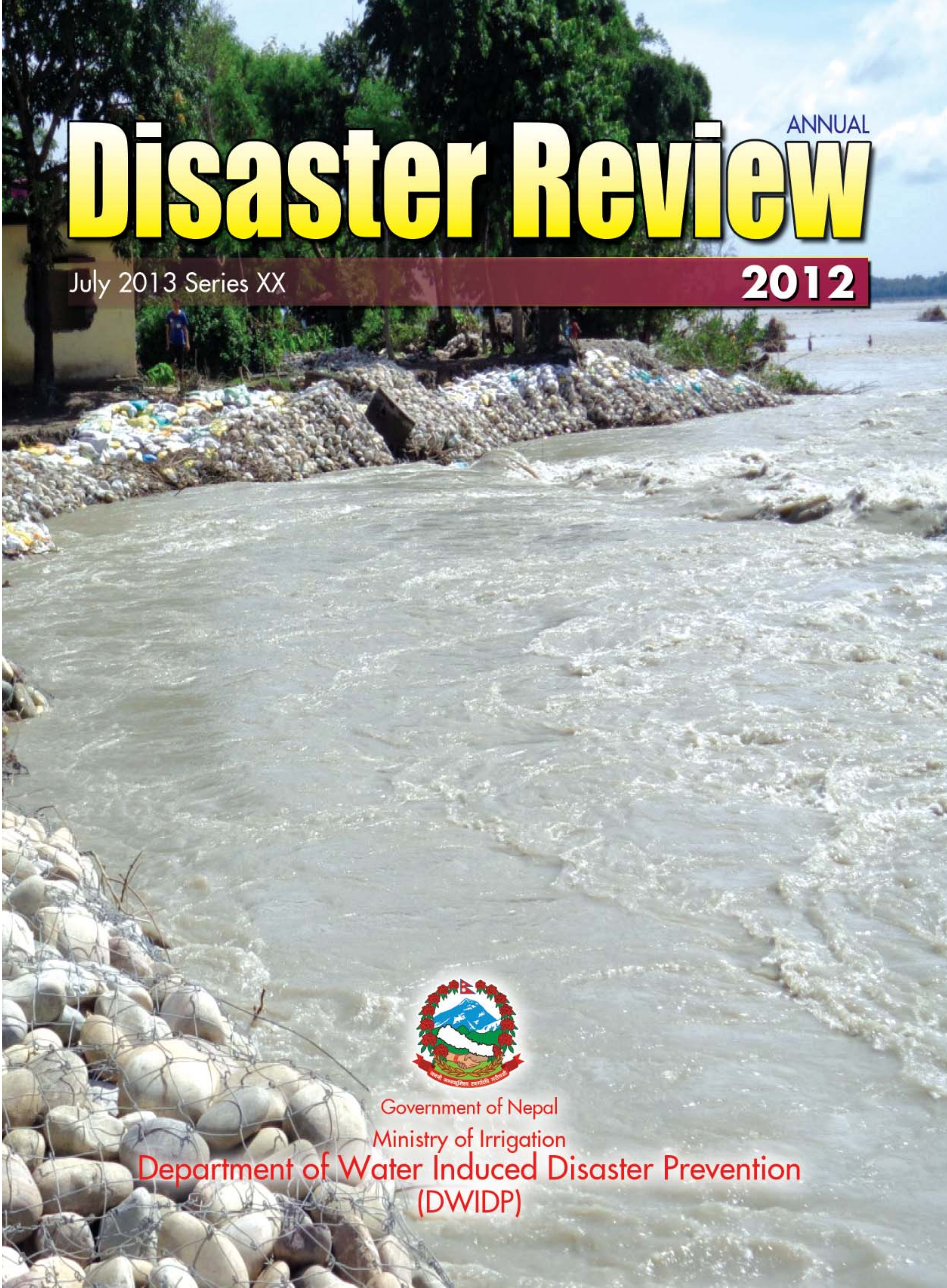
July 2013 Series XX



Government of Nepal

Ministry of Irrigation

Department of Water Induced Disaster Prevention (DWIDP)

Emergency works Mahakali River, Kanchanpur, June 2013


Left Bank of Mahakali River at Bhujela


Right Bank of Mahakali River at Dhakanaghat


Right Bank of Mahakali River at Dhakanaghat


Right Bank of Mahakali River at Shyaule Bazar.

Left Bank of Mahakali River at Pipariya

DISASTER REVIEW 2012

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Ministry of Water Resources
Department of Water Induced Disaster Prevention
(DWIDP)

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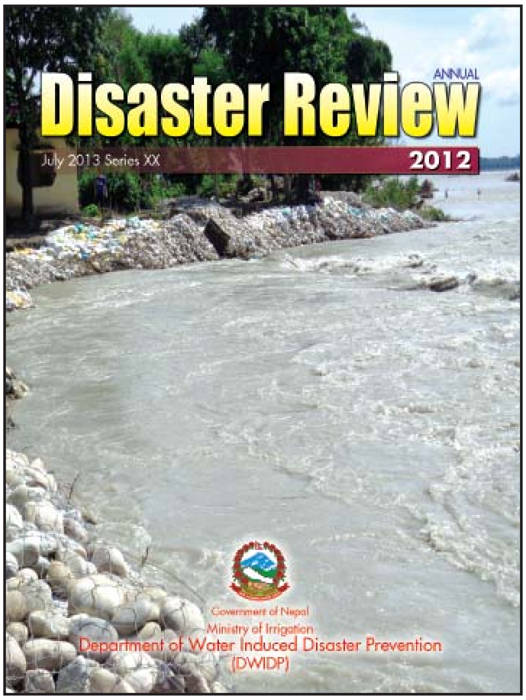

Photographs of Cover Picture
Emergency work at Bhujela, Left Bank of Mahakali River.
June 2013

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EDITORIAL

Nepal is ranked in 30th position in incidence of water induced disasters in the world. The country is also suffering from other disasters like earthquake, drought, windstorm, fire, epidemics, etc. Especially extreme high rainfalls during monsoon, topography, fragile geology massive deforestation and unsystematic village road construction are the main causes of water induced disasters in Nepal. These disasters draw the pace of economic development backwards and hinder the efforts of poverty alleviation due to recurrent damages to national infrastructures, private and public properties. In June 2013, monsoon entered into the sub-continent unusually; one from the Bay of Bengal and the another from Arabian Sea. Nepal's Far-Western and Mid-Western regions were affected by the devastating floods and land slides which damaged a lot of public properties and lost human lives.

Nepal adopted disaster risk reduction policy for the first time in the 10th Five Year Plan. The policy addressed disaster management as the core need for the economic growth, preparedness activities for disaster management at national and community level and provided opportunity for preparedness actions including rescue and relief to the local bodies, NGOs, community organizations and the private sectors. Although government and non government organizations are continuously involved in disaster mitigation programs, their efforts seem functional only during project period. The government needs to conduct capacity building and community empowerment programs to disaster affected communities for resettlement and rehabilitation for socio economic sustainability.

Community participation in planning and implementation of appropriate mitigation activities can effectively reduce the cost incurring in disaster management cycle like preparedness, rescue, relief, reconstruction and resettlement. Furthermore, active participation of vulnerable communities in disaster management and plans helps to identify local hazards for reducing the possible disaster risks and creates ownership to the expected output.

Top down and supply driven approaches of the government have been proved ineffective to meet the targeted goals and humanitarian needs in spite of increasing public investment on disaster management. The Department of Water Induced Disaster Prevention (DWIDP) being a focal agency for the prevention and mitigation of water induced disaster, needs to support, empower and facilitate the community as the primary stakeholder as well as the victims of disaster to participate in decision making for risk assessment, mitigation, and prevention.

- The Editorial Board

The opinions expressed in the articles are solely of the authors only.

DWIDP Concerns: Water Induced Disaster Prevention

Background

Nepal suffers from different 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 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 management and 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 Nepalese 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.

The 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 carry out 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 enact 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 in on 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 works so far has been done in floods 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 lakes and rivers. Based on field investigations, very little work on preparing inventories of potentially dangerous landslides have been 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 in ranking includes:

- Magnitude of the risk, consequences, expected level of mitigation or disaster reduction
- Potential for injury or loss of life, economic value of lost property or infrastructure
- Feasibility of the alternative actions and cost of the actions
- Loss of cultural resources, potential environment impacts, extent of disruption to transportation.

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.

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 (MoI), have not been effective in resolving outstanding problems. They will be strengthened and activated and will receive support at the heist level to facilitate bilateral dialogue and actions. DWIDP is acting as the lead agency under MoI 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 causalities 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 Niyantran 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 Niyantran Yojana)

To Manage and mitigate the water induced disasters such as bank erosions and inundation caused by the medium and small size rivers and other water induced disasters emergency works throughout the country is carried out by the River Training Project.

ii. Study based, Disaster Prevention (Adhdyayan Gari Garine Prakop Niyantran Karyaharu)

For the continuation of the ongoing projects that have already been studied, budget is being allocated continually. These works are being conducted by the division and sub division offices throughout the country.

iii. Master Plan based, Disaster Prevention Works

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 disaster prevention works based on the master plan for 18 rivers is being implemented.

iv. People's Embankment Program (Janata ko Tatabandha 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 the following specific objectives:

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

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. Under this program 14 big rivers are incorporated for implementation. They are-Kankai river in Jhapa district, Ratuwa-Mawa river in Jhapa-Morang Districts, Rato river in Mahotari district, Aurahi and Jalad rivers in Dhanusha District, Lakahandei and Jhim rivers in Sarlahi district, East rapti river in in Makawanpur and Chitawan Districts, Narayani river in Chitwan and Nawalparasi districts, Tinau - Danav river in Rupendehi district, West Rapti river in Dang and Banke districts, Karnali river in Bardia and Kailali Districts and Dhoda and Mahakli river in Kanchanpur district. By the end of the fiscal year 068/69 in total about 91 km embankment has already been constructed.

v. Landslide Management

About 83% of Nepal is covered by the hills and mountains so the country is prone to landslides and debris flows. These landslides and debris flows are activated due to natural phenomena or due to human factor. If these landslides are not addressed in time it will have an adverse effect in the flat land of Teria . So, the Department and its division and sub-division offices have focused on managing and controlling these landslides every year at least for in a small scale.

vi. Institutional Infrastructure Development

Under this program the activities Such as Central level monitoring and evaluation, institutional strengthening, capacity enhancement of office personnel , construction of office buildings and maintenance of the infrastructures etc. in different districts are being conducted.

B. Disaster Mitigation Support Program (DMSP)

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

- Public awareness campaign
- Development of appropriate and cost effective technology
- People's participation in disaster mitigation
- Preparation of hazard maps of the watersheds
- Disaster mitigation program in infrastructures developed.
- Institutional development
- Survey and loss estimation
- Model site development
- Development of information technology and its dissemination
- Organizing seminars and trainings
- Preparation and amendment of policies and regulations
- Watershed/sub-watershed 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 Khola watershed in chitwan and Makawanpur districts , Kerunge Khola watershed in Nawalparasi district and Bhotekoshi(Langkhola) watershed in Sindhupalchowk district have been selected for developing model sites. Moreover, various training and seminars are being conducted to raise peoples' awareness about the consequences of water induced disasters, preparation of the hazard maps, landslide control works and settlement protection measures etc. have been carried out under the DMSP program

The DMSP is also being involved in the protection of existing infrastructure like transportation, hydroelectric plant etc of the country. 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. For the sustainability of the water induced disaster 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

C. India Supported River Training Program (Bharatiya Sahayogma Sanchalit Nadi Niyantran 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 teamfrom 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. By the end of the fiscal year the total length of the embankment constructed in the above rivers is about 188 km. For the fiscal year 069/70 additional 12km embankment construction work in these rivers is purposed .

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

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.

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

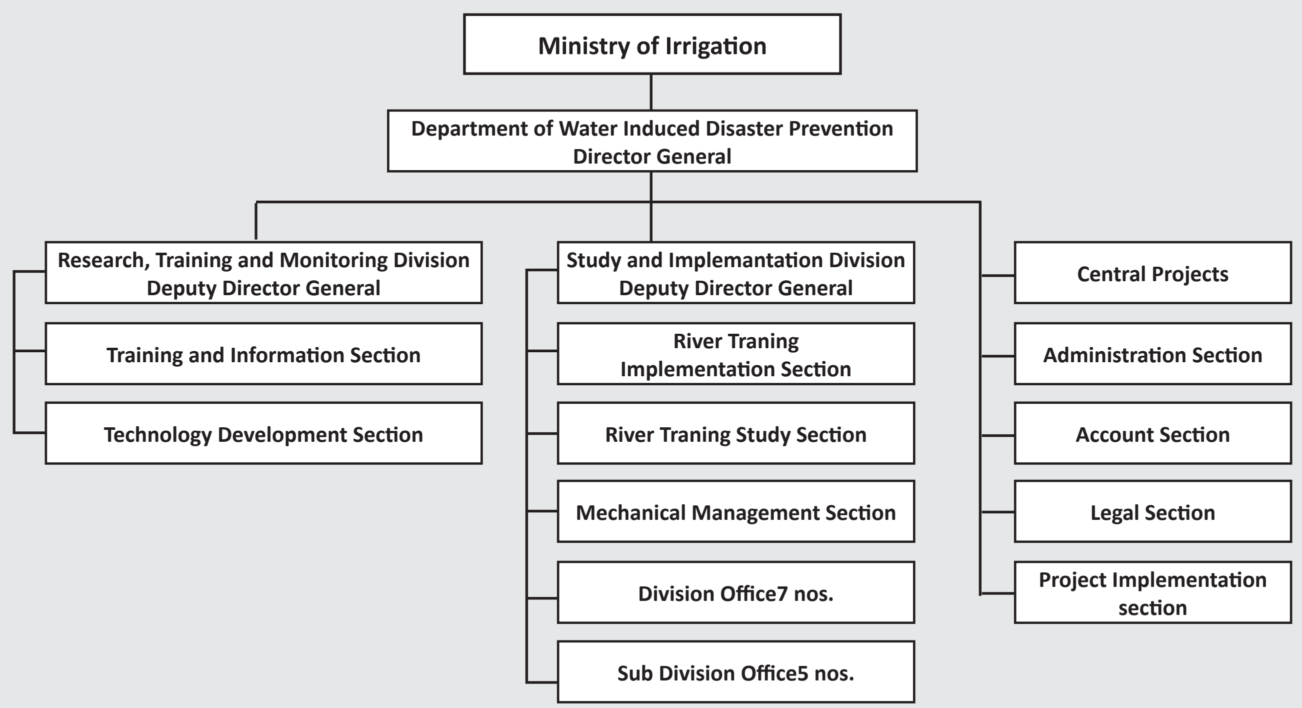
For the smooth functioning of the departmental activities the department consists of multi-disciplinary professions of different levels. These professionals have been mobilized in different offices within the department; the general overview is as follows: Organization and management (O&M) survey has 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
7	Non-Gazetted II (Tech.)	-	6	14	-	20
8	Non-Gazetted II (Tech.)	-	-	2	-	2
9	Non-Gazetted II	-	2	7	10	19
	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 shiffed 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

The recorded total loss of lives by different types of disasters from 1983 up to 2012 is about 23244 (table 1). Amongst the different types of disasters, the epidemic claimed the highest loss of lives of 11503 and is followed by the flood and landslide which is about 8181 in the period of 1983 to 2011. The table 1 shows the fact that the death of people by the flood and landslide is about 273 per year in average within 30 years from 1983 to 2012. The death rate by flood and landslide seems constantly fluctuating in the higher range. In case of the epidemic the death rate is decreasing per year during this period. This may be due to increasing awareness of people and improvement of health facilities. The table also reveals the fact that the condition of loss of lives by the flood and landslide is severe. It may be of lower awareness of people and lower priority of the government of Nepal on flood and landslide damages.

Occurrence of disasters and losses by them including flood and landslide in different places of the country has been recorded in the year of 2012, which is tabulated in Table 2. Altogether 1830 disaster events were occurred in 2012. Among them1273 events were related to fire, 104 were of landslide, 45 of flood, 2 of flash flood and the rest were related to other types of disaster (Table 2)

The total number of death of lives by all kinds of disaster in 2012 was 433. The lives claimed by the flood and landslide were 120, which is 27.71 percent of the total number of lives loss of the the year. Similarly about 34.41 percentages of lives were claimed by wind storm, hailstorm and thunderbolt in the year. Fire is equally seemed sensitive which claimed 64 numbers (14.78%) of people in the same year. The 34 numbers (7.85%) of people were also lost their lives by air crash in 2012. It is observed that Flood, landslide, epidemic and fire are continually recurring calamities rather than others. However, in the year 2012, Windstorm, hailstorm and the thunderbolt came into the first position in losing of lives which was followed by flood and landslide (table 1). The estimated loss of property as recorded was about Nrs 1489.97million in the year 2012.

It is concluded that the death causing disaster in 2012 were mainly wind storm, hail storm, thunderbolt, flood and landslide. The government of Nepal needs to undertake initiation for the mitigation measures to cope these factors immediately in order to save the lives and property of the people.

Table: 1

Loss of Lives by Different Disasters in Nepal

(1983-2012)

Types of Disasters	1983-2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Flood and Landslide	5829	196	441	232	131	141	114	216	134	135	240	252	120	8181
Earthquake	726	1	0	0	0	0	0	0	0	0	0	6	1	734
Wind storm, Hailstorm & Thunderbolt	491	38	6	62	10	18	15	40	16	7	70	105	149	1027
Avalanche	98	0	0	0	0	21	NA	6	0	2	NA	0	11	138
Fire	1116	26	11	16	10	28	3	9	11	35	69	46	64	1444
Epidemic	10721	154	0	0	41	34	0	3	10	462	36	9	33	11503
Stampede	71	0	0	0	0	0	NA	NA	0	0	NA	0		71
Rainfall	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11	11	22
Boat Capsize	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6	7	13
Bridge Collapse	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	0	2
Cold Wave	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	72	1	73
Air Crash	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	34	34
Others													2	2
Total	19052	415	458	310	192	242	132	274	171	641	415	509	433	23244

NA: Not Available *Source: Ministry of Home Affair*

Table: 2 Loss of Life and Property by Different Types of Disaster, in 2012

Type of Disaster	No. of Events	People					House Destroyed			
		Death	Missing	Injured	Affected Family	Animal Loss	Comp.	Partly	Shed Destroyed	Estimated Losses (in Rs.)
Air Crash	2	34	0	6	0	0	0	0	0	0
Avalanche	3	11	3	13	0	30	0	0	0	0
Boat Capsize	3	7	3	3	0	0	0	0	0	0
Cold Wave	1	1	0	0	0	0	0	0	0	0
Earthquake	1	1	0	0	0	0	0	0	0	0
Epidemic	28	33	0	0	0	0	0	0	0	0
Fire	1273	64	0	137	3662	1002	4300	242	542	1,408,428,939
Flash Flood	2	43	32	5	31	59	31	0	0	11,000,000
Flood	45	9	7	3	139	16	139	309	3	21,376,000
Hailstone	2	0	0	0	0	0	0	0	0	334,000
Landslide	104	68	8	37	66	49	66	74	11	20,597,500
Others	2	2	0	0	0	0	0	0	0	0
Rainfall	137	11	0	9	70	31	70	60	8	23,631,000
Storm	31	18	0	21	42	0	42	108	0	2,128,278
Thunderbolt	196	131	0	232	0	262	38	21	9	2,470,000
Total	**1830**	**433**	**53**	**466**	**4010**	**1449**	**4686**	**814**	**573**	**1489965717**

Source: MoHA

Table:3(a) Loss of Lives and Properties from Water Induced Disaster : Flood, in 2012

District	VDC / Municipality & Ward No.	Date	People			Affected Family	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)
			Death	Missing	Injured			Comp.	Partly		No.	Unit		
Banke	Betahani-4,6,7	2-Aug-12				0								
	Holiya-1,2,3,4	3-Aug-12				0								
	Phattepur-8	4-Aug-12				0								
	Betahani-9	4-Aug-12		1		0								
Bardiya	Dhadhabar-6	18-Jul-12	3			0								
Bhojpur	Chaukidanda-3	20-Aug-12			2	2	16	2	2					
Dailekh	Sattala-1	11-May-12				0								1000000
Dang	Lalmatiya	18-Jul-12				0								
	Sisaniya-5,6,78	19-Jul-12				0								
	Saigha-7	19-Jul-12				0			1					400000
	Sonapur-3	3-Aug-12	1			0								
	Sonapur-2	3-Aug-12	1	1		0								
Humla	Srimasta-3	18-Aug-12				0								150000
	Saya-1	19-Aug-12				0								640000
	Sarkedew-3	19-Aug-12				0								70000
	Sarkedew4,5,6,7,8	19-Aug-12				0								2416000
Ilam	Chulachuli-3	16-Jul-12				2		2		2				4000000
	Chulachuli-3	16-Jul-12				1		1						1000000
	Chulachuli-3	16-Jul-12				1		1						1500000
	Chulachuli-3	16-Jul-12				0								1500000
Jhapa	Ghorabari-5	16-Jul-12				0								
Kailali	Chaumala-2	3-Aug-12	1			0								
	Dhangadhi-12	14-Aug-12	1			0								
Kanchanpur	19 VDC	18-Sep-12				107		107	274					
Kaski	Sardikhola-7	5-May-12	40	32	5	31	59	31			120	Ropani		11000000
	Pokhara-13	18-Jun-12	1			0								
	Hemja-1	3-Jul-12				1		1						500000
	Ghandruk-9	10-Jul-12				0								

District	VDC / Municipality & Ward No.	Date	People			Affected Family	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)
			Death	Missing	Injured			Comp.	Partly		No.	Unit		
	Pokhara-1	12-Jul-12				0								
	Pokhara-1	13-Jul-12				0								
Kathmandu	Thankot-8	1-Sep-12				0				1				900000
	Thankot-9	2-Sep-12				0			1					2500000
Lamjung	Bhorlaetar-3	3-Aug-12	1			0								
Myagdi	Arman-6	3-Aug-12				0								4750000
Nawalparasi	Sukrauli-9	19-Jul-12				3		3						
	Sahani-9	19-Jul-12				6		6						
Nuwakot	Haldekalibuka-3	16-Jul-12				0			1					50000
Parbat	Dhairing-5	2-Sep-12				0								
	Salija-9	2-Sep-12				1		1						
Pyuthan	Libang-1,5	17-Jun-12	3			0								
Rautahat	Bairiya-4	18-Jul-12		1		0								
Rupandehi	Dhakdhahi-9	19-Jul-12				0			4					
Sankhuwasabha	Khandbari-3	27-Jun-12		1		0								
	Hatiya-2	25-Aug-12				0			26					
	Savapokhari-2	2-Oct-12				15		15						
Sunsari	Panchkanya-3	19-Sep-12			1	0								
Taplejung	Sabadin	23-Jun-12		3		0								
			52	**39**	**8**	**170**	**75**	**170**	**309**	**3**	**120**	**0**	**0**	**32376000**

Source: MoHA

Table:3(b) Loss of Lives and Properties from Water Induced Disaster : Landslide in 2012

District	VDC / Municipality & Ward No.	Date	People			Affected Family	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)
			Death	Missing	Injured			Comp.	Partly		No.	Unit		
Baglung	Hatiya-3	29-Jun-12	3			1		1						6000000
	Boharagaun-9	3-Aug-12			2	0								
Bajhang	Kalfaseri-8	4-Sep-12		2		1		1		1				
Bajura	Kuldevmandu-7	15-Aug-12				0								
Dadeldhura	Aalali-6	19-Sep-12				0	6			1				
Darchula	Dhuligada-1	5-Jul-12				0			2					280000
Dhading	Besari-5	25-Jun-12			2	1	8	1		1				500000
	Gamdi-1	26-Jun-12	1			0								
Dhankuta	Teliya-3	22-May-12	4			0								
Dolakha	Bhirkot	5-Aug-12			2	2		2		1				
	Marbu-7	29-Dec-12	2			0								
Gorkha	Dhumi-5	25-Jun-12	1			2	1	2		1				
	Kerauja-7	4-Jul-12	1		2	0	3		1					
Gulmi	Arkhabang-8	18-Jun-12			5	0								
	Thulo Lumpek-2	3-Aug-12	4		2	0								
Humla	Darma-2	27-Jun-12	1			0								125000
	Sarkedew-4	19-Aug-12				0								1040000
	Saya-9	19-Aug-12				0								45000
	Saya-9	19-Aug-12				0								25000
	Rodikot-7	21-Aug-12				0			28					
	Limi-5,6,7	22-Aug-12				0								
Ilam	Kanyam-1	15-Jun-12			2	0								
	Kanyam-1	14-Jul-12			2	1		1						413000
	Pashupatinagar-6	15-Jul-12				1		1						
	Fikkal-6	15-Jul-12			2	1		1						1200000
	Pashupatinagar-6	15-Jul-12				1		1						194000
	Namabazar-2	23-Jul-12				1		1		1				
	Kolbung-1,2	30-Sep-12	10	4		0								

District	VDC / Municipality & Ward No.	Date	People			Affected Family	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)
			Death	Missing	Injured			Comp.	Partly		No.	Unit		
Jajarkot	Bhagawati-8	20-Jul-12	1		1	0								
	Portang-7	5-Sep-12	1			0				1				
	Khalanga-2	21-Feb-13	1			0								
Jumla	Badaki-4	14-Mar-13	8		4	1	22	1						
Kailali	Mohanayal-6	19-Jul-12		1		1		1						
Kaski	Sarangkot-8	30-Aug-12	1			1		1						
Kathmandu	Chaimale-9	20-Jul-12				1		1						400000
Kavrepalanchowk	Panchkhal-9	13-Aug-12	1		2	0								
Lalitpur	Aasung-7	19-Jul-12				1		1						800000
Lamjung	Puranokot-3	24-Apr-12			1									
Manang	Dharapani-1	3-Aug-12			1	0								
Mustang	Chussang-7	16-May-12	4			0								
Myagdi	Tatopani-9,4	13-Jul-12				2	1	2						
	Dona-3,7,9	13-Jul-12				3		3						
	Dhara-9	13-Jul-12				1		1						500000
	Doba-5	13-Jul-12				8		8						
	Singana-4	30-Aug-12				1		1						1000000
Nuwakot	Belkot-2	12-Jul-12				1		1						150000
	Belkot-1	13-Jul-12				1		1						250000
	Duipipal-7	16-Jul-12				1		1						195000
	Panchakanya-8	22-Jul-12				0			1	1				50000
	Duipipal-4	1-Aug-12				0			1					210000
	Narjamandap-3	8-Aug-12				0			1					30000
	Bidur-7	8-Aug-12				1		1						30000
	Madanpur-4	17-Aug-12				1		1		1				66000
	Manakamana-3	17-Aug-12				0			1					
	Ralukadevi-7	18-Aug-12				0			1					50000
	Madanpur-2	18-Aug-12				0			1					625000
	Jilid-5	20-Aug-12				0			1					192000
	Belkot-5	21-Aug-12				1		1						110000

District	VDC / Municipality & Ward No.	Date	People			Affected Family	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)
			Death	Missing	Injured			Comp.	Partly		No.	Unit		
	Ratmate-1	24-Aug-12				0			1					10000
	Chaturale-6	26-Aug-12				1		1						302000
Nuwakot	Duipipal-3	27-Aug-12				1		1						141000
	Duipipal-3	27-Aug-12				1		1						138000
	Belkot-2	27-Aug-12				1		1						46000
	Belkot-6	27-Aug-12				1		1						477500
	Madanpur-2	27-Aug-12				1		1						40000
	Ralukadevi-3	27-Aug-12				0			1					100000
	Thansing-8	29-Aug-12				1		1						185000
	Chaturale-4	29-Aug-12				1		1						155000
	Chaturale-4	29-Aug-12				0			1					150000
	Chaturale-4	30-Aug-12	1			1		1						239000
	Madanpur-7	30-Aug-12				1		1						150000
	Madanpur-8	30-Aug-12				1		1						50000
	Madanpur-7	30-Aug-12				1		1						200000
	Lachchang-2	30-Aug-12				1		1						265000
	Sundardevi-3	1-Sep-12				1		1						317000
	Madanpur-5	5-Sep-12				1		1						92000
	Sundaradevi-5	8-Sep-12				0			1					60000
	samundratar	12-Sep-12				0			1					
	Okharpauwa-1	20-Sep-12				0			1					150000
	Gerkhu-1	4-Oct-12				0			1					
Panchthar	Amarpur-5	24-Jul-12				0								
Parbat	Dhairing-6	27-Jun-12				0	2			1				
	Deupur-7	23-Mar-13	2			0								
Rasuwa	Dandagaon-7	29-Aug-12			2	2		2						
Rolpa	Ghartigaun-1	30-Jun-12				0								
Sankhuwasabha	Matsyapokhari-9	28-Jun-12				1	3	1						
	Bala-9	13-Jul-12				0			4					
	Madimulkharka-4	19-Jul-12			1	0			1					

District	VDC / Municipality & Ward No.	Date	People			Affected Family	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)
			Death	Missing	Injured			Comp.	Partly		No.	Unit		
	Hatiyagola1,2,3	25-Aug-12				0			9					
	Barabisae-5	1-Oct-12	1			0			6					
	Dhup-8	2-Oct-12	5			2		2	9					
Sindhupalchowk	Bhotaechaur-2	15-Jun-12	3			0								
Surkhet	Chappre-5	7-Jul-12	2		2	1		1						
	Hariharpur-2	7-Jul-12				0	3			1				
	Betan-3	2-Oct-12			1	0								
Tanahau	Jamunae-1	28-Jun-12	7			1		1						
Taplejung	Mehalae-1	26-Jun-12	1	1	1	1		1						
	Mehalae-6	28-Jul-12				2		2						950000
	Mehalae-6	28-Jul-12				1		1						350000
	Mehalae-6	28-Jul-12				1		1						350000
	Sablakhu-6	29-Jul-12				1		1						500000
	Tapethok-9	18-Sep-12	1			0								
Terathum	Morahang-1	27-May-12				0								700000
Udayapur	Triyuga-11	5-May-12	1			0								
			68	**8**	**37**	**66**	**49**	**66**	**74**	**11**	**0**	**0**	**0**	**20597500**

Source:MoHA

Table 3 (c) Loss of Lives and Properties from Water Induced Disaster : Avalanche, 2012

District	VDC / Municipality & Ward No.	Date	People			Affected Family	Animal Loss	House Destroyed		Shed Destroyed	Land Loss		Public Property Losses	Estimated Losses (in Rs.)
			Death	Missing	Injured			Comp.	Partly		No.	Unit		
Darchula	Bhusa-7	18-Jan-13				0	30							
Dolpa	Saldang-1	12-Feb-13	2			0								
Gorkha	Samagaon-4	23-Sep-12	9	3	13	0								
Total			**11**	**3**	**13**	**0**	**30**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Comparative Disaster Scenario of Nepal Since 1983 to 2012

Our country is facing the problem of recurrent different natural calamities including water induced disasters like flood, landslides, avalanches which are vulnerable to human lives, livestock, agricultural land, public and private infrastructures and environment disrupting the socio-economic condition of the country.

The Table 4 and the bar diagrams show the occurrence and nature of year wise disasters and their affect on human casualties, affected families, animal loss, and houses destroyed and estimated economic losses in the last 30 years since 1983 to 2012.

The total human death caused by all sorts of disasters were 23244. In average 1052 human lives were lost per year in the first 18 years from 1983 and 350 lives were lost annually in 12 years from 2001 to 2012. Similarly the total number of 5829 human casualties were found in between the year 1983 to 2000 and the rest 2352 people were killed by water induced disasters like flood and landslide in the first 12 years of the21st century. This informed that the trend of loss of lives by disasters is declining. The reason may be the fact of increasing consciousness of people about disasters and provision of mitigation measures and management efforts made by the government.

The total number of people injured by all forms of disasters from 1983 to 2012 were 23734 (table 4). More than 90 percent of people were injured in the last 18 years of the 20th century whereas the 10 percent of people were injured in the first 12 years of 21st century by the disaster events.

The total loss of livestock, by disasters, was 83875, which shows that about 2796 animals were lost annually in 30 years from 1983. This figure also displayed alarming trend in the sector of livestock. The government needs to focus in time towards it.

Altogether 432146 houses were destroyed by disasters in 30 years from 1983 to the year 2012, which indicates that in average about 14405 houses were destroyed annually in these years. Table 4 reveals that the trend of destruction of the houses by the disasters is highly varying and depends upon the type of houses, type of land and construction technology. The highest number of houses(108801) were destroyed in the year 1988 in 30 years within 1983 to 2012. The factor may be the occurrence of earthquake along with the regularly recurring calamities like flood, landslides etc.

The total number of families affected by different disasters were 899788. In an average nearly 17709 houses were destroyed excluding the higher figures of the year 1987, 1993, 1995 and 2007 (see table4 and bar diagram of family affected).

Estimated economic loss by the disasters is also tabulated in table 4. It was NRs.35670.28 million in 30 years from 1983 to 2012. It was found that the highest economic loss was NRs. 6099 million in 1988 and the least was NRs 23 million in the years 1985 and 1986 by the disasters. After 1995 the estimated loss followed more or less similar trend up to 2012.The economic loss in 2012 was NRs.1489.97 million, which was 4.17 percent of the total estimated loss of 30 years (table4).

Large area of agriculture land and many infrastructures were washed away by the disasters in these years. The principal causes of destruction of the infrastructures and wash away of large area of land were the disasters like flood, debris flow, landslide and earthquake. Some of the statistical data of land loss and destruction of infrastructures from 1983 to 2012 are tabulated in table 4.

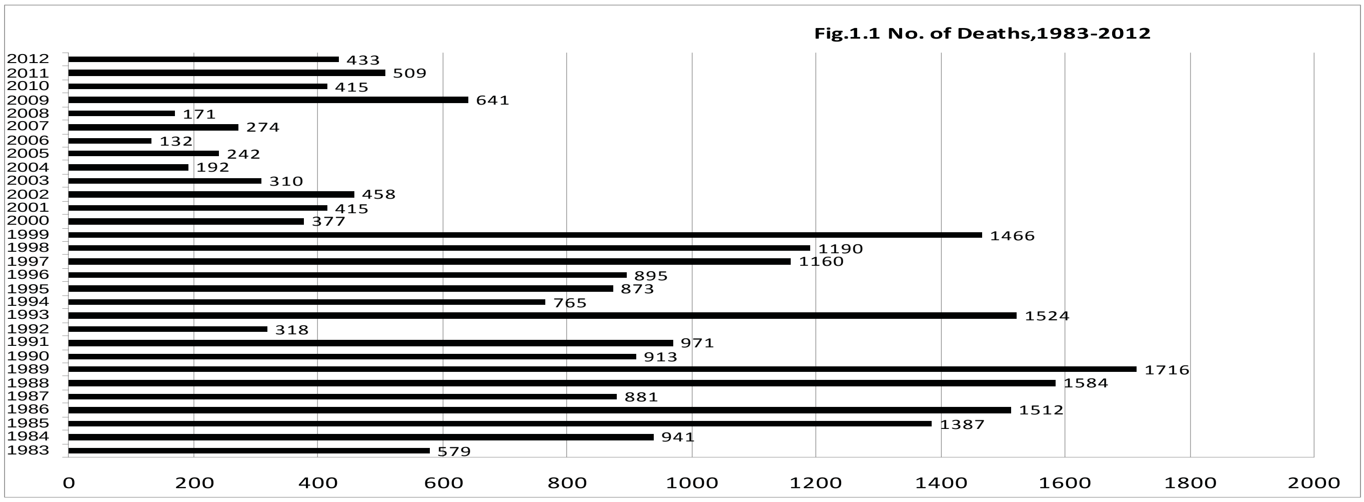
Table : 4

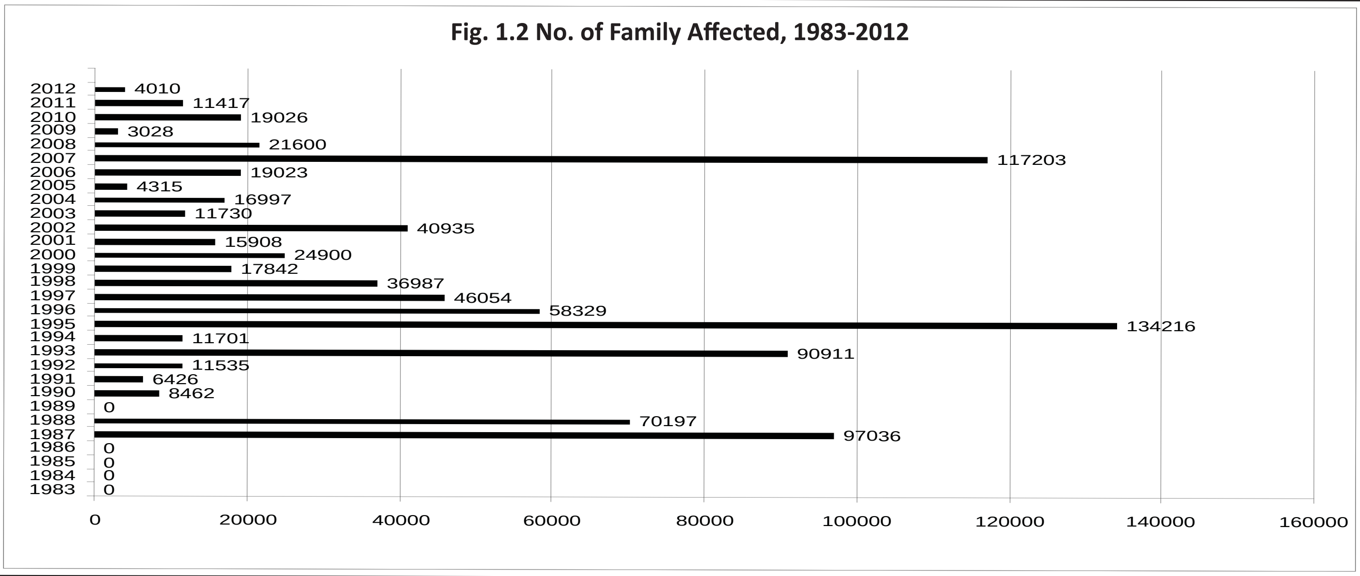
Comparative Disaster Scenario of Nepal since 1983-2012

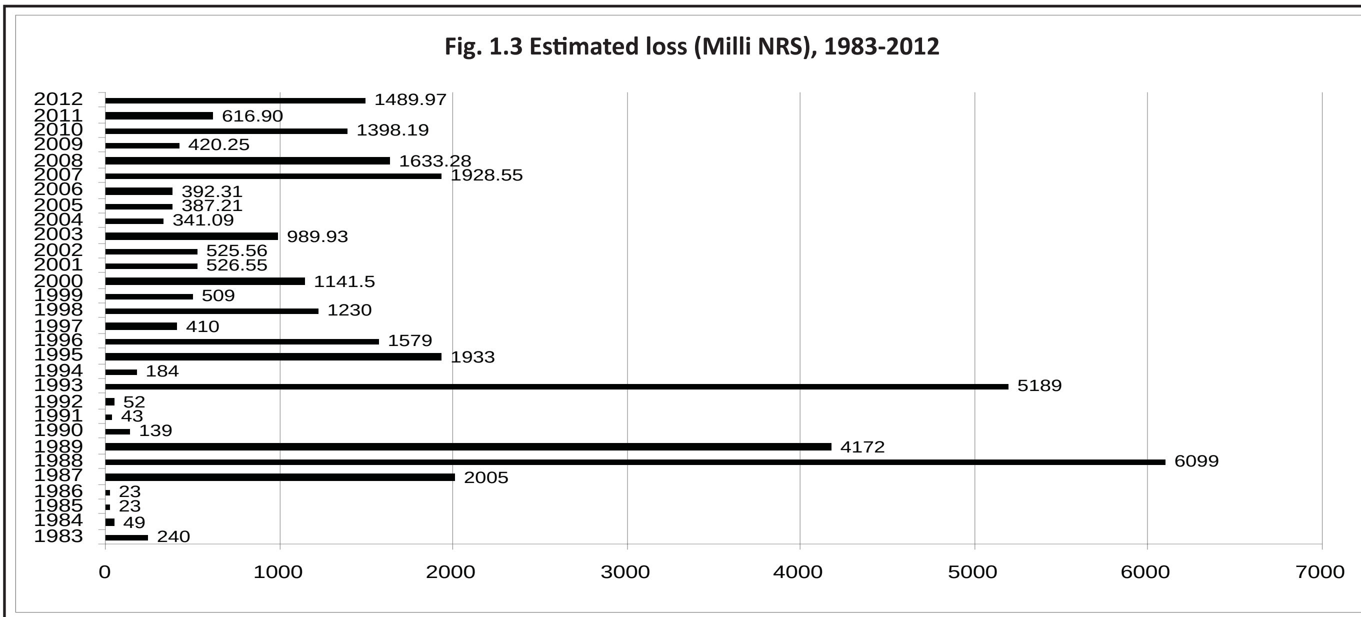
Year	People		Livestock loss(Nos.)	Houses Destroyed(nos.)	Affected Family (Nos.)	Land Affected (Ha.)	Public Infrastructure	Estimated Loss(Million NRs.)	Remark
	Death	Injuired							
1983	579	NA	248	12	NA	NA	NA	240	
1984	941	NA	3547	10597	NA	1242	869	49	
1985	1387	NA	3399	7166	NA	1355	436	23	
1986	1512	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	513.65	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	2.85	1398.19	
2011	509	271	254	9644	11417	120	0	616.90	
2012	433	466	1449	5500	4010	0	0	1489.97	
Total	**23244**	**23734**	**83875**	**432146**	**899788**	**118087.24**	**6639.73**	**35670.28**	

Source: MoHA

Figure 1: All Types of Disasters, 1983-2012







Sand Mining as an Adaptation Measure against Climate Change Related Water Induced Disaster: A Case Study of Banke District, Nepal

Prof. Dr. Hari Krishna Shrestha
Nepal Engineering College

Abstract

The ongoing processing of formation of the Himalayas and the young fragile and erosion prone mountains in Nepal are the major reasons and sources of debris in river flow in this country. The unsuitable land use and the rapid changes in land cover in the Mahabharat Range and the Siwalik Hills in Nepal, including rapid deforestation and indiscriminate construction of hill roads, are exacerbating the process of land degradation, resulting in very high rate of fluvial sedimentation in Nepalese rivers. The numerous landslides are other sources of debris in the river. Each year a very large amount of debris flows along with the river water in the upper erosion area and gets deposited in the lower deposition area along the river. The climate change and the consequent increase in rainfall intensity is causing larger volume of erosion, transport and deposition of debris in the river beds and river banks, causing river bed degradation in the upper areas of the river catchment, river bed aggradation in the lower area of the catchment, and shift in river course, resulting in flooding in and inundation of riparian agricultural lands and settlements during wet periods of the year, which, in turn, results in annual loss of life and property, water borne epidemics, and infrastructure damage and destruction. The different District Development Committees of Nepal have started to exploit the annual deposition of debris, in the form of sand-gravel-stone (SGS) along the river bed as a reliable source of revenue for the local government by issuing sand mining permit, thus turning the climate change related problem into a renewable natural resource, at least for the time being. This paper discusses different aspects of sand mining, also referred as SGS mining, operations in Nepal, using the Banke District as an example.

Keywords: sand mining, river bed aggradation, flood, inundation, climate change

Introduction

As a consequence of plate tectonics, the mountain building process is still very active in the Hindu-Kush Himalayan region of South Asia. Many mountains in Nepal are young and fragile. The erosion prone top soil and the highly weathered rocks of the top layer of the mountains are a constant source of high fluvial sedimentation in the rivers of Nepal. The rapid rate of population growth in Nepal and the consequent rise in demand for food is resulting in farmers trying to use marginal and unstable lands in the mountains for agricultural production. In order to increase land for settlements and produce, the forests are being cut or burned annually; the fertility of the forest land cannot sustain economically viable intensive crop cultivation for many years, so the burned forest lands are abandoned after a few years of cultivation. Studies show that the erosion rate at these abandoned lands (degraded forests) is more than 8 times higher compared to forest area or well terraced rice fields (Shrestha 1997). The recent trend of constructing non-engineered roads in each and every nook and corner of Nepal, with total disregard for slope stability and deforestation has resulted in increased incidences of landslides and debris flow, with devastating effects to the downstream settlements and riparian agricultural fields. The very high temporal variability in annual rainfall pattern of Nepal, with 80% of the annual precipitation occurring in four months of a year is another factor resulting in high debris flow in steep sections of Nepalese mountains.

On top of all these natural and anthropogenic factors, the climate change is adding additional burden on the maintenance of ecosystem and natural balance of erosion, transportation and deposition of sediment in Nepalese rivers. In the upstream parts of the rivers, the rate of erosion is increasing with further deepening of river channels and degradation of river banks and river bed. In the mid-sections of the rivers, the rate of sediment and debris transport is increasing, and random deposit of sediments at different sections of the rivers, creating diversion of river channels in each flood season. In the downstream parts of the river the annual deposit of large volume of sediment and debris in the river bed is causing the river bed to rise annually, resulting in river flow to divert towards low lying riparian settlements and agricultural fields. In the Banke district of Nepal, 6664 families were affected, with death of 7 persons and estimated economic loss of Rs. 200,524,127, from a flood event of August 2006 (DWIDP 2006). Similarly, the flood in 2007 in the same district affected about 2500 families and inundated major portion of Nepalgunj Municipality for several weeks (KC 2008). The photographs 1 and 2, taken in 2007, show one of the main highway intersections of Nepalgunj Municipality, and a religious shrine (Bageshori Temple) under several centimeters of water, respectively.

Photographs 1 and 2 of inundation of Nepalgunj in 2007 flood. Source: K.C. 2008

To address this problem created by the annual rise of river bed, the local governments in Nepal are employing various measures, including river bank stabilization, embankment construction, gabion walls on vulnerable sections of the river, spurs to divert river flow away from settlements, and installation of early warning systems. The concerned central line agencies like the DWIDP and DSCWM are involved in slope stabilization activities and river training works. The success of these various initiatives has been marred by the increased effect of the climate change; the river beds in many districts of Nepal in the terai belt are increasing annually.

Using the authority vested in them by the Local Self Governance Act-1999, the local governments in Nepal, specifically the District Development Committee (DDC), have started issuing permits to the private sector contractors to mine the sand-gravel-stone (SGS) deposits in the river bed. This adaptation measure against the ill effects of the climate change has resulted in maintenance of the river bed without spending public money and revenue generation for the DDCs to conduct development activities, including river bank protections. However, unmanaged SGS mining can result, and has resulted, in a range of devastating effect on environment, river bank degradation, infrastructure damage, river bed degradation, social and institutional conflict, and diversion of raised revenue back into rectification of problems created by SGS. This paper discusses some pertinent issues related to SGS mining activities in Nepal, with the Banke district as a case study.

Sand Gravel Stone Mining Issues in Banke District

Background information on Banke District

The Banke District, located in the Mid-Western Development Region, with Nepalgunj as its district head-quarter, covers an area of 2,337 km2 and has a population (2011) of 493,017 (Fig. 1). The Banke District is bordered in the west by Bardiya District, separated by Man Khola. Rapti Zone's Salyam and Dang Deukhuri Districts border to the north and east. To the south lies Uttar Pradesh, India; specifically Shravasti and Bahraich districts of Awadh. East of Nepalgunj the international border follows the southern edge of the Dudhwa Range of the Siwaliks. There is no Nepalese Outer Terai in this part of Banke district. Nepalgunj is a municipality in Banke District, Nepal on the Terai plains near the southern border with Bahraich District, Utter Pradesh State of India. Nepalgunj town lies at 16 km south of Kohalpur and the east-west Mahendra Highway.

Nepalgunj is the administrative center of Banke District as well as Bheri Zone. It's also the main transport hub for Nepal's Mid-Western and Far-Western regions. The nearest Indian border is about 8 km south and Bahraich city is about 55 km south of the city center. Nepalgunj is an important business center for at least 5 zones of Nepal: Bheri, Rapti, Mahakali, Karnali and Seti. The heart of the important traffic junction of the town referred to as Birendra Chowk, is the main business hub with several banks, book shops, lodges, motor-parts and hardware dealers, and other general home appliance distributors. The 24 km long Surkhet Road, starting from Mahendra Chowk in Kohalpur and terminating at Nepal-India Border, runs through the middle of the city passing through Birendra Chowk.

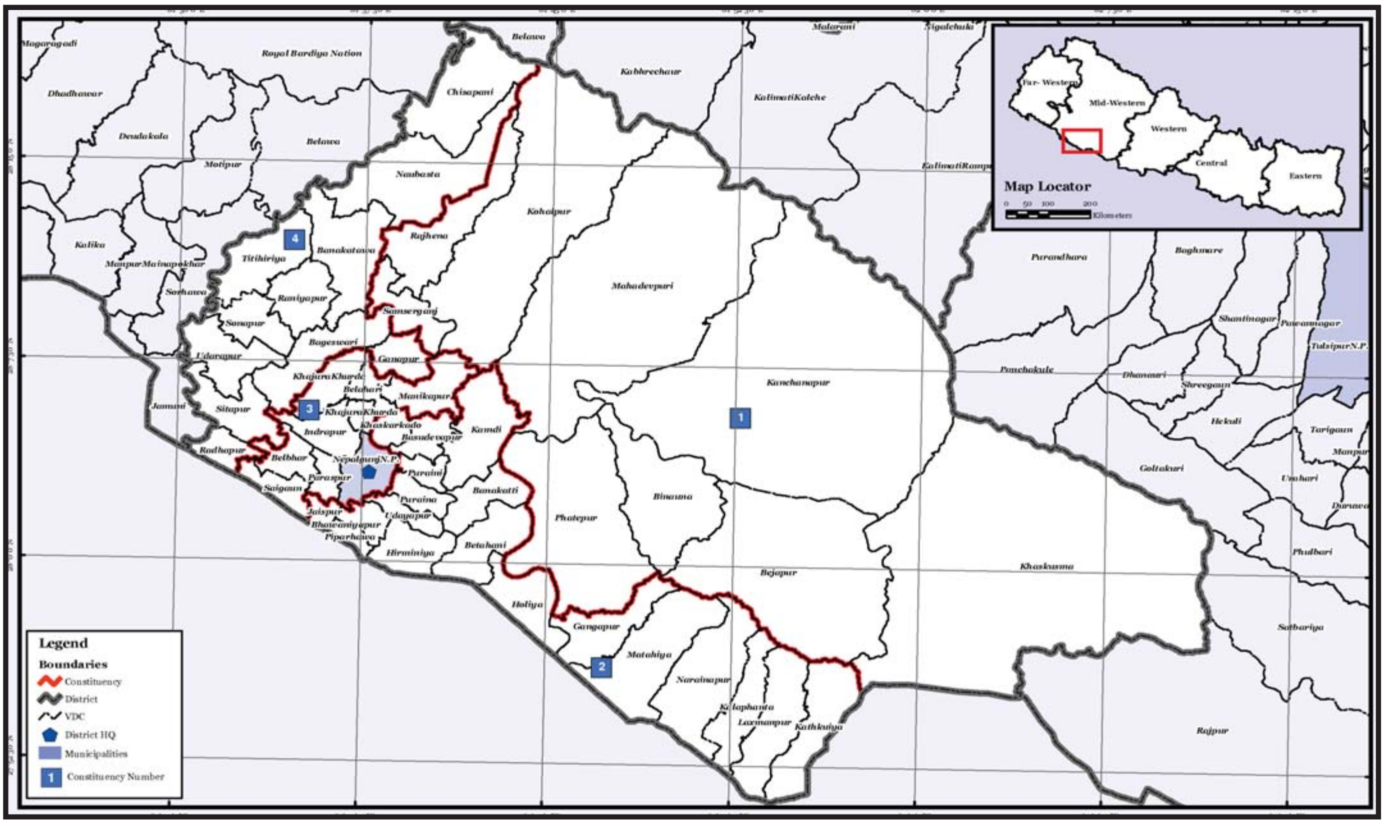


Fig. 1. Map of Banke District

Source: OCHA, United Nations, Nepal, 2008

Situation analysis of Sand Mining in Banke District

Sand Mine Locations and Revenue

For the fiscal year 2069-70, the Banke DDC has approved sand mining from Man Khola (bordering Banke and Bardiya districts), Rapti River, Dunduwa Khola at Dunduwa Bridge, Jhijhiri Khola, Muguwa Khola and Khairi Khola (Fig. 2). The sand mine locations of these rivers are located in different VDCs like Naubasta/Jabdahawa VDC, Kohalpur VDC, Kamdi VDC, Puraina VDC, Puraini VDC, and Khajurakhuda.

The revenue generated from the sand mining operation in Banke district is a significant portion of its total developmental budget, and the trend of the annual gross revenue generated from sand mining contracts awarded by Banke district is encouraging. The table 1 provides the gross revenue generated from sand mining in Banke District, for the last four years.

Table 1: Gross revenue in Banke DDC from SGS mining contract

Fiscal Year (B.S.)	066/067	067/068	068/069	069/070
Actual Gross Revenue (NRs.)	3259000	4648000	10659747	15921900

Source: Banke District Development Plan

The data in Table 1 are 'actual gross revenue' generated, based on contract amount. The 10% rebate has been subtracted from the contract amount to calculate the 'actual revenue'. The 10% rebate is provided when the contractor pays up front the total contracted annual revenue during the contract signing.

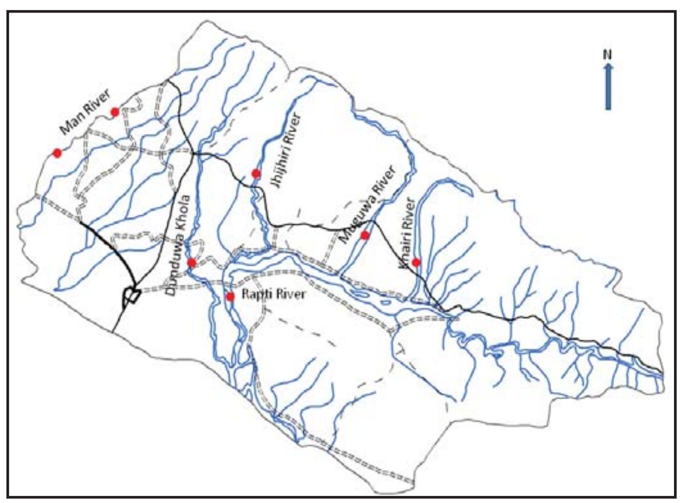


Figure 2. Approximate locations of sand mining sites in Banke marked by dots

The current arrangement between the DDC and the District Forest Office (DFO) is that if the sand mine is located entirely within the demarcated forest area, then 10% of the revenue is provided to the Banke DDC by the DFO. However, if the sand mine are is partly within the demarcated forest area, then a joint contract is issued by district forest office and DDC, the ratio of revenue sharing is 65% to DFO and 35% to the DDC. Out of 35% of the DDC's revenue, 40% of the 35% goes to concerned VDC. The concerned VDCs are the VDCs within the DDC where the sand mining activities take place.

Due to the current fluid political situation, different local organizations are demanding higher share of the SGS revenue. Some local organizations defy the existing regulatory system and issue their own permit and/or collect fee in different heading, like transportation permit fee from the contractors and transporters of the SGS materials. This situation, if not addressed in proper manner, can create confusion and conflict.

Once a contract is signed, there is no effective monitoring mechanism of the sand mining activities. The three administrative monitoring methods currently in practice are: (i) the limitation of "dawn and dusk" extraction, (ii) verification of extracted amount by concerned Range Post, and (iii) use of receipt with DDC stamp. However, the ground reality of the implementation of these monitoring mechanisms, and the loop holes in this mechanism has not been corrected. The result of the preliminary study show that if proper monitoring can be done, the revenue from the sand mining activities in Banke district can be increased by three fold. The sources of leakage in revenue are: (a) more volume of SGS are extracted than the contract amount, (b) the SGS are extracted from the locations other than specified in the contract, (c) the SGS extraction amount not specified in the receipt is not accounted for. In fiscal year, 2068/2069, the licensed amount of SGS excavation was exhausted within one week of licensing, as per the copy of the receipt submitted by the contractor. However, the SGS mining continued till the arrival of the monsoon period.

Social and Institutional Conflicts

The Banke DDC has not given permit to export SGS materials to India because all the SGS materials mined in Banke are required for its own development projects within the district like the construction of Hulaki Marg and the Sikta Irrigation Project. However, due to various political interferences, the DDC has not been able to prevent illegal export of SGS materials. The tractors carrying SGS materials have been frequently spotted in the border area between Nepal and India.

The contractor of the Sikta Irrigation Project (SIP) is allowed to mine SGS materials from river stretches within the project area, without specific DDC permit or the District Forest Office (DFO) permit. However, no one monitor the SGS material mined by the contractor, and there is no record of the amount of the SGS extraction by the SIP. Since part of the SIP lies within the buffer zone of the forest area (Banke National Park), there has been conflict between the SIP and the forest officials over extraction of the SGS materials. Another source of conflict is the current regulation banning use of excavators for SGS mining purpose. Since the SIP requires large amount of SGS materials, extraction using menial labor alone is insufficient for the project activity.

Due to fluid political situation, the level of rule-of-law in Nepal is declining (Paudel et al 2011). The local residents in the vicinity of the sand mine area are claiming right to resources and obstructing SGS excavation and transportation, even if DDC license is issued. The local clubs and local strongmen charge illegal fee from the SGS transporters on various pretexts; some even issue receipts for these fees, thus challenging the DDC authority over its jurisdiction.

The right over issue of license and collection of revenue from sand mining has been a contentious issue from the very beginning mainly between the DDC and the DFO, each side claiming exclusive right to issue permit and raise revenue. The formation of District Forest Coordination Committee to find the middle path to resolve the conflict between DDC and DFO has been partly successful. As per the current provision, there is a distribution of revenue from the sand mining if the mine area falls partly in the forest area. However, if the sand mining area is outside the forest area but the road for transportation of the SGS material passes through the forest area, then the DFO officers frequently stop the SGS transportation, citing the Forest Act 1993, even if the transporter has obtained DDC permit. In Banke district, most of the sand mines are located in the recently formed Banke National Park (BaNP, established on 2067/03/28 with an area of 550 sq. km, and a buffer zone of 343 sq. km, covering parts of Salyan, Dang and Banke districts), which has severely limited DDC's access to the mining sites. As a result the DDC has to import SGS materials for its development projects from neighboring districts like the Salyan, Dang and Surkhet, thus increasing the cost of the projects.

The contractors involved in sand mining activities in Bakne are engaged in illegal syndicating practices wherein they consult with each other before submitting bid and prevent "outsiders" from submitting bid, using force if needed; thereby artificially lowering the bid amount. They even challenge the amount of the extractable SGS materials mentioned in the Initial Environmental

Examination (IEE) report, and force the DDC to arbitrarily reduce the extractable SGS amount. When the DDC refuses to reduce the extractable SGS amount, then the unofficial contractors' syndicate decides to offer no bid. This situation has put the DDC in difficult position because if there is no bid, even after repeated publications of the bid notice, then the DDC will have to spend its own fund to extract the SGS materials to reduce the possibility of the riparian settlements from getting flooded in the coming monsoon season. The contractors' syndicate is attempting to exploit this apparent vulnerability DDC.

Consequences of Mismanagement of Sand Mining in Banke District

As already stated, the DDCs in Nepal, including the Banke District, have treated sand mining as an adaptation measure against the climate change related water induced disaster in Nepal. However, sand mining has also opened up a plethora of social and institutional problems, mostly associated with mismanagement of the issues. The biggest issue related to the better management of the sand mining is the weak, or almost non-existent, monitoring of the sand mining operations. The current capability of the DDC is too inadequate to effectively monitor all the activities at the mine sites. As a result, the provisions of the sand mining contract are regularly breached. For example, the excavators are routinely used at different sand mining sites; the banning of SGS extraction from 500 m upstream and downstream of major infrastructures, like a bridge, are ignored; the SGS materials are excavated from the depth below the normal bed level of the rivers; the volume of SGS materials extracted are several times higher than the contracted volume; forest areas along the rivers are destroyed for easier transportation of the SGS materials, and so on. The social conflicts between the local settlers and SGS contractors, and among the SGS contractors, have increased, often resulting in use of physical force and sometimes violence to settle the disputes.

As a consequence of unmanaged and over extraction of SGS materials, the river banks are eroded, threatening the life, livelihood and property of the local settlements along the river. To protect the land and property and to reduce further erosion of river banks, the DDC is forced to spend a significant portion of the sand mining revenue back into the river training works at the same spot where it has issued sand mining permit. Currently, the most popular method employed by the DDC for controlling river bank erosion is construction of gabion walls along both banks of the affected river sections..

Potential Solutions

Based on the discussions with concerned stakeholders, and study of the existing sand mining related regulations of Nepal, the following potential list of preliminary solutions to the problems discussed above have been proposed for better utilization of the SGS deposits in the rivers of Nepal.

The DDC capacity development to effectively monitor the sand mining activity should be immediately started on priority basis. If needed, the DDC officials should be teamed up with security officials for this purpose.

The initial environmental examination (IEE) should consist of a series of natural river bed cross sections before and after the SGS deposition of the proposed sand mining site, including the site specific photographs, so that better estimate of the volume of SGS materials can be made.

The exact volume of SGS materials extracted from each site should be estimated based on the river cross sections after the cessation of the sand mining activities for the year. This data can be corroborated with the receipt the contractor presents from time to time to the DDC office.

The specific area from where SGS materials can be extracted should be clearly demarcated, and local residents and DDC monitoring officers should be made aware of the area and depth of excavation so that SGS material extraction from the area outside the demarcated zone and the SGS material excavation below the natural river bed can be prevented.

There should be provision of specific responsibility of the sand mine contractor if the negligence of the contractor's activity results in river bank erosion or similar other incidences which results in financial burden to the DDC to rectify the situation.

The practice of submitting the IEE of all the potential sand mining sites from all the rivers and terrace deposits in Nepal to the Ministry of Federal Affairs and Local Development (MoFALD) at roughly the same time should be changed. The MoFALD officers get overwhelmed at the submission time since the limited number of staff cannot go through all the reports submitted at the same time.

The current practice of making one rule for all the sand mining sites of Nepal needs to be seriously reviewed. The minimum price of SGS materials from each sand mining site can vary depending on different factors, for example. A clear guideline for setting minimum price should be developed. Similarly, the current practice of one value of minimum distance from major infrastructure for sand mining site should be reviewed. The minimum distance should depend on the location of the SGS material deposit.

Conclusions

The climate change is exacerbating the existing problem of river bed aggradation in downstream areas of Nepalese rivers. The river bed aggradation is causing river to divert from their natural path, resulting in flooding and inundation of riparian settlements and destruction and life and property. The DDCs in Nepal have tried to exploit the sand-gravel-stone deposits in the river beds by issuing permit to mine the deposit, for a fixed fee from the contractors. If monitored and managed properly, this adaptation measure can benefit the DDC and the local settlements. However, if the sand mining activities cannot be monitored closely and managed properly, this potential resource can quickly turn into a source of problem and source of conflict.

Just like the concept of "controlled burning" is practiced in the forestry sector to prevent uncontrollable wild fire during dry periods, the environmental friendly "controlled sand mining" should be adopted, even inside the forest areas, so that this year's SGS deposits do not result in diversion of river flow in next year's flood season. If the deposited SGS materials are not contracted out for excavation in time, then the DDC will lose on both ends – the DDC will lose the potential revenue from contract, and DDC, or other government agency, will have to spend public money to excavate the materials from the river channel to prevent riparian settlements from flooding.

The better coordination among the DDC, DFO and other stakeholder line agencies is essential for management of sand mining without institutional conflict.

If the DDC's capability to effectively monitor and manage the sand mining sites is enhanced, then the net revenue can increase by two to three times compared to the current rate of revenue generation. Hence the capacity development effort will be very cost effective.

A part of the revenue from the sand mining should be earmarked to improve watershed management in the upstream part of the river basin so that the uncontrolled erosion in the upstream part of the river and unmanageable deposition of SGS in the downstream part of the river can be minimized.

The design process of the river training structures and other structures to prevent flooding of riparian settlements and loss of agricultural lands should incorporate the expected ill effects of the global climate change.

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Acknowledgement

The field visit related to the study of the sand mining operations in Banke District, Nepal, was funded by an undergoing project on Mainstreaming Climate Change Risk Management in Development, under the Ministry of Science, Technology and Environment, the Government of Nepal.

Estimation of Water Storage using GIS in Dam Construction

Nab Raj Subedi,
Visiting Assistant Professor, Geomatic Engineering, Kathmandu University
Under Secretary (Tech.), Ministry of Land Reform and Management, Singha Darbar, Kathmandu

Abstract

Hydrological analysis is very much important to be carried out before any construction process. A proper analysis determines the durability and effectiveness of the structure, and reduces the risk associated with construction. The traditional method of analysis consists of survey and manual analysis which may result in human error in calculation. Such error causes disaster leading loss of life and property. A case study for estimation of back water storage using GIS due to construction of a dam was performed using GIS in the sub watershed of Khoryang Khola, tributary of Tamor River in the Eastern part of Nepal. This entails generation of DEM and locating the dam axis in GIS environment. Potential upstream water surface can be easily identified by generating the contour up to the height of the dam to be constructed. This allows to calculate the water depth raster, which when multiplied by the cell size renders the water volume confined within a pixel. The integration of volume raster provided the total volume of water confined within the pondage area formed by the dam. The result was then cross-checked with the available alternative tool in GIS which showed that the result tallies within the 10% of what is achieved by the first method.

Background

Modeling of hydrology is necessary to see the water flow phenomena in a give geographic area. This can be simulated using GIS through the construction of digital elevation model. It is known fact that the shape of a surface determines how water will flow across it. Geographic Information System (GIS) provides a method to describe the physical characteristics of a surface. Using a digital elevation model as input, it is possible to delineate a drainage system and then quantify the characteristics of that system. The tools let one determine, for any location in a grid, the upslope area contributing to that point and the downslope path water would follow.

Watersheds and stream networks, created from Degital Elevation Models (DEMs) using GIS, are the primary input to most surface hydrologic models. These models are used for determining the height, timing, and inundation of a flood, as well as locating areas contributing pollutants to a stream, or predicting the effects of altering the landscape.

An understanding of the shape of the Earth's surface is useful for many fields such as regional planning, agriculture and forestry. These fields require an understanding of how water flows across an area, and how changes in that area may affect that flow.

Before one can model the behavior of water, he/she must determine where the water came from and where it is going. The following sections explain how the tools are used to help model the movement of water across a surface. The following section briefly explains the concepts and key terms regarding drainage systems and surface processes and then ultimately how water volume is calculated in GIS environment. The case study for estimation of back water storage using GIS due to construction of a dam was performed using GIS in the sub watershed of Khoryang Khola, the tributary of Tamor River in the Eastern part of Nepal. The figure 1. shows the study area by spatial method.

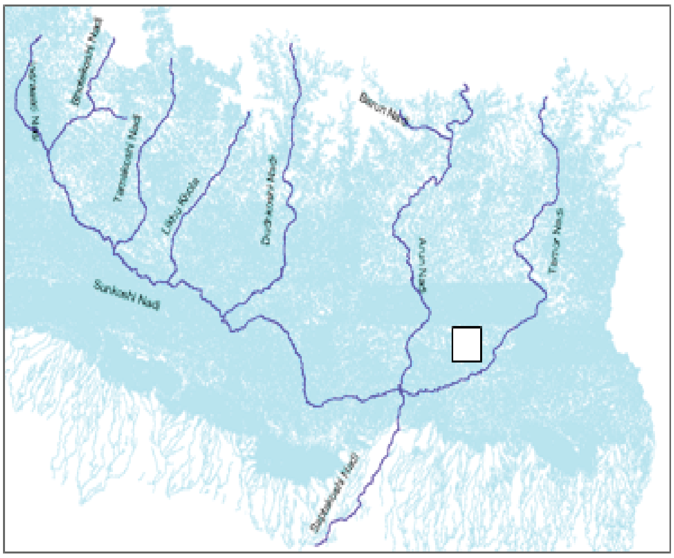


Fig. 1 Tentative location of the study area (not in scale)

Generation of Digital Elevation Model

The most common digital data of the shape of the Earth's surface is cell-based DEMs (digital elevation models). This data is used as input to quantify the characteristics of the land surface. Topo to Raster interpolator is used to calculate the DEM of the given surface.

A DEM is a raster representation of a continuous surface, usually referring to the surface of the Earth. The accuracy of this data is determined primarily by the resolution (the distance between sample points). Other factors affecting accuracy are data type (integer or floating point) and the actual sampling of the surface when creating the original DEM.

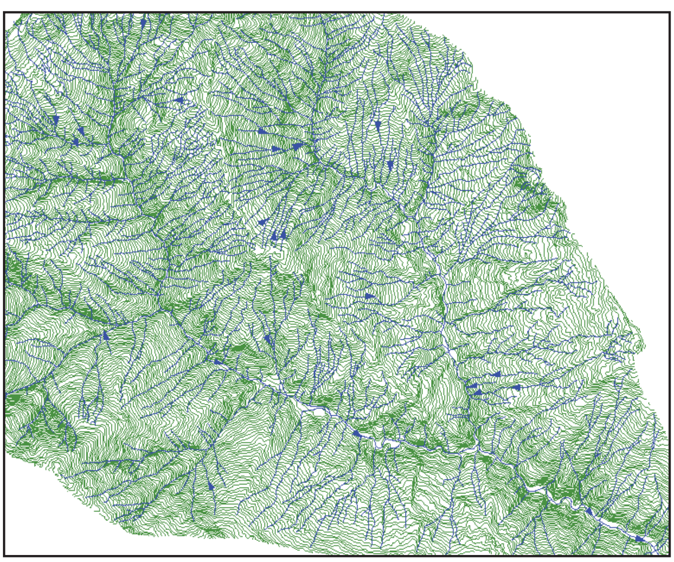


Fig. 2. Distribution of the contour and river lines of the area

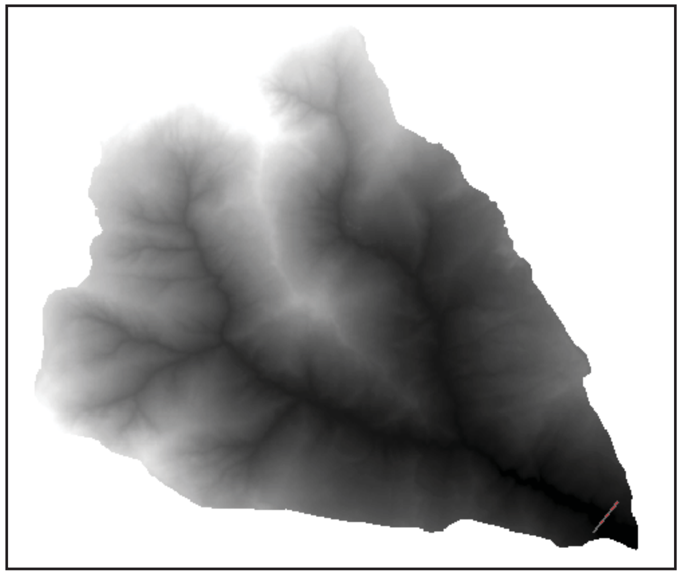


Fig.3 DEM of the area

Rectification of DEM from the hydrological perspective

Errors in DEMs are usually classified as either sinks or peaks. A sink is an area surrounded by higher elevation values, and is also referred to as a depression or pit. Likewise, a spike or peak is an area surrounded by cells of lower value. Errors such as sinks were removed by passing the Dem through the process called FILL.

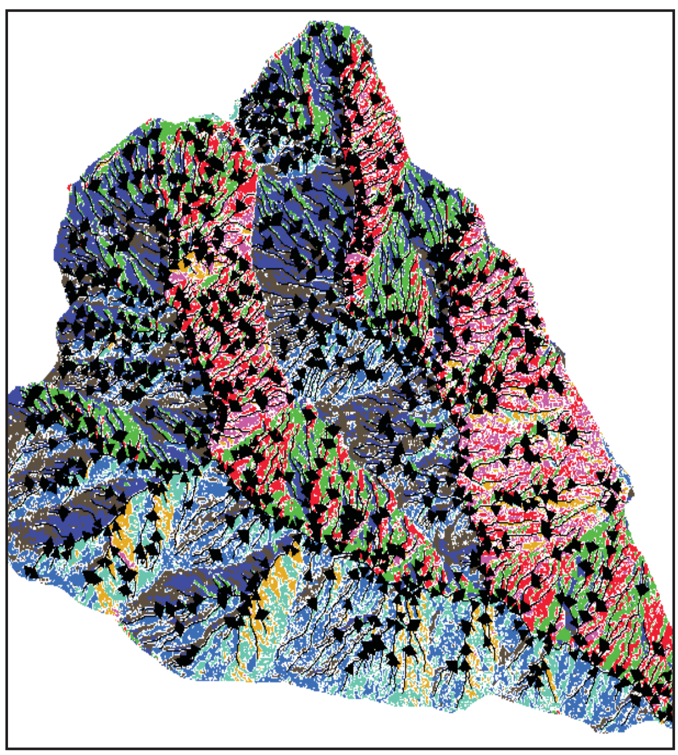


Fig 4. Flow direction map

Calculation of flow direction

One of the keys to deriving hydrologic characteristics about a surface is the ability to determine the direction of flow from every cell in the grid. This is done with the Flow Direction dialog. This dialog takes a surface as input and output a raster showing the direction of flow out of each cell. There are eight valid output directions, relating to the eight adjacent cells into which flow could travel. The direction of flow is determined by finding the direction of steepest descent, or maximum drop, from each cell. This is calculated as

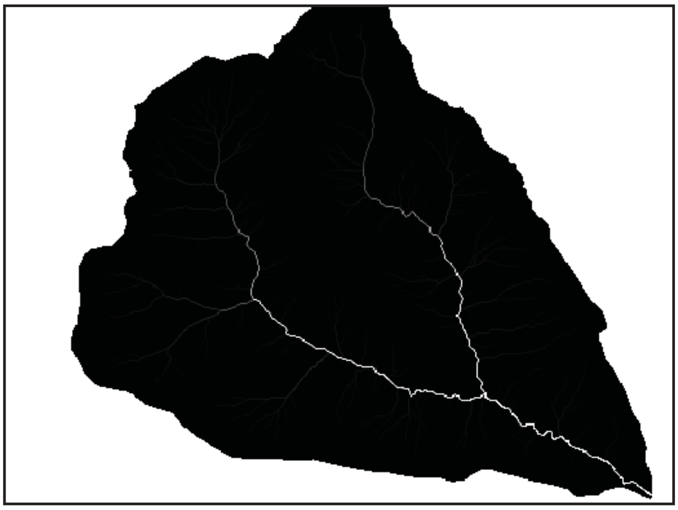


Fig 5 Flow Accumulation map

Flow of accumulation

The Flow Accumulation dialog calculates accumulated flow as the accumulated weight of all cells flowing into each down slope cell in the output raster. If no weight raster is provided, a weight of one is applied to each cell, and the value of cells in the output raster will be the number of cells that flow into each cell. Cells with a high flow accumulation are areas of concentrated flow and may be used to identify stream channels. The output from the Flow Accumulation process would then represent the amount of rain that would flow into each cell, assuming that all rain became runoff and there was no interception, evapo-transpiration, or loss to groundwater. This could also be viewed as the amount of rain that fell on the surface, upslope from each cell.

Watershed delineation

A watershed is the up slope area contributing flow to a given location. The watershed is also referred to as a basin, catchment, sub-watershed, or contributing area. Watershed was delineated from a DEM by using the flow direction and flow accumulation raster to control the size of the watershed. An alternative for creating a watershed raster is to interactively identify the pour points and delineating the watershed using the Watershed tool on the sample extension tool bar. The process is described in the 'Interactive Tools' section. The Watershed tool in GIS helps to identify the contributing watershed to a specified point, known as a pour point.

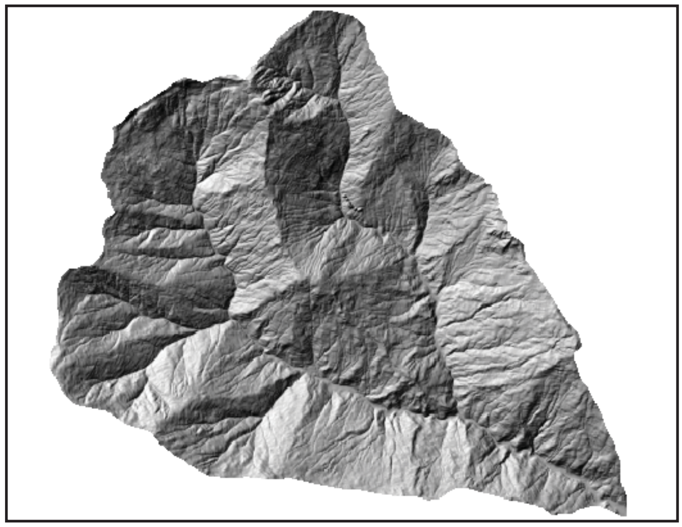


Fig 6 Topographic simulation of the area

Hill shade calculation

The Digital elevation modal so generated was also used to calculate the hill shade of the Area. The watershed over the dam axis, and the flow accumulation was made transparent and displayed over the hill shade area to have a simulated view of the hydrology model in GIS.

Locating the Dam position and finding the water surface contour after the dam construction

The tentative Dam location was added in the simulated view and its base height was obtained form DEM. Using this height as a base height, the contour with the interval of dam height was calculated in GIS to have a look on

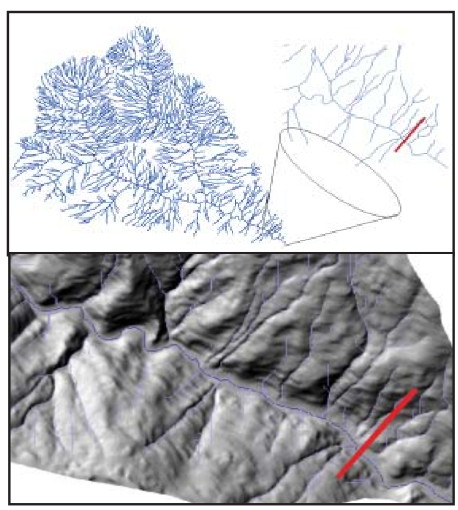


Fig 7 Locating Dam axis through the pour point

the level of water in the topography. The water surface contour along was separated from the set of other contour lines and then dam axis was delineated by touching the water surface contour at both ends. This data was then used to calculate the plan area of backwater storage.

Calculation of backwater storage volume and cross validation

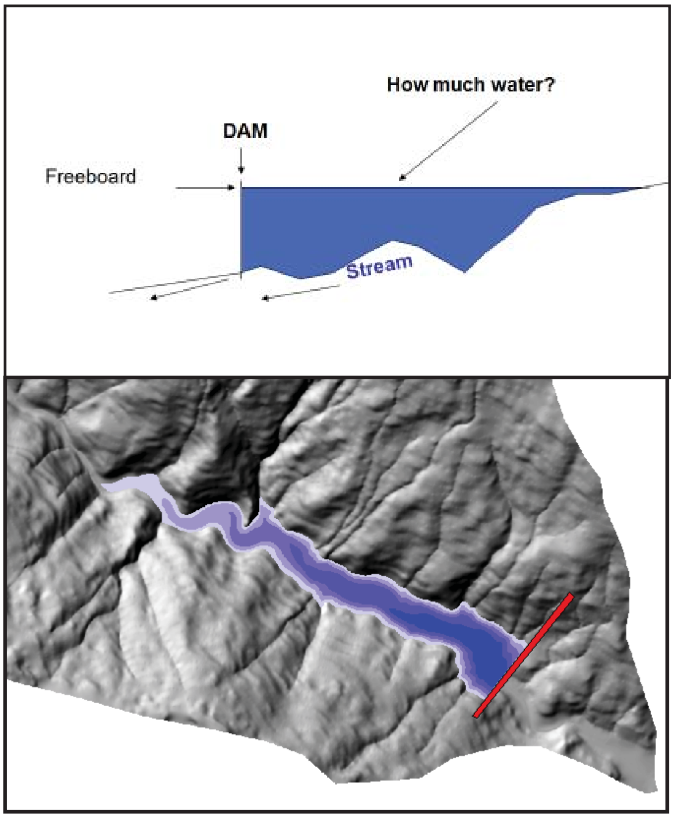
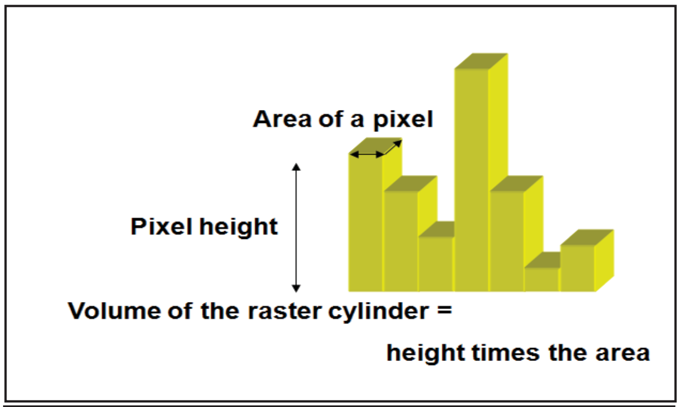
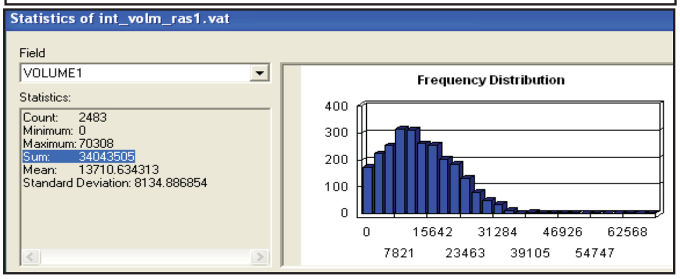


Fig. 8 Calculation of Volume in GIS environment

The backwater storage area was used to mask for confining the analysis upstream the dam. The DEM was subtracted from the mean sea level of water surface in the map algebra environment. This provides the water depth raster within the pondage area. This raster was then multiplied by the pixel area to generate volume raster file for each pixel. However, this data does not allow to open the data table due to its floating nature. It is then converted into integer raster which then is used to integ rate into the total volume of water within each pixel area. The total volume of water over the point of study was 34043505 cubic meters reserved by the dam of 100 meter height above the base.





The above result was cross validated suing the tool available in GIS for area and volume calculation in the 3D analysis. It rendered the volume more by 10% than what was calculated using the previous method. However, the accuracy depends on the accuracy of DEM or contour as well.

Conclusion

Hydrological analysis is very much important to be carried out before any construction process. A proper analysis determines the durability and effectiveness of the structure, and reduces the risk associated with construction. The traditional method of analysis consists of survey and manual analysis which may result in human error in calculation. Volume calculation simulation is an example. Hydrological analysis with GIS has many advantages compared to the traditional methods. The major advantages can be listed as, Analysis process is quick and accurate, Analysis based on some conditions could be applied hence suitable result can be obtained, The result can be stored with the process included hence correction can be done, GIs reduces the budget hence it is economic for large scale project, The most suitable site for dam construction can be selected with highest possible precision.

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Monsoon Rain 17-18 June, 2013
and
Floods in Mid and Far Western Regions

Mani Ratna Shakya
Department of Meteorology,
Tri-Chandra Multiple Campus, Tribhuvan University, Nepal

Abstract

The heavy monsoon rain that lashed in the mid and far western region on 17 and 18 June 2013, have resulted floods and landslides in the main rivers such as Mahakali, Seti and Karnali causing death of several people and damaging huge amount of property. Heavy rain amounting 104.4 mm and 167.7 mm were recorded in Dadeldhura on 17 and 18 June respectively. Likewise, Dipayal recorded 186.6 mm on 18 June which is 116 percent of the normal rainfall for the month of June. As a result, the discharge in the Mahakali river rose from 139,000 cubic feet per second to 440,716 cubic feet per second on 17 June 2013, well in excess of the flow of 398,000 cubic feet seconds recorded in the 2012 monsoon. Hence, a study has been made to understand the monsoon disaster 2013.

Introduction:

Nepal is a small mountainous country covering an area of 147,181 sq.km in the middle of Hindu Kush Himalayan region. The country experiences wide topographical variation ranging from 60 m in the south to 8848 m in the north above mean sea level, resulting different climatic conditions varying with space and time. Owing to its geographical location and high elevation, Nepal has a dense network of rivers numbering more than 6000 including big and small.

Unstable steep slopes and fragile geological condition of the mountains, under extreme weather events especially during the monsoon season makes the country susceptible to different natural disasters such as landslides, debris flow and floods. As about 80 % of the total annual rain in the country occurs during the monsoon season, the incessant monsoon rain create havoc causing landslides in the hills and mountains and floods in the low lying Terai plains. Rivers are swollen almost every year during the monsoon season that threatens and affects the human lives reluctantly. Actually, abundance of water during the monsoon season holds great potentiality for various activities such as hydropower, irrigation, domestic and industrial uses but, swollen river which causes floods are main reason behind loss of lives and destroying high economic value of property. Data based on 1983 -2010 shows that every year on an average of 283 people are killed due to flood and landslides only in the country (DWIDP).

Emerge of the event:

The monsoon this year in Nepal was observed on 14 June 2013 in the eastern part, delayed by 4 days against the normal onset date. Right after two days of onset of monsoon in eastern Nepal, the heavy down pour occurred in the mid and far western regions due to the active monsoon onset over Arabian sea.

Initially, the severe monsoon phenomenon was observed over Arabian sea affecting the northern Indian Himalayan territory such as Himanchal Pradesh, Uttarakhand and vicinity bringing heavy downpour in those areas. From 14 to 17 June 2013, Indian state of Uttarakhand and adjoining areas received heavy rainfall, which was about 375 percent more than the benchmark rainfall during a normal monsoon (www.imd.gov.in). Fig 1 shows areas of heavy rainfall in India and Nepal with accumulated rain for the period from 14- 20 June 2013.

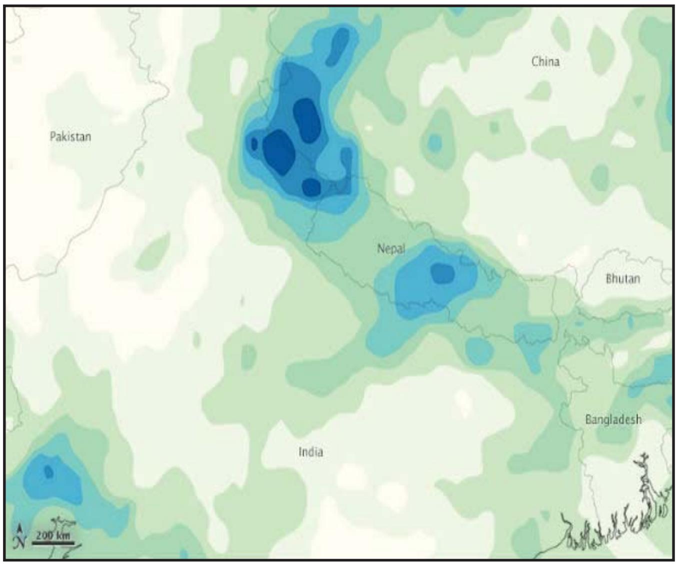
The same weather system while moved into far and mid western parts of Nepal in later days with invasion of the strong westerly wind caused heavy rain that triggered divesting floods and landslides. The impacts of monsoon is also observed in northern boarder of China. A few villages close to the China border have claimed unseasonal snowfall, leaving dozens of shepherds and thousands of sheep stranded (http://www.nepalnews.com/archive/2013/jun/jun18/news12.php).

The monsoon this year in South Asia begain with onset of monsoon first and foremost in Kerala, India on 01 June, which is also the normal date of monsoon onset in Kerala. The normal onset of monsoon in India has given expectation of betterment of agricultural products this year in various country in South Asia but, extreme weather phenomenon that has arisen in early stage of monsoon in northern India such as in Himanchal Pradesh and Uttarakhand and, far and mid western Nepal has claimed heavy loss of life and huge amount of property in India and Nepal. Actually, the normal date of onset of monsoon in Himanchal Pradesh and Utterakhand is 01 July and entire India is 15 July but, this year entire India is covered by monsoon by 16 June a month ahead of normal schedule which was the first time in India that monsoon observed so early after 21 June 1960 (IMD).

Rainfall record from Far and Mid Western Nepal showed a heavy rain associated with thunderstorm on 17 and 18 June 2013. On 17 June 24 hours rainfall over Dadeldhura was recorded to be 104.4 mm rainfall at 03:00 UTC followed by 67.8 mm in Dipayal, 92.6mm in Dhangadhi, 60.1 mm in Surkhet, 71.4 mm in Nepaljung and 144.6 mm in Bhairahawa (DHM). Likewise, on 18 June at the same time the 24 hour rainfall recorded at Dadeldhura was the highest of 167.7 mm followed by 186.6 mm in Dipayal, 93.6 mm in Dhanaghadi, 98.7 mm in surkhet, 42.0 mm in Nepaljung and 86.1 mm in Bhairahawa. (Table 1.)

Table 1. June 2013 rainfall (03:00 UTC) and normal

Station	Rain on 17 June (mm)	Rain on 18 June (mm)	Normal rain for the month June (mm)
Dadeldhura	104.4	167.7	171.6
Dipayal	67.8	186.6	161.3
Dhanghadi	92.6	93.6	252.4
Surkhet	60.1	98.7	252.3
Nepaljung	71.4	42	199.4
Pokhara	41.4	76.8	669
Bhairahawa	144.6	86.1	269.4



Source: DHM

Fig 1. Map of rainfall totals in India, Nepal, and surrounding countries from June 14-20, 2013. The heaviest rainfall—greater than 300 millimeters (12 inches)—appears in dark color. The lightest rainfall (less than 15 millimeters, or 0.6 inches) appears in light. (Credit: NASA/MPA/TRMM)

Synoptic feature leading to heavy rainfall:

The weather situation leading to rainfall during the monsoon season in South Asia rely on the monsoon depression formed over the Bay of Bengal and Arabian sea and its movement into the continent.

On 17 June 2013, a low pressure area was located over northeast Rajasthan and adjoining area of Haryana with associated cyclonic circulation extending up to mid- tropospheric level. As a result, the axis of monsoon trough at sea level passed through Bikaner of Rajasthan, Gwalior, Gaya and across Gangetic west Bengal. At the same time, the western disturbance as a trough in mid tropospheric level was persisting along 74° E and north of 25º N moving eastward (http://www.imd.gov.in). The resulting affect showed a vigorous monsoon activity over Utter Pradesh, Utterkhand, Himanchal Pradesh, Gujarat region, Saurastra and Kutch, Madya Maharastra, Kokon and Goa and Kerala.

Satellite imagery at 12:00 UTC on 17 June shows convective clouds over above mention areas and Central Bay of Bengal and, North East and East Central Arabian sea.

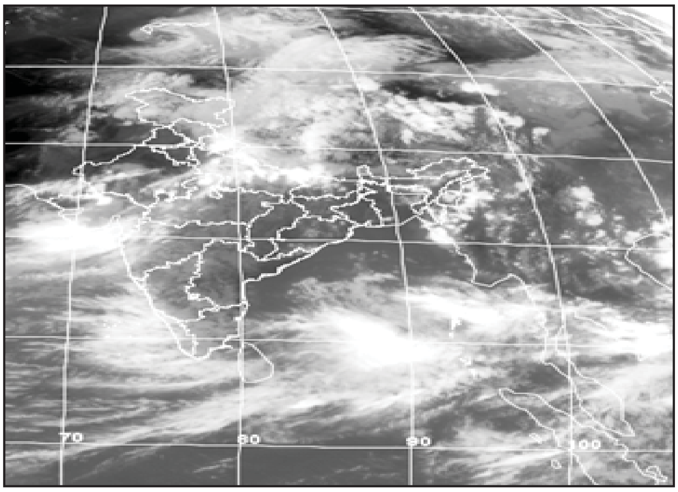


Fig 2. Satellite image at 09:00 UTC on 17 June 2013.

Floods associated with heavy monsoon rain :

The incessant rainfall in the mid and far western regions of Nepal affected 20 districts in Nepal with occurrence of floods in the major river such as Mahakali, Seti and Karnali (Fig 3). The Mahakali river is a transboundary river between Nepal and India with a catchment area of 14,871 sq. km. It flows for about 223 km in Nepal and around 323.5 km in India to its confluence with the Karnali river in India.

Continuous rain in the upper catchments caused the water level in the Seti river east of the Mahakali to rise from 6.94 m to 11.56 m and 5.53 m to 12.81 m in the Karnali at Chisapani on 17 June as measured by Department of Hydrology and Meteorology, Nepal's real time network (www.icimod.org/?=10932). Unfortunately, no real time stations are being installed by the Department in the Mahakali river.

The discharge in the Mahakali river rose from 139,000 cubic feet per second to 440,716 cubic feet per second on 17 June 2013, well in excess of the flow of 398,000 cubic feet per second recorded in the 2012 monsoon. (http://www.kantipuronline.com/2013/06/18/top-story/massive-floods-in-mahakali-river-6-killed-update/373456/)

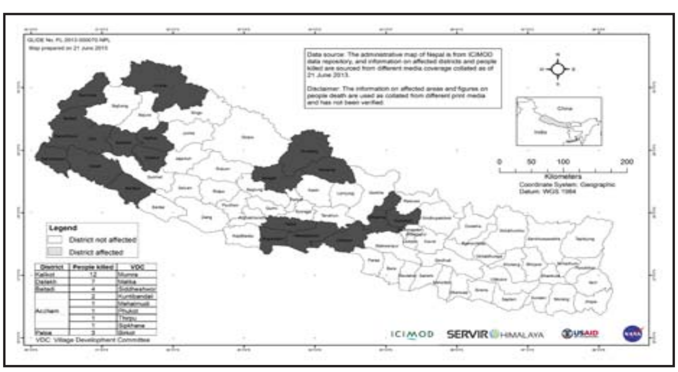


Fig 3. Flood and landslide affected districts in Nepal (source: ICIMOD)

The Mahakali river has swept away an entire settlement in Khalanga of Darchula District. Actually the full extent of the devastation in Nepal is yet to be known but the report shows the flood swept away 77 buildings and displaced 2,500 people in Darchula (http://www.nepalnews.com/archive/2013/jun/jun18/news12.php).

The swollen river also has smashed a suspension bridge at Khalanga, the head quarter of Darchul and swept away the Kalagadh Micro Hydro project's power house and its transformer, two storied building of Resource Centre of District Education Office, and the District Hospital's morgue (Fig.4). While a few houses collapsed in Rigaune Tal, Brahmadev and Khalanga-2, Khalanga-5 has been worst hit.

Six people were killed in Achham and Baitadi districts and eight people also were missing in Dhungaad. It is reported that 150 families have been rendered homeless in Dodhara and Chadani and around 30 families have been affected in Kuda. Four houses in Salyan have been damaged due to a landslide. In Kalikot district, 4 people were dead and 11 were missing and 27 families have been displaced. Flood in the Karnali river has affected many villages in the southeast region of Kailali, inundating large areas in Tikapur Municipality and the VDCs of Lalbojhi, Bhajani, Thapapur and Khailad. In Bardiya the floods have intensely affected the Rajapur Tappu region where 2,000 houses were inundated by the Karnali river. Approximately 600 families were at great risk in Khairichandanpur (http://www.ekantipur.com/2013/06/19/headlines/Monsoon-fury-claims-at-least-20-many-missing/373488/).

Fig 4. Swollen Mahakali river smashes suspension bridge at khalanga, the head quarter of Darchula on Monday June 17, 2013. (Photo Narendra Bhatta, The Himalayan times).

A picture of swollen rivers flowing in India and adjoining Far and Mid Western part of Nepal on June 21, 2013 and the same the river during the dry period on May 30, 2012 can be observed in Fig 5.

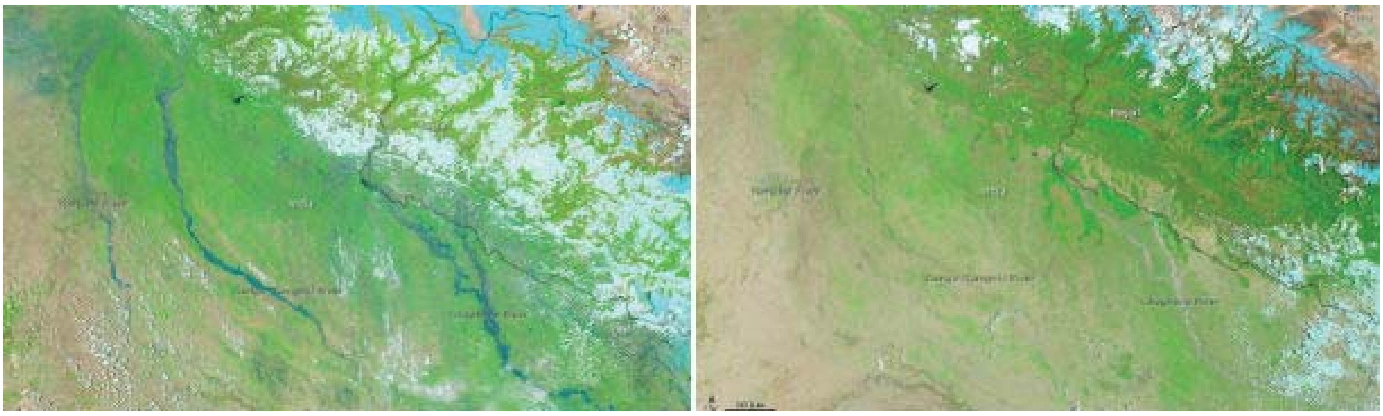


Fig 5. Flooding in Nepal and adjoining India on June 21, 2013 (left) and same area (right) on May 30, 2012 (NASA/LANCE/ MODIS)

Conclusion:

Floods are main hazards and disasters that occur repeatedly during the monsoon season in low lying areas of Nepal which cause tremendous loss of life and property. Although, severe monsoon activity and geographical feature of the country play significant role in occurring floods in Nepal, increase in frequency and magnitude of floods can be considered as impacts of emerging drastic change in land use planning and land cover, excavation of river beds for extracting the construction materials and, development of infrastructure such as roads, culverts, bridges, buildings etc. on river bank or close to river without making due consideration to draining the natural flow of water in the river.

If such human activities can be minimized by following strict application of disaster management and mitigation procedure, the impacts of floods and human loss can be reduced to some extent. Besides this, the most important thing that has to be done in the modern age of science and technology to save life and property of human beings mitigating the impact of natural disasters, is the timely issuance of reliable early warnings concerning severe weather phenomena. Such early warnings should be disseminated to the community level in time.

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Emergency works Karnali River (Right Bank), June 2013

Emergency Works, Karnali River

Department of Water Induced Disaster Prevention (DWIDP)
Pulchowk, Lalitpur
Post Box No.: 13105, Kathmandu, Nepal
Phone: 977-1-5535407, 5535502, 5535503, Fax: 977-1-5523528
e-mail: dwidp@ntc.net.np
website: www.dwidp.gov.np