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Water Induced Disasters of Nepal: Floods and Landslides

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Letter from the editors

The Emergency and Disaster Reports is a journal edited by the Unit for Research in Emergency and Disaster of the Department of Medicine of the University of Oviedo aimed to introduce research papers, monographic reviews and technical reports related to the fields of Medicine and Public Health in the contexts of emergency and disaster. Both situations are events that can deeply affect the health, the economy, the environment and the development of the affected populations.

The topics covered by the journal include a wide range of issues related to the different dimensions of the phenomena of emergency and disaster, ranging from the study of the risk factors, patterns of frequency and distribution, characteristics, impacts, prevention, preparedness, mitigation, response, humanitarian aid, standards of intervention, operative research, recovery, rehabilitation, resilience and policies, strategies and actions to address these phenomena from a risk reduction approach. In the last thirty years has been substantial progress in the above mentioned areas in part thanks to a better scientific knowledge of the subject. The aim of the journal is to contribute to this progress facilitating the dissemination of the results of research in this field.

This monographic issue is about Water Induced Disasters risk of Nepal.

Nepal is located in the middle portion of the Hindu-Kush Himalayan Region. The country has extreme variations in natural environment that ranges from tropical plain to alpine heights with decreasing elevations from north to south. It is divided into three ecological zones from North to South namely: Mountain (Northern Range), Hill (Middle Range) and Terai (Southern Range).

Due to variation in altitude there are extreme changes in temperature and climatic conditions. Most parts of the country have an average annual rainfall of 1,500mm to 2,500mm. A combination of sharp relief and fast-moving monsoon clouds brings frequent hailstorms and cloudbursts; the latter trigger numerous landslides, landslide dams and debris flow resulting from the subsequent bursts of the temporary natural dams. In many places, rainfall intensity exceeds 100mm/24hours.

Nepal consists of four main rivers that flow from mountain ranges in the North to the downstream towards plain belts in the South. The major rivers of Nepal (east-west) are Koshi River, the Narayani River, Karnali River and the Mahakali River and there are thousands of smaller rivers originating below the permanent snowline. Most of the rivers are originated in Himalayas and some flow from Tibet in border.

The risk profile presented here is based on vulnerability and risk factors of water induced disasters (floods and landslides) of Nepal and the national disaster risk management of those events

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TABLE OF CONTENTS

ACKNOWLEDGEMENT	I
TABLE OF CONTENTS	II
ABBREVIATIONS	IV
LIST OF TABLES, MAPS AND FIGURES	VII
1. BACKGROUND	1
1.1 Geographical Structure	1
1.2 Administrative Division	2
1.3 Climate and Temperature	3
1.4 River System in Nepal	3
2. OBJECTIVES	5
2.1 General Objective	5
2.2 Specific Objectives	5
3. METHODOLOGY	5
4. DISASTER HISTORY AND IMPACT	6
5. FLOODS	8
5.1 Flood and Landslide Causative Factors in Nepal	8
5.2 Case Study: Mahakali flood in Darchula District	10
6. LANDSLIDES	12
6.1 Causes that contribute to landslide in Nepal	13
6.2 Case Study: Sunkoshi Landslide	13
7. RESULTS	15
8. DISASTER RISK MANAGEMENT IN NEPAL	23
8.1 Policy measures and existing legal framework	24
8.1.1 Natural Calamities (Relief) Act, 1982	
8.1.2 Local Self Governance Act	
8.1.3 National Disaster Management Act	
8.1.4 Milestones in DRM in Nepal	
8.2 National strategy for disaster risk management 2009	25

8.2.1	Priority actions and strategic activities of HFA	
8.2.2	Disaster prevention and response strategies by authorities	
8.2.3	Progress towards Hyogo framework of Action	
8.3	Water Resources Strategy, 2002	31
8.3.1	Water Induced Disaster Targets	
8.3.2	WRS activities to achieve the targets	
8.3.3	Different Programs and projects under DWIDP	
8.3.4	The Water Induced Disaster Management Policy	
8.4	National Disaster Response Framework	35
8.4.1	National and International Assistance during emergency	
8.4.2	The coordination Cluster	
8.4.3	Agencies coordination structure for disaster response activities	
8.5	Nepal Risk Reduction Consortium Flagship Programmes	39
9.	DISCUSSIONS	41
10.	CONCLUSIONS	44
11.	BIBLIOGRAPHY	46

ABBREVIATIONS

ADB	:	Asian Development Bank
ADPC	:	Asian Disaster Preparedness Center
CBO	:	Community Based Organization
CBS	:	Central Bureau of Statistics
CNDRC	:	Central Natural Disaster Relief Committee
DC	:	Department of Custom
CDRC	:	Central Disaster Relief Committee
DDC	:	District Development Committees
CDRC	:	Central Disaster Relief Committee
DDRC	:	District Disaster Relief Committee
DDMC	:	District Disaster Management Committee
DEOC	:	District Emergency Operation Center
DHM	:	Department of Hydrology and Meteorology
DI	:	Department of Immigration
DIMS	:	Disaster Information Management System
DMSP	:	Disaster Mitigation Support Program
DRR	:	Disaster Risk Reduction
DSCWM	:	Department of Soil Conservation and Watershed Management
DMC	:	Disaster Management Council
DoLIDAR	:	Department of Local Infrastructure and Agricultural Roads
DP-Net	:	Disaster Preparedness Network
DPTC	:	Disaster Prevention Technical Centre
DRM	:	Disaster Risk Management
DUDBC	:	Department of Urban Development and Building Construction
DWDO	:	District Women Development Office
DWIDP	:	Department of Water Induced Disaster Prevention
DWSS	:	Department of Water Supply and Sewerage
EDCD	:	Epidemiology and Disease Control Division
EIA	:	Environmental Impact Assessment
EOC	:	Emergency Operation Centers
FAO	:	Food and Agriculture Organization
FWR	:	Far Western Region
GDP	:	Gross Domestic Product
GIS	:	Geographic Information Systems
GLOF	:	Glacial Lake Outburst Flood
GoN	:	Government of Nepal
HDI	:	Human Development Index
HFA	:	Hyogo Framework for Action

ICIMOD	:	International Centre for Integrated Mountain Development
IFRC	:	International Federation of Red Cross and Red Crescent Societies
IHC	:	International Humanitarian Communities
INGO	:	International Non-Governmental Organization
INSARAG	:	International Search and Rescue Advisory Group
IOM	:	International Organization for Migration
JICA	:	Japan International Co-operation Agency
LDOF	:	Landslide Dam Outburst Floods
LDMC	:	Local Disaster Management Committee
MBT	:	Main Boundary Thrust
MCT	:	Main Central Thrust
MFT	:	Main Frontal Thrust
MoAC	:	Ministry of Agriculture and Cooperatives
MoAD	:	Ministry of Agriculture Development
MOE	:	Ministry of Education
MoEn	:	Ministry of Environment
MoFALD	:	Ministry of Federal Affairs and Local Development
MoFSC	:	Ministry of Forests and Soil Conservation
MoHA	:	Ministry of Home Affairs
MoI	:	Ministry of Irrigation
MoIC	:	Ministry of Information and Communication
MoHP	:	Ministry of Health and Population
MoLD	:	Ministry of Local Development
MoPPW	:	Ministry of Physical Planning and Works
MoST	:	Ministry of Science and Technology
MoUD	:	Ministry of Urban Development
MoWCSW	:	Ministry of Women, Children and Social Welfare
NCRA	:	Natural Calamity Relief Act
NEA	:	Nepal Electricity Authority
NEOC	:	National Emergency Operation Center
NDRF	:	National Disaster Response Framework
NGO	:	Non Government Organization
NHRC	:	National Human Rights Commission
UNOCHA	:	UN Office for the Coordination of Humanitarian Affairs
NPC	:	National Planning Commission
NRCS	:	Nepal Red Cross Society
NRRC	:	Risk Reduction Consortium
NSDRM	:	National strategy for disaster risk management
RDRC	:	Regional Disaster Relief Committee
REOC	:	Regional Emergency Operation Center

RNCRC	:	Regional Natural Calamities Relief Committee
RRT	:	Rapid Response Team
SAARC	:	South Asian Association for Regional Cooperation
SC	:	Save the Children
SOP	:	Standard Operating Procedures
SWC	:	Social Welfare Council
UNDAC	:	United Nations Disaster Assessment and Coordination
STDS	:	South Tibetan Detachment System
UNDP	:	United Nations Development Programme
UNFPA	:	United Nations Population Fund
UNHCR	:	United Nations High Commissioner for Refugees
UNICEF	:	United Nations Children's Fund
UNISDR	:	UN International Strategy on Disaster Reduction
USD	:	United States Dollar
USGS	:	U.S. Geological Survey
VDC	:	Village Development Committees
WECS	:	Water and Energy Commission
WFP	:	World Food Programme
WHO	:	World Health Organization
WRS	:	Water Resources Strategy

LIST OF FIGURES

- Figure 1: Loss of lives from natural disasters
- Figure 2: 3D illustration of different types of landslides
- Figure 3: Number of flood events by types (1954-2014)
- Figure 4: Deaths due to all types of floods (1954-2014)
- Figure 5: Total number of affected people and damaged by different types of flood (1954-2014)
- Figure 6: Impact of all types of flood (1954-2014)
- Figure 7: Number of deaths caused due to landslide (1971-2011)
- Figure 8: Number of houses damaged and destroyed by landslides (1971-2011)
- Figure 9: People affected, relocated and evacuated by landslide (1971-2011)
- Figure 10: Infrastructures and livestock damaged by landslides (1971-2011)
- Figure 11: Comparison of International data records with National Data
- Figure 12: National and International Assistance and Coordination Structure during Emergency

LIST OF TABLES

- Table 1: People affected by disasters in Nepal (1934-2014)
- Table 2: Losses from water induced disasters (1983-2013)
- Table 3: Top 10 districts with floods and landslides events in 2012/13
- Table 4: Index for Risk Management for Nepal
- Table 5: NRRC Steering Committee
- Table 6: Flagship Programmes and five-year budget

LIST OF MAPS

- Map 1: Geographical location and topography of Nepal
- Map 2: Administrative division of Nepal
- Map 3: River system of Nepal
- Map 4: Geographical view of Sindhupalchok Landslide
- Map 5: Flood and landslide affected districts in Nepal

1. BACKGROUND

Nepal is a land-locked country bordering with China in the North and India in East, West and South. It covers a total area of 147181 square kilometers. It covers only 0.03% and 0.3% of total area of the world and Asia respectively. The country is 885km in length from west to east and mean width of 193km from North to South. Globally, the county measures 26°22' North to 30°27' North in Longitude and 80°04' East to 88°12' East in Latitude. A country has a total population of 26.5 million with 1.35 percent annual growth rate. The altitude ranges from 70 meters to 8848 meters and the climate varies from tropical to arctic depending upon altitude.

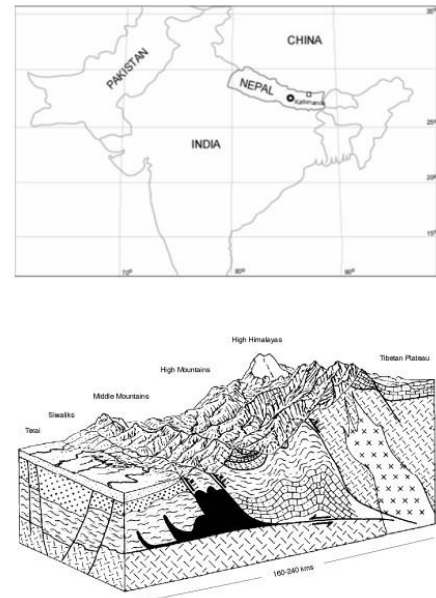
For the year, 2012/13, the preliminary estimated per capita GDP is around US \$ 717. The country has an economic growth of 3.56 (based on GDP) is percent per annum as of year 2012/13. About one fourth of the population i.e. 25.16% lives below poverty lines as per the Nepal Living Standards Survey 2010/11. The survey also shows that there is inequality in income distribution.

¹ According to UNDP (1980-2014) HDI of Nepal has an increasing trend with 0.54 in 2013.

1.1 Geographical Structure and Topography:

Geographically, Nepal is located in the middle portion of the Hindu-Kush Himalayan Region. The country has extreme variations in natural environment that ranges from tropical plain to alpine heights with decreasing elevations from north to south. It is divided into three ecological zones from North to South namely: Mountain (Northern Range), Hill (Middle Range) and Terai (Southern Range). Northern range consists of mountain range of eight peaks higher than 8,000 meters known as Himalayas that includes Mt. Everest measuring 8848m on the border with China. The Himalaya is recognized as highly active and delicate mountain range in the world. The Himalaya is still increasing with its rocks being under stress because of the Indian plate moving northward that pushes the Tibetan block. The middle range occupies the central part of the country which is covered by Greenery Mountains, hills, high peaks, valleys and lakes. The Kathmandu Valley- capital city of Nepal also lies in middle region. The southern range is a complete plain land which consists of dense forest areas, national parks,

Map 1. Geographical location and topography of Nepal

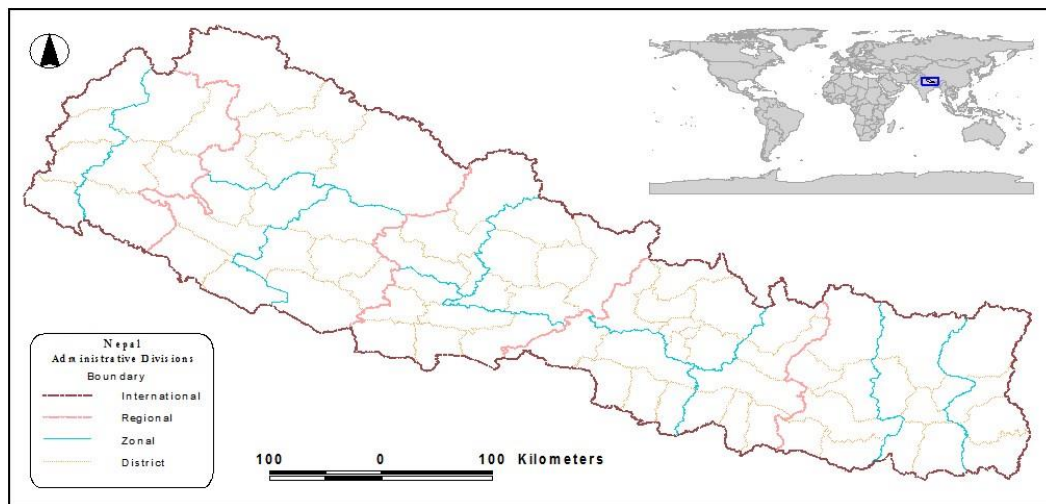


wildlife reserves and conservation areas. Terai zone consist of large range of fertile land for food production.^{1, 6} Terai belt in south consists of plain about 20 -75 km wide, with elevation varying gently from approximately 60-200m above the sea level. The hills alone cover two-third (about 83 per cent of the total area of the country) area.² In comparison to Hills and mountain Region, Terai Region is densely populated because of its fertile land, access to road and other facilities.⁷ Tectonically, Nepal is divided into five major tectonic zones, namely, Terai, Sub-Himalayan Zone (Siwaliks), Lesser Himalayan Zone, Higher Himalayan Zone, and Tibetan-Tethys Zone (Ganser 1964, Upreti 1999). These tectonic zones are separated by major thrusts and faults of the Himalaya, namely from north to south, South Tibetan Detachment System (STDS), Main Central Thrust (MCT), Main Boundary Thrust (MBT) and Main Frontal Thrust (MFT).¹⁴

1.2 Administrative Division:

Nepal is largely a rural country. It is divided into five developmental regions: Eastern Development Region, Central Development Region, Western Development Region, Mid-Western Development Region and Far-Western Development Region. The country is sub-divided into 14 zones and 75 administrative districts. Furthermore, the districts are divided into smaller units, called Village Development Committees (VDCs – total 3,633) and Municipalities (130)³. The VDCs represent the rural communities and the municipalities represent the urban areas of the country.¹ Each VDC is further divided into smallest administrative units consisting of 9 wards, whereas the municipalities vary from 9-35 wards.²

Map 2: Administrative division of Nepal



1.3 Climate and Temperature:

Due to variation in altitude there are extreme changes in temperature and climatic conditions. During the summer, Nepal faces maximum temperature of about 28° Celsius in the Hills and more than 40°C in the Terai region. In winter, the temperature ranges from 7° Celsius to 23° Celsius in Terai and much colder in higher regions.

In monsoon, June-September, the environment has more precipitation (about 80%) that is converted into rain. Most parts of the country have an average annual rainfall of 1,500mm to 2,500mm. A combination of sharp relief and fast-moving monsoon clouds brings frequent hailstorms and cloudbursts; the latter trigger numerous landslides, landslide dams and debris flow resulting from the subsequent bursts of the temporary natural dams. In many places, rainfall intensity exceeds 100mm/24hours.²

1.4 River System in Nepal:



Nepal consists of four main rivers that flow from mountain ranges in the North to the downstream towards plain belts in the South. Himalayan ranges are considered as a major source of river water. The major rivers of Nepal (east-west) are Koshi River, the Narayani River, Karnali River and the Mahakali River and there are thousands of smaller rivers originating below the permanent snowline. Most of the rivers are originated in Himalayas and some flow from Tibet in border. These, rivers ultimately meet at Ganges River in northern India showing large density of water. After sinking through deep gorges, the rivers are responsible for deposit of heavy debris and sediments on the plains, renewing their alluvial soil fertility. During monsoon season, the rivers often overflow their banks and shift the course periodically as they reach the Terai region (plain). The rivers are deeply-incised across the east-west structural grain of Nepal and the Himalaya, having eroded with the uplift of the mountains.²

Koshi River is present in Eastern part of Nepal, also known as Saptakoshi River (formed by combination of seven small rivers). All these tributaries, namely, the Indrawati River, the Sunkoshi River, the Tamakoshi River, the Likhu River, the Dudh Kosi River, the Arun River and the Tamor River, from east to west, originate from the High Himalaya. Among the seven rivers, the Sun Koshi

or Bhote Koshi, the Arun and the Tama Koshi originate in Tibet.⁹ Koshi is the largest river of Nepal, with the largest catchment area of approximately 60,000 square kilometers. 10 percent of its catchment is covered by ice and snow. Most of its part lies in Nepal (55%) and remaining in Tibet.¹⁰

Narayani River occupies central part of country, formed by combination of Trishuli River, the Budhi Gandaki River, the Marsyangdi River, the Seti Gandaki River, and the Kali Gandaki River.⁹ It is one of the largest rivers of Nepal with catchment area of 26,300 square kilometers. It is originated at Tibetan plateau and passes via the Nepal Himalayas present between Annapurna and Dhaulagiri mountains in the form of world's deepest gorge.¹¹

The Karnali River is the third largest river of Nepal with catchment area of 41500 square kilometers in Nepal Karnali River is the combination of Mugu Karnali and Humla Karnali that meets at Galwa. Some tributaries of this river originate from glaciated region and some from Tibet.⁹

The Mahakali River forms a border between Nepal and India with a catchment area of 15,260 square kilometers. It flows for about 223 km in Nepal and around 323.5 km in India. It originates from Api Himal and is about 223 km in length. ⁹

2. OBJECTIVES

2.1 General Objective

The overall objective of this paper is to develop disaster risk profile of Nepal mainly focused on water induced disasters (floods and landslides) and to compile and collect updated information about those events since last 40 years.

2.2 Specific Objectives

The specific objectives are as follows:

- To compile and collect information of floods and landslides happened in Nepal and to assess their impact on health of the population, the environment, the economy and the development.
- To assess main flood and landslide disaster risk factors present in Nepal
- To identify the disaster prevention and response strategies implemented by the authorities
- To identify the Structure and characteristics of the emergency and disaster response system in Nepal

3. METHODOLOGY

The disaster risk profile of Nepal was developed using the secondary data resources focusing mainly in floods and landslides. The statistics and information were adopted from international disaster sources: CRED database: EM-DAT, DesInventar, literature review of international reports and journals. National figures and information were obtained from Government databases including Ministry of Home Affairs and Ministry of Irrigation. The maps, tables and figures were adopted from national official reports of Ministry of Home Affairs, Ministry of Irrigation and ICIMOD and international source including EM-DAT, DesInventar, INFORM, Disaster-reports and various other online sources.

All the information was first compiled in a folder and they were processed and analyzed through review. Then relevant information was presented in written form accompanied by figures. Compiled information was processed in Microsoft word and Excel and analyzed in table and figures.

4. DISASTER HISTORY AND IMPACT

Nepal has a complicated geo-physical structure which is prone to various kinds of disasters (soil erosion, debris flow, glacier lake outburst flood, bank erosion, concentrated monsoon rains, earthquakes, forest fires, epidemics, avalanches and snowstorms) including flood in lower plain regions and landslides in hilly and mountain regions.³ Nepal ranks most disaster-prone country in the world and has experienced several natural calamity causing high property and human losses. It has got seasonal disasters. Flooding and landslides usually takes place in rainy season that has higher effect on loss of property, structures and lives of people. Similarly, Nepal is prone to fire

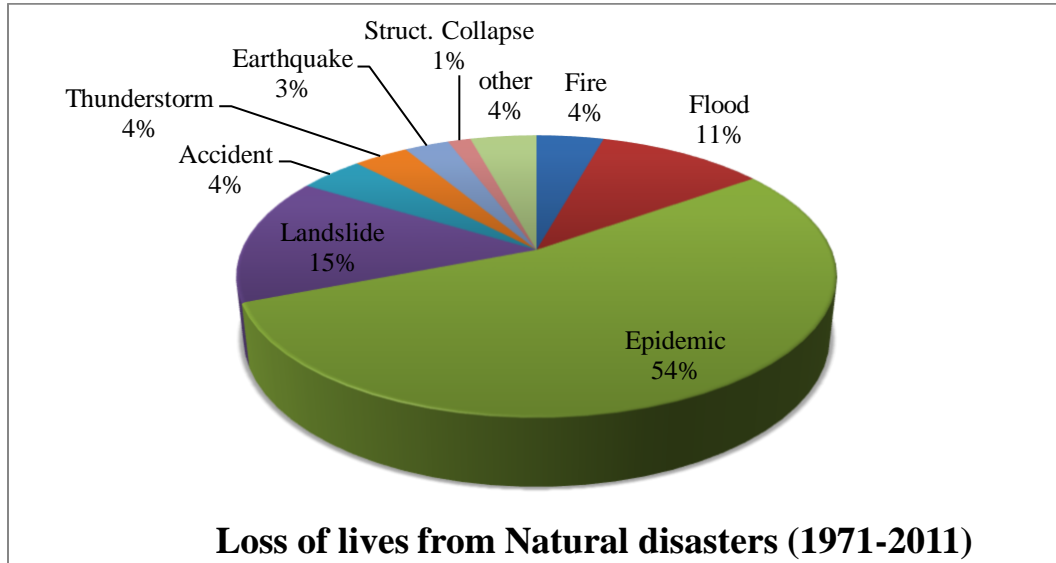
and wild fires during dry seasons. In the other hand, avalanches and snowstorms takes place in hilly regions causing physical damage and human losses. Besides, epidemics and pollution are some events that have been affecting the country. Every year noticeable loss in GDP is encountered by natural disasters in the country.⁶

In Nepal, there are more than 6000 high velocity rivers and streams that flow from North to South being higher Himalayan range the main source for most of them. The main reason for flooding and landslide in Nepal are adverse geo-climatic conditions and cloudburst. Further, unplanned building of houses and construction of physical structures without due consideration to the natural hazards are significantly aggravating the environment in mountain regions. Floods and landslides cause considerable loss of lives, crops, lands and infrastructure every year. In July, 1993 Nepal experienced a devastating flood in the Terai region which took the lives of 1336 people and left 487,534 affected. In 1998, severe flood and landslide affected different parts of the country, largely the Terai and the mid Hill region. These disasters created loss of 273 human lives and 982 cattle and injured 80 people. Flood and landslide disaster in 1999 killed 193 people and affected 8,844 families. In 2008, Koshi flood affected about 200,000 people in the eastern region of Nepal. The landslide and flood occurred in different parts of Nepal resulted in death of 114 and 127 in August and July, 2011, respectively. Similarly in 2012, May-June, heavy loss of lives and property were reported due to flood and landslide in Seti River. This caused death of 40 people and swept away 21 houses with 32 left missing. Nepal has experienced major flood in 1978 (Tinao basin), 1980 (Koshi River), 1985 (Tadi River Basin), 1987 (Sunkoshi Basin) and devastating cloud burst in 1993 in Kulekhani area which alone was responsible for killing 1336 people.⁷ The most common type of hazards found in the history are fires, floods, epidemic and landslide with their occurrence 29%, 19%, 17% and 16% respectively. Epidemics only account for 59% of deaths in the inventory, and landslides for 15 % and floods for 11 %. In addition, floods account for 37% of destroyed housing and fire for a 32% and earthquake 18%.⁸

On August 1, 1968 Nepal experienced a huge landslide that blocked Budhi Gandaki River at Labu Besi in central Nepal. The landslide created a lake of 60m deep with a result of 29 hours of its blockage. When the river suddenly passed through the heavy deposit, flash flood and debris flow washed away many people and properties downstream. Similarly, on September 20, 1988 landslide in Darbang dammed the Myagdi Khola (River) and caused many properties loss after it was

breached. Same incident had happened in the same place around 62 years ago which killed around 500 people.³⁹

Figure 1: Loss of lives from natural disasters



Source: *DesInventar*

The pie chart illustrates that the epidemic is responsible for most of the deaths among all the natural disasters followed by landslide and flood. Total deaths of 3320 and 4478 were caused due to flood and landslide respectively. According to historical data, Epidemics account for 54% of deaths in the inventory, and landslides for 15 % and floods for 11 %. In addition, floods account for 37% of destroyed housing and fire for a 32% and earthquake 18%.⁸

5. FLOODS

Floods are usually defined as significant rise of water level in a stream, lake, reservoir, or coastal region (Preventionweb). Rivers are the main source of floods during rainy season in Nepal. Floods in Nepal is considered as main, frequent and wide spread natural hazard that is responsible of causing massive loss of lives and damaging properties every year. Major rivers in Nepal, namely, Koshi, Narayani, Karnali, and Mahakali are the snow fed rivers. They have thousands of tributaries in the small form of rivers flowing north to south. There are more than 6000 rivers and streams that are ultimate source of major rivers formed in Himalayas. All the rivers flow from Himalayas

to lower plain- Terai region. Monsoon season usually takes place between June-September. During this Season Rivers become more vulnerable causing damages to villages, crops lands, people and livestock that are within the river basins.⁷

5.1 Flood and Landslide Causative Factors in Nepal:

According to ICIMOD report, there are five major factors that are responsible for flood in Nepal [12]

- i) Continuous rainfall and cloudburst,
- ii) Glacial lake outburst floods (GLOFs)
- iii) Landslide dam outburst floods (LDOFs),
- iv) Infrastructural failure and
- v) Sheet flooding

i) Continuous rainfall and cloudburst

During the monsoon season floods are more common when the land is saturated and surface runoff increases. High intensity precipitation or cloudburst in this season causes landslides, debris flow and floods. During the year 1948 – 1955, there was an extreme precipitation that caused landslides and debris flow, which simultaneously increased the water level in the river causing flood towards downstream. High intensity precipitation, landslides and debris flow has caused destructive floods in the history of Nepal. Such occurred in Lele (Lalitpur district) on September 30, 1981; in Kulekhani-Sindhuli area on July 19-20, 1993; and in Syangja district on August 27, 1998. In the 1993 event, the loss of life and property was not confined to the mountain areas where high-intensity precipitation had taken place; hundreds of people were also swept away in downstream areas as far away as Rautahat and Sarlahi districts in the Terai. According to some researches ¹⁴, ¹⁵, the extremely non-uniform rainfall pattern is considered one of the major triggering agents of landslide-related disasters in Nepal.

ii) Glacial lake outburst floods (GLOFs)

There are altogether 3,252 glacial lakes in Nepal. Glacial Lakes are present in high areas formed by the melting of snow. In Nepal, altogether 24 GLOF events have been recorded from the past. Of these, 14 are assumed to had happened in Nepal itself while 10 were the result of floods passing

across the China border.¹³ A GLOF in 1981 damaged a hydropower plant and many houses along the Sunkoshi River and a similar event in 1985 swept away three persons, one hydropower plant, 14 bridges, and 35 houses along the Dudhkoshi River. Nearly 26 glacial lakes are found to be potentially dangerous and much of the infrastructure alongside the rivers that gets generated from these lakes is at immediate risk.¹² Similarly, various erosion and sedimentation disasters have been induced by glacial lake outburst floods (GLOFs) occurring along various segments of rivers in the Nepal. The landslide produced by GLOF in 1985 washed away many houses, bridges and hydropower station.¹⁶

iii) Landslide dam outburst floods (LDOFs)

Steep and rugged mountain topographies over tectonically folded and faulted rock masses, especially near the thrust faults are the primary reason for roadside slope collapses and landslides in the Nepal Himalaya.¹⁴ LDOFs takes place after landslide blocks the river forming a lake, then bursts in the form of flood. In Nepal, between the year 1967 and 1989, eleven devastated LDOFs were recorded. Budhigandaki River near Lukubesi in 1968, Sunkoshi River near Barhabise in 1982, Balephi Khola in Sindhupalchok in 1982, and Gyangphedi Khola in Nuwakot in 1986 were dammed by landslides and resultant outburst floods that took away many lives of people and destroyed houses and infrastructures.

iv) Infrastructural failure

Floods caused due to weak infrastructure are common in Nepal. Flood due to Failure of checkdams and embankments had been responsible for loss of lives and property. Such event in 1981 killed 41 people, 120 houses, and one bridge were swept away in Butwal. Flood triggered by failure of a checkdam on the Rapti River in Chitwan (1990) took away 26 people lives and 880 houses. In 1993, tree logs at the Bagmati barrage dammed the river that took away 816 people after the dam burst out. Similarly, Larcha River towards the China boarder was dammed by a boulder at the bridge over the highway in 1996 and an outburst flood swept away 54 persons and 22 houses were damaged.

v) Sheet flooding

During the monsoon season sheet flooding are common in lower plain region of the country. Such event is caused due to increasing development of infrastructure like roads, checkdams etc. unilateral construction of roads perpendicular to natural flow without sufficient drainage and construction of barrages, dams, afflux bunds, and dykes on the rivers near the border area between India and Nepal have also exacerbated flooding in Nepal. More than 10 events of sheet flooding have been recorded near the border area.

5.2 Case Study: Mahakali flood in Darchula District

Mahakali River is basically a trans-boundary River which forms boundary between Nepal and India at major stretches. Both Government of Nepal and India had signed a treaty mentioning integrated development of the river with the main objective to define the compulsion and corresponding rights and duties of the parties in terms of water in the Mahakali River and its utilization.²⁵

Flash flood and landslides accompanied by massive rainfall from 16 June 2013 heavily affected the Far Western Region (FWR). The flood affected a total of 6 districts (Darchula, Kanchanpur, Kailali, Baitadi, Accham and Dadeldhura) in the country with



Darchula being highly affected.³⁰ *Figure: District Headquarter being swept away by flood*

Khalanga in Darchula district that is situated near the Mahakali River was massively affected by unprecedented rainfall in basin area resulting in dangerous flood that swiped away entire settlements in Khalanga, the district headquarter. Such nature of flood with highest magnitude occurred in Darchula district after around 100 years.²⁶ The flood started after midnight of 17 June and people started to evacuate nearby places. There was mud flow in the river which devastated settlements in different places of Darchula.²⁵ Due to the flood generated by the rainfall, heavy loss of land and property in Darchula and Kanchanpur districts occurred by Mahakali river. An estimated 4,400 people were affected by the flood as a whole and displacing 2,500 only in Darchula. People were displaced to nearby school and their relative houses. The

flood killed total of 9 people³⁰. During the initial stage of flooding, it swept away a total of 77 houses that included 64 residential and 13 government office buildings including district hospital and district education office in Khalanga. The swollen river also swept away concrete houses of the Dalit settlement, culturally represented as “outcastes” communities.^{26,27} 158 homes were swept away and more than 200 families were displaced due to floods in June, 2013.²⁸ The flood damaged the bridge that at Joljibi and threatening risk to bridge that joins Nepal and India. The landslide, that took place due to flood disrupted transportation along the Prithvi Highway.²⁶ A powerhouse of Kalagada Micro Hydro Project at Bramhadev VDC was also washed away that resulted in power cut in the whole district.²⁹ Two suspension bridges were taken away by the river that joined Darchula with India.³⁰

In Kanchanpur, the flood affected 950 people from 115 households. Dodhara-Chandani Village Development Committee (VDC) and Bramhadev area of Mahendranagar Municipality were highly affected with 150 displaced people who stayed in school. In Kailali, 75 households were affected with 750 affected people. The most affected VDCs were Thapapur, Lalbojhi, Bhajani, Narayanpur and Dhansingpur and Tikapur municipality. Similarly, 5 people from same family were killed by landslide caused due to flood in Baitadi. In Accham, Kuntibandali ward no. 3, Laungra ward no.7 and Mangalsen ward no. 6 were highly affected. In Dadeldhura, most affected villages were Sarkuna, Tatapani, Parigaun and Sirsha with around 52 total displaced households.

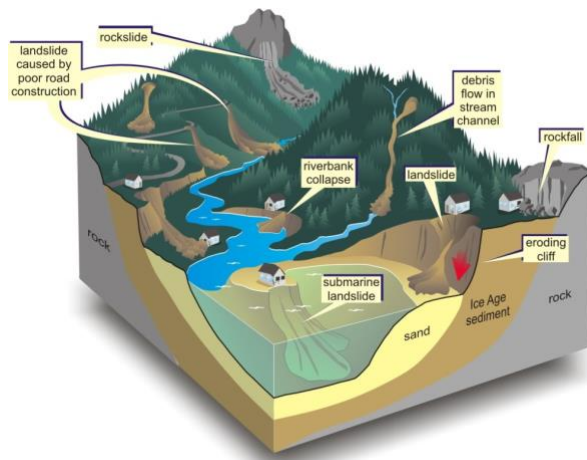
After the flood, the situation of people was very worst mainly in highly affected area. The natural disaster response committee in district urged the government to instantly release Rs 5 million to provide relief to the displaced. People living in the bank of river were asked to get evacuated.²⁷ Three Rapid Response Team (RRT) were deployed by District Disaster Relief Committee (DDRC) to identify the number of affected/displaced people and types and amount of relief materials required. Security forces along with Nepal Redcross Society (NRCS) carried out rescue tasks for the affected helping them to find safe places. Basic materials like foods and clothes were also distributed to the displaced and affected.³⁰

6. LANDSLIDES

A landslide is a descending mobility of rock and soil debris that has become separated from the underlying slope. The material can move by sliding, toppling, falling, spreading and flowing. After

flood, landslide is considered as most common natural hazard that is responsible for causing loss of lives, houses, livestock and properties mainly in the hilly regions of the country. Landslide is caused by both natural and man-made factors including fragile geology, steep slopes, high intensity of rainfall, unplanned human settlements, deforestation, etc. The risk of landslide is further exacerbated by anthropogenic actions like improper land use, encroachment into fragile land slopes and unplanned development of infrastructures such as building of roads and irrigation canals without appropriate protection procedures in the vulnerable mountain belt. The hills and mountains have steep topography and fragile ecosystem that are more susceptible to landslide. The hilly districts of Nepal located in the Siwalik, Mahabharat range, Mid-land, and also fore and higher Himalayas are more susceptible to landslides.⁷ Landslides in the Nepal Himalaya differs in size, from whole mountain collapse to very minor slope sliding. However, in most of the times, only the issues of small-scale landslides, rain-induced and roadside slope collapses are found to be addressed.¹⁴

Figure 2: 3D illustration of different types of landslides



Source: USGS

6.1 Causes that contribute to landslide in Nepal: ¹⁷

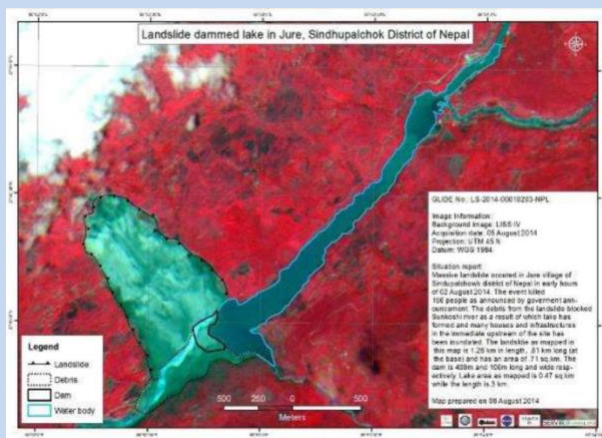
The causes of landslide in Nepal can be categorized into four factors:

- i) Geological causes: The geographical causes for landslides are weak, weathered, sheared materials, and contrast in permeability of materials used.
- ii) Morphological causes: Fluvial, tectonic uplift, erosion of slope toe, erosion of marginal sides are the morphological causes for landslides.

- iii) physical causes: Physical cause include intense rainfall, prolonged or exceptional precipitation, earthquake, and snowmelt
- iv) Human causes: Man-made causes for getting landslides are: deforestation, irrigation, mining, road construction, water leakage, land use changes etc.

6.2 Case Study: Sunkoshi Landslide, Jure Village of Sindhupalchok District

Jure Village in Mangkha Village Development Committee of Sindhupalchowk district, situated around 70 kms (43.5 miles) northeast of Kathmandu was hit by the massive landslide on 2nd August, 2014 causing loss of more than 150 lives, loss of more than 115 households and 436 displaced people. The incident took place in crowded area between 2-2:30 am local time while the whole village was asleep.^{31, 32}



Map 4: Landslide geographical view (left) and house damaged by landslide (right)
Photo Source: Disaster-report

Heavy rainfall caused collapse of the big mountain that blocked the Sunkoshi River, one of the main tributaries of Koshi River forming a dam and a lake of 3km in length, 130m deep and

0.47km² in area. According to the Department of Water Induced Disaster Prevention (DWIDP), the estimated volume of the lake water is 8 million m³. The landslide itself measured was 0.81km width at the bottom and 1.26km in length covering the area of 0.71km². The landslide disrupted 2kms of Araniko Highway, only road that connects Nepal to China boarder. Infrastructures that were damaged by landslide and artificial lake were hydropower plant, Transmission line, Poultry farm, High school, Resort, Community building, school bus, vehicles, shops and cement block factory. The blockage of highway created disruption to tourism and trade with neighboring country. Similarly, the shutting down of hydropower plants created no supply of electricity power to the incident area also contributing to the country's scheduled power cuts.^{31, 32} The incident created threat to deliver of regular basic needs, and has also put risk to the lives of sick, injured and people needing special medical attention including pregnant women, children and elderly from the highly affected area. The blockage of main highway was not only limited to loss in tourism area but also disturbed the major trade link between Nepal and China that stands at nearly at NPR 38 million (around USD 400,000) every day.³⁵ According to DpNet Nepal³³, the following direct loss has been calculated: Secondary School building (Rs. 10 million), Primary Schools at Dawi and Jure (Rs. 2 million), Bridge and Road at Jure (Rs. 40 million), Math and Temple (Rs. 2 million), Paddy field (Rs. 15 million), Small shops (12.5 million), Fish Pond (1.5 million), Poultry firm (2.4 million), and vehicles (45 million). A total of Rs. 130.4 Million physical property damage was observed. Beyond this direct loss of lives and infrastructure, it is thrilling to know the impact and economic loss due to blockage of road, disturbance on livelihood, economic activities on downstream and disturbances in electricity power supply³³. Large volume of accumulated water in the dam again shaped a threat to downstream communities, districts of Nepal and also a Bihar state of India creating a risk of flash flood.^{33, 34}

Government of Nepal evacuated the communities downstream declaring the high risk areas as crisis zone. Government asked local administration, rescue team and humanitarian assistants to be alert for evacuation, relocation, rescue and other emergencies. Almost 700 army personnel were deployed in the incident area, who found ways out to flow accumulated water from the dam. Families of Kuleshwor, Jhagajholi, Khurkot, Gwaltar and dozens of VDCs including communities in 11 downstream districts were evacuated. The Government also coordinated with

various national level organizations as well as with the neighboring countries in seeking help to minimize the risk.³⁴ Technical support in managing the risk was obtained from Government of India and China for the Sunkoshi event.³⁵

7. RESULTS

Table 1: People affected and damage caused by disasters in Nepal (1934-2014)

Events	Occurrence	Deaths	Affected	Injured	Homeless	Total Affected	Total damage ('000\$)
Drought	6	0	4903000	0	0	4903000	10000
Earthquake	6	9936	688090	6860	35000	729950	306000
Epidemic	20	4568	174797	0	0	174797	N/A
Extreme tem.	7	217	25000	210	0	25210	123
Floods	41	6450	3507727	1209	89239	3598175	1038242
Mass movement	21	1797	362294	124	80200	442618	N/A
Storm	6	97	165	19	0	184	3600
Wildfire	2	88	0	0	54000	54000	6200
Total	109	23153	9661073	8422	258439	9927934	1364165

Source: EM-DAT

The table illustrates total events of disasters, as well as deaths, affected and damaged caused due to different types of disasters that took place in last 80 years in Nepal. Various kinds of disaster including droughts, earthquake, epidemics, extreme temperature, floods, landslides, storms and wildfire are highly responsible for large number of affected people and creating huge economic loss in Nepal.

Table 2: Losses from water induced disasters (1983-2013)

Year	People		Livestock Loss	Houses Destroyed	Affected Family	Land Affected	Economic Loss (Nrs) Million
	Dead	Injured					
1983-2013	8343	2031	86770	228561	668246	121386	22872
Average/Year	278	67	2892	7618	22274	4046	762

Source: Ministry of Home Affairs (DWIDP)

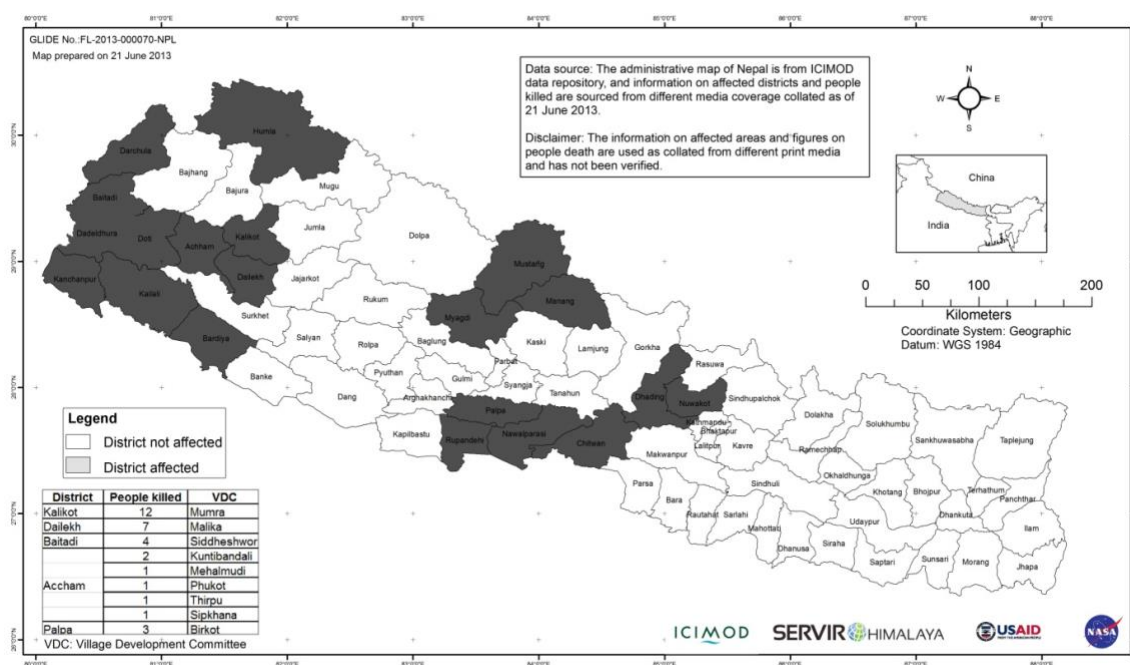
Table shows the summary of the water induced disasters by floods, landslides and avalanches in Nepal from 1983 to 2012/13. Thirty years of data review shows that water-induced disasters kills 278 people, 67 houses damaged, 2892 family affected, 7618 land affected and Rs. 762 (approx. USD 7855670) million losses every year. Total estimated loss till 2013 was Rs. 22872 (approx. USD 235793814) million.

Table 3: Top 10 districts with floods and landslides events in 2012/13

Rank	Floods				Landslides			
	Districts	Regions	Events	Rank Factor	Districts	Regions	Events	Rank Factor
1	Kaski	WR	6	1	Nuwakot	CR	35	1
2	Dang	MWR	5	0.9	Illam	ER	7	0.9
3	Banke	MWR	4	0.8	Humla	MWR	6	0.8
4	Humla	MWR	4	0.7	Sankhuwasabha	ER	6	0.7
5	Illam	ER	4	0.6	Taplejung	ER	6	0.6
6	Sankhuwasabha	ER	3	0.5	Myagdi	WR	5	0.5
7	Kailali	FWR	2	0.4	Jajarkot	MWR	3	0.4
8	Kathmandu	CR	2	0.3	Surkhet	MWR	3	0.3
9	Nawalparasi	WR	2	0.2	Dhading	CR	2	0.2
10	Parbat	WR	2	0.1	Gorkha	WR	2	0.1

Source: Ministry of Home Affairs (DWIDP)

Map 5: Flood and landslide affected districts in Nepal

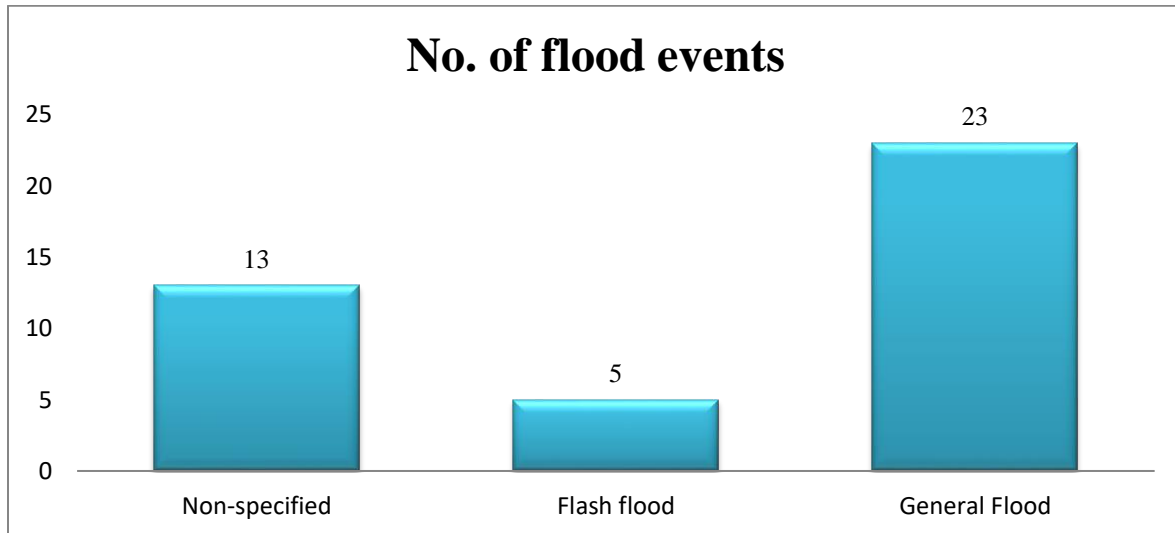


Source: ICIMOD

Top ten districts that are prone to floods and landslides (2012/13) are shown in the table. Kailali district in Western Region of Nepal being more prone to floods with rank factor 1. Likewise,

Nuwakot in Central Region is ranked as number 1 landslide prone district. The Parameter Repetition Factor (PRF) is calculated, which is the number of repetitions of the disaster affected districts by floods as well as landslides that is occurring under various parameters in the Table.

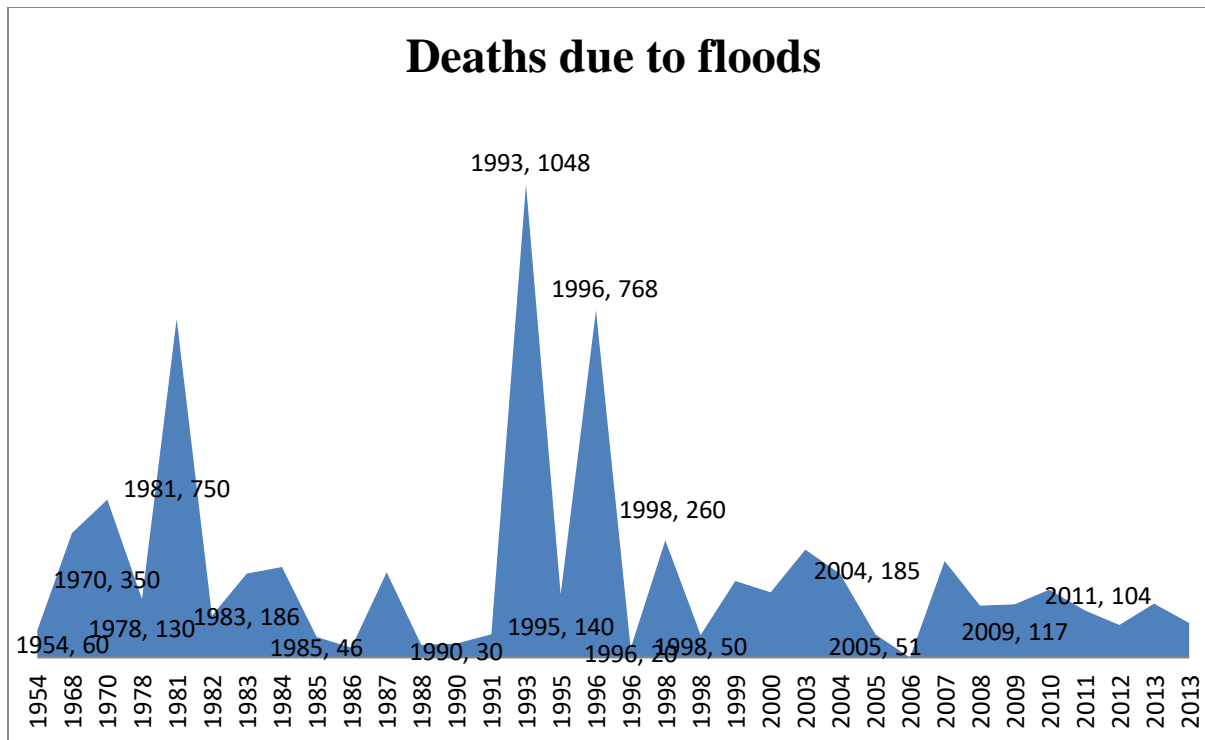
Figure 3: Number of flood events by types (1954-2014)



Source: EM-DAT

Three different types of floods were responsible in causing loss of lives and property. 23 general floods, 5 flash floods and 13 other types of floods were recorded being vulnerable.

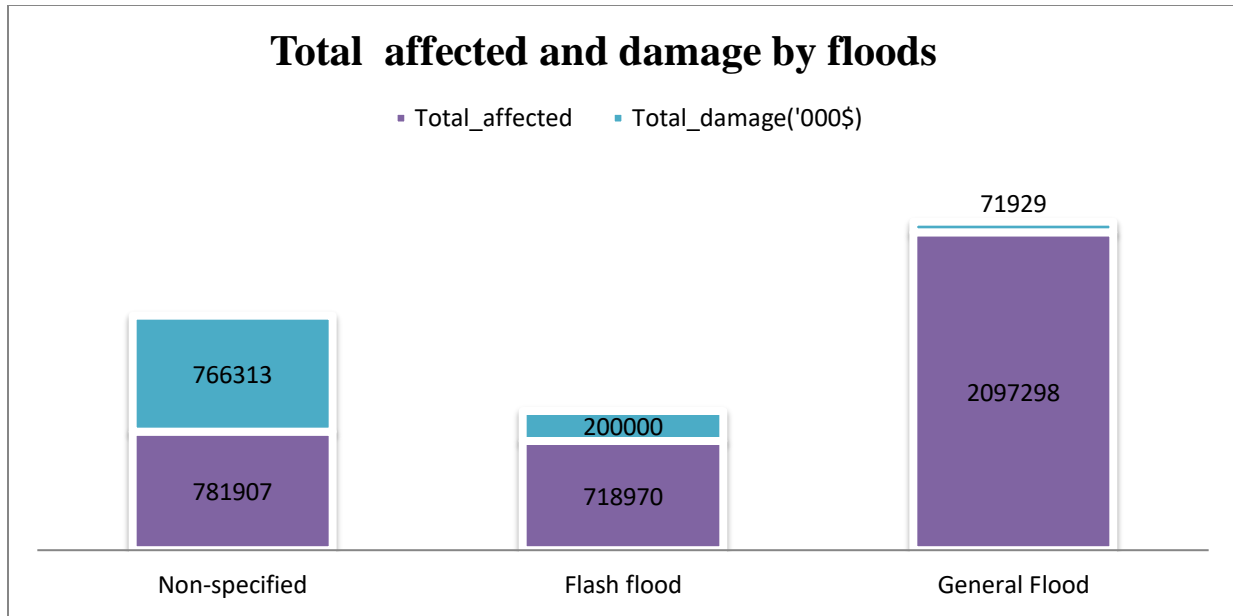
Figure 4: Deaths due to all types of floods (1954-2014)



Source: EM-DAT

Loss of lives due to flood was seen highest in 1993 with the total death of 1048 i.e. 16.24% of total deaths that took place from 1954-2014. Total number of deaths due to the event was 6450. The peaks of death are also seen higher in the year 1996 followed by 1981 that are 768 and 750 respectively. Higher concentration of deaths is seen in lower region of the country.

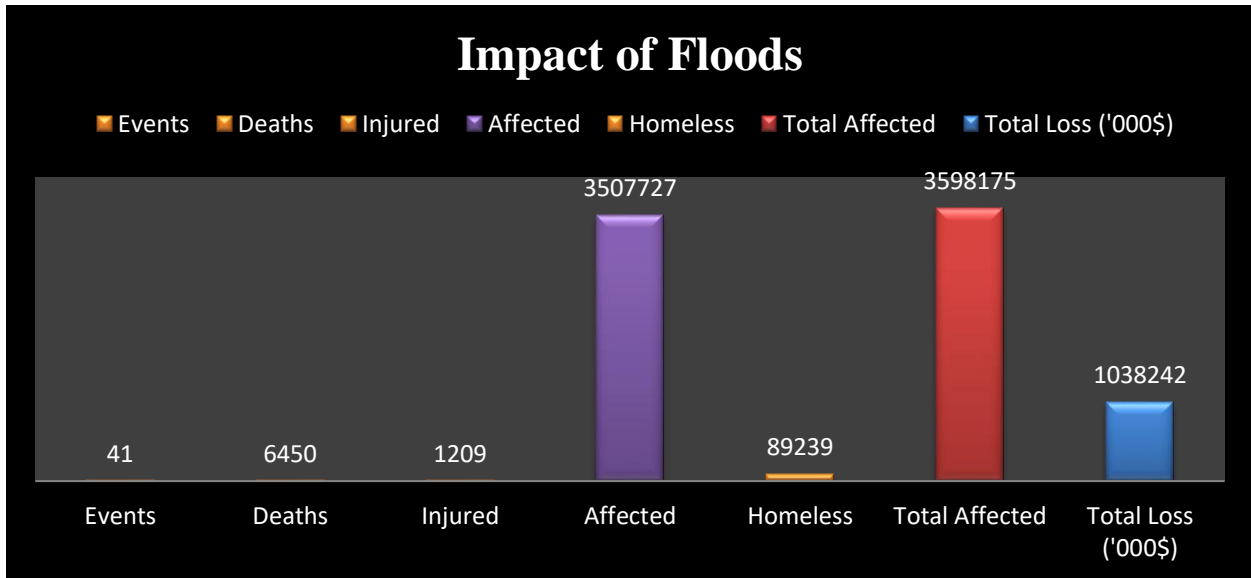
Figure 5: Total number of affected people and damaged by types of floods (1954-2014)



Source: EM-DAT

Multiple bar diagram shows the total affected people and total damage caused due to different types of floods. The other types of flood alone damaged infrastructure total of 58.3% and general flood alone is seen affecting 73.8% of infrastructure.

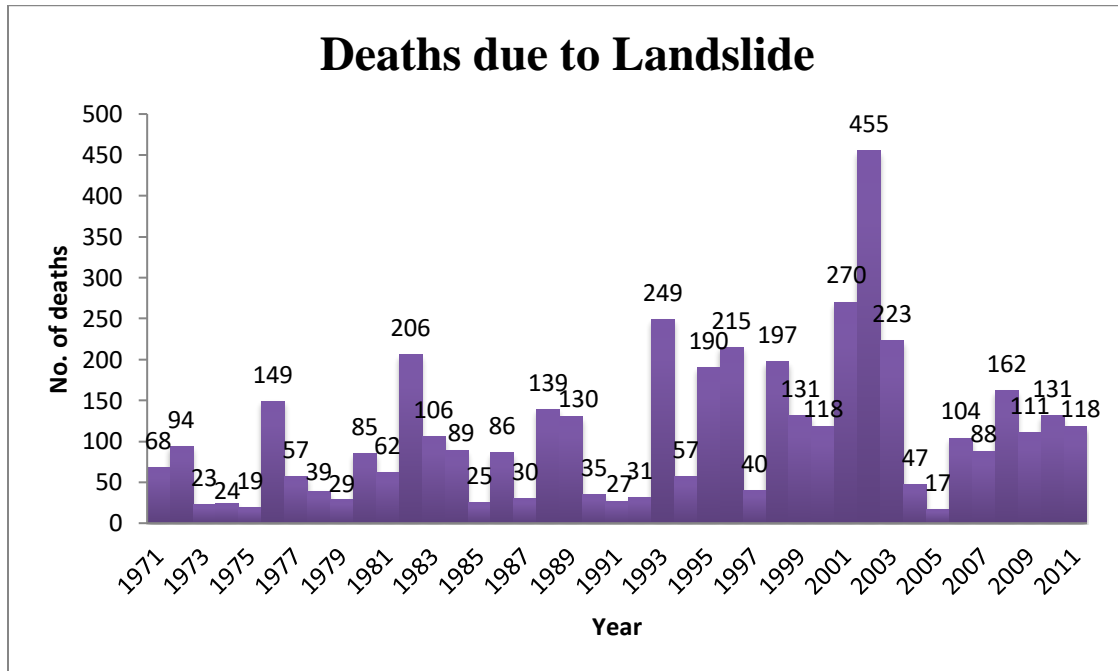
Figure 6: Impact of all types of flood (1954-2014)



Source: EM-DAT

Above figure illustrates the total affected and total economic loss encountered due to flood in 60 years. Significant number of affected and economic loss due to floods can be seen. Total numbers of people affected were 3598175, while more than 1 million USD economic losses were caused by flood alone.

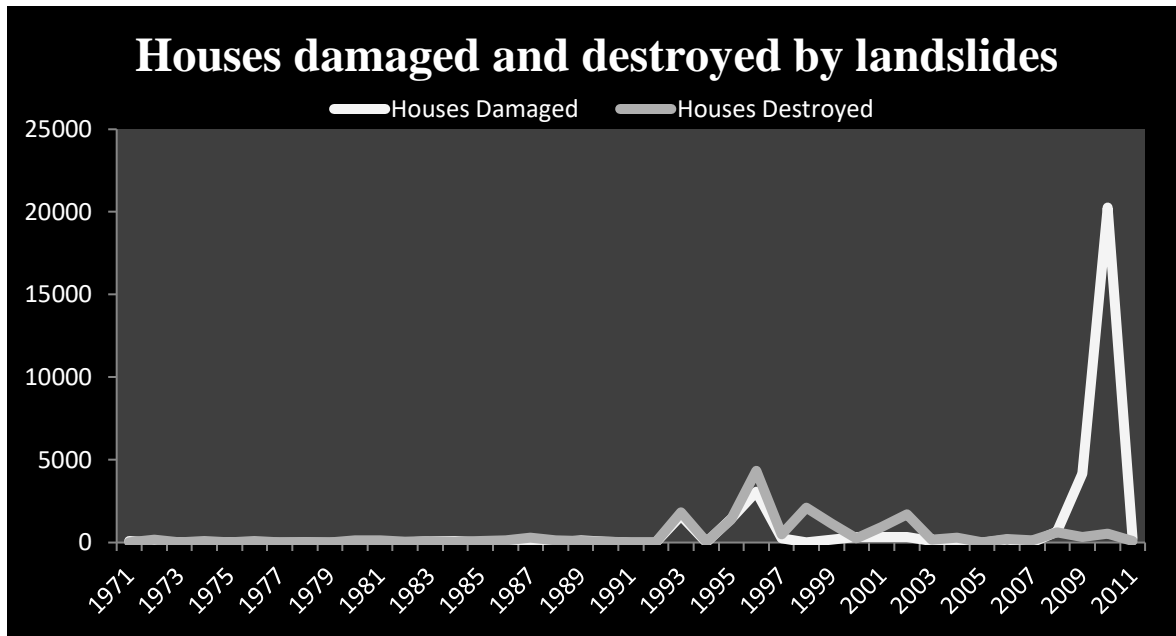
Figure 7: Number of deaths caused due to landslide (1971-2011)



Source: DesInventar

In 2002, higher number of deaths (15.65%) due to landslide were recorded followed by deaths in year 2001 (9.28%), 1993 (8.5%) and 2003 (7.7%). Total deaths recorded were 4476.

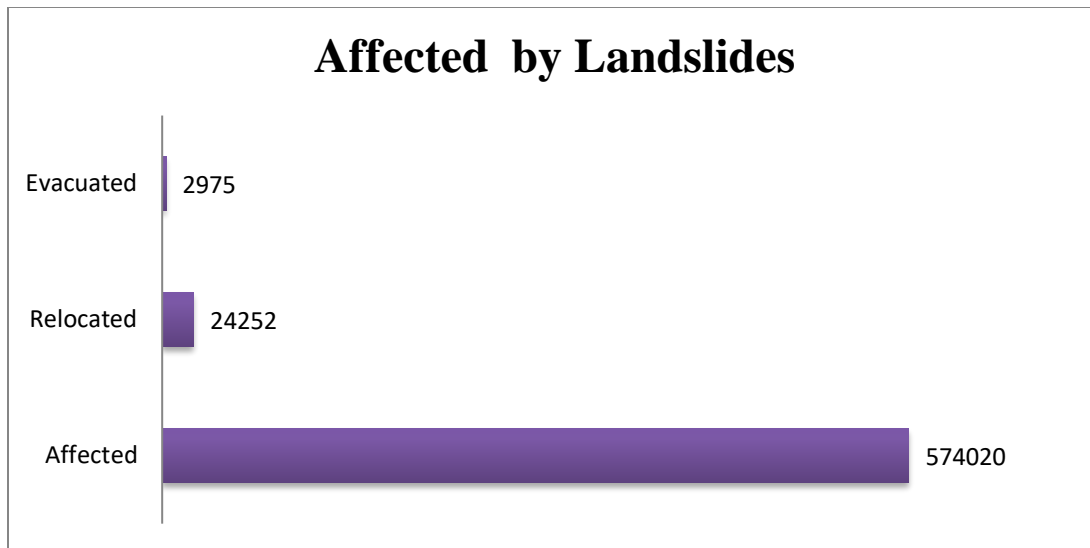
Figure 8: Number of houses damaged and destroyed by landslides (1971-2011)



Source: DesInventar

Above line graph shows the frequency of houses destroyed and damaged by landslides in last 40 years. The highest peak of houses damaged is seen in 2010, which covers 59.67%. Similarly, total destroyed houses were 18491, out of which 4339 (23.46%) were seen in the year 1996. In 1993, 1995, 1996, 1998, 1999 and 2002 more than 1000 houses were destroyed (N= 18491). Similarly, in 1993, 1995, 1996, 2009 and 2010 more than 1000 houses were damaged (N= 33960).

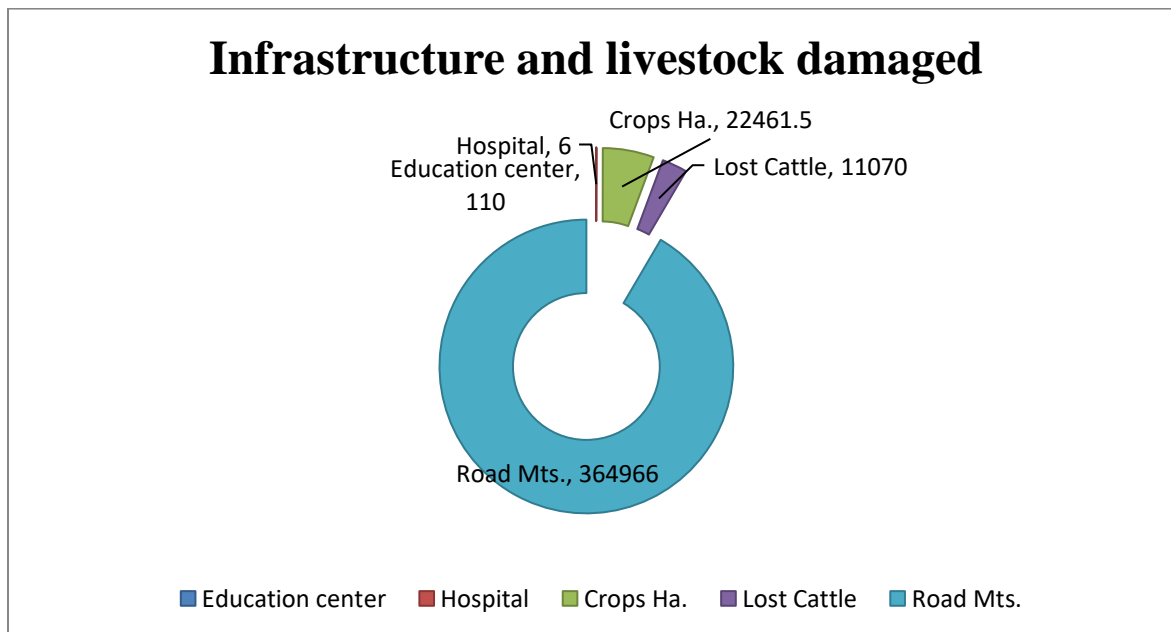
Figure 9: People affected, relocated and evacuated by landslide (1971-2011)



Source: *DesInventar*

The bar graph shows the total number of evacuated, relocated and affected populations due to landslide in last 40 years. However, the events are responsible for highly affected people followed by relocated and evacuated.

Figure 10: Infrastructures and livestock affected by landslides (1971-2011)



Source: *DesInventar*

The landslides (1971-2011) have damaged significant number of infrastructures and livestock. Total of 364966 meters roads, 22461.5 yields (ha.) of crops, 11070 numbers of cattle, 110 education center and 6 hospitals were damaged.

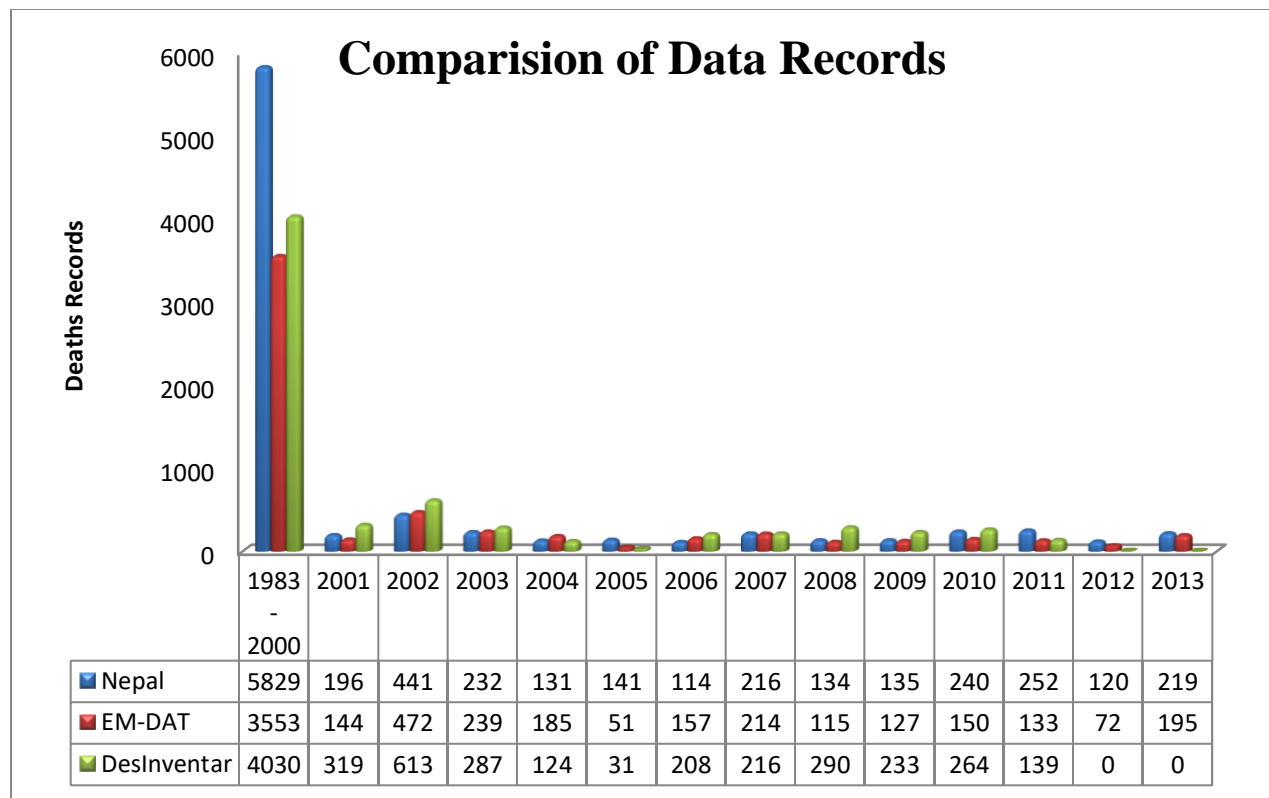
Table 4: Index of Risk Management for Nepal⁴⁶

	Value	Rank	Trend (3 Years)
INFORM Risk	5.2	28	Decreasing
Hazard & Exposure	5.5	35	Decreasing
Vulnerability	4.1	68	Decreasing
Lack of Coping Capacity	6.4	54	No Change

Source: INFORM

INFORM risk, Hazard & Exposure, vulnerability and Lack of Coping Capacity are 5.2, 5.5, 4.1 and 6.4 respectively, with 10 being the worst. There is a decreasing trend in INFORM risk, Hazard & Exposure and vulnerability but lack of coping capacity has remained as it is since last 3 years.

Figure 11: Comparison of International data records with National Data



Source: DWIDP-Nepal, EM-DAT, DesInventar

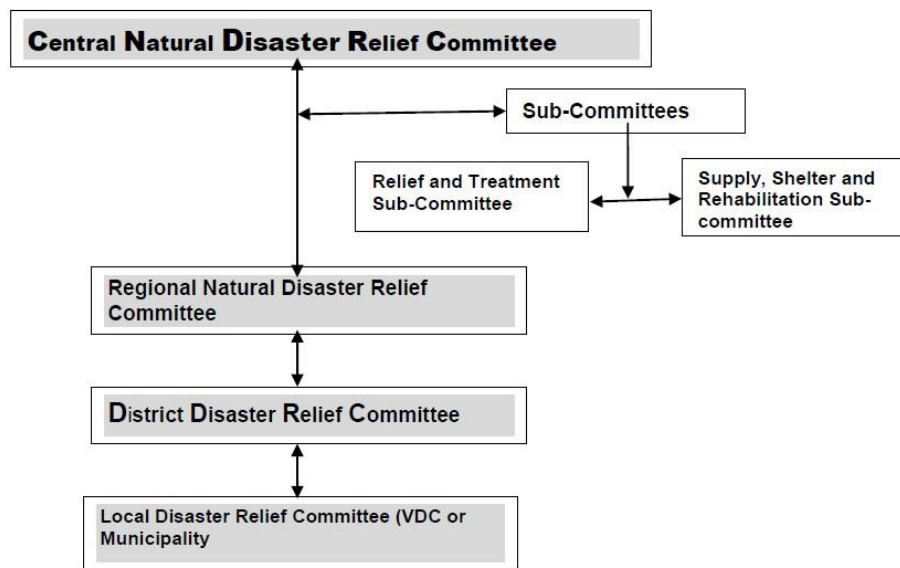
Comparison of deaths records by International databases and National database is shown in the above diagram. The recording of data fluctuation can be seen. Higher number of death records can be seen in National data (1983-2000), while lower records are seen in International databases. Similarly, higher record is seen in DesInventar than other sources (2008).

8. DISASTER RISK MANAGEMENT IN NEPAL

8.1 Policy measures and existing legal framework:

8.1.1 Natural Calamities (Relief) Act, 1982:

Natural Calamities (Relief) Act, 2039 was promulgated in 1982 in the history of Nepal with the extent of disaster management administrative structure in the country.²⁰ The main objective of this Act is to smoothly execute pre and post-disaster relief and rescue works by bringing the work of disaster management under the scope and responsibility of the government. However, the act missed the provision of proactive mitigation measures like preparedness, and mainstreaming of hazards reduction in development process.¹⁹ Later in 1988 after the Udaypur Earthquake, the Act underwent three modifications and included some elements of preparedness and mitigation. The Act primarily focused on provisions of immediate response and relief to the affected population by formulating standard norms and also creating institutions such as the Central Disaster Relief Committee (CDRC) and District Disaster Relief Committee.²¹ The institutional structure of CDRS looks as follows:



Source: MoHA, Nepal

8.1.2 Local Self Governance Act, 1999

The Local Self Governance Act, 1999 has promoted the concept of local-self governance within the decentralization framework for managing the environment-friendly development. The Act has given due emphasis to interrelationship between development process, environment, and disaster explicitly and inexplicitly. The Act encourages local entities, i.e., District Development Committees (DDCs), Municipalities, and Village Development Committees (VDCs) for finding solutions to problems by themselves. Although, the Act has made local entities responsible, as the situation stands, integrated execution of concepts introduced through the Act has stalled due to absence of necessary rules and budgetary allocation for the purpose.¹⁹

8.1.3 National Disaster Management Act 2007²³

In order to provide a legal basis for instituting a disaster management system in the country, National Disaster Management Act was drafted. The Act forms a national level council namely, Disaster Management Council (DMC) with three different committees for preparedness, rescue and relief, and rehabilitation and reconstruction. The DMC is chaired by the Prime Minister, vice-chaired by the Home Minister with participation of various relevant ministries and organizations to provide direction to disaster risk management in the country. The Act also defines the institutional structures of District Disaster Management Committee (DDMC) and Local Disaster Management Committee (LDMC) at regional and local level respectively for disaster response activities. It also clarifies the role of army, police, I/NGOs, private organizations, CBOs and general public.

Others related act and regulation formulated so far for disaster management are as follows: ²³

- Water Resources Act (1992)
- National Action Plan on Disaster Reduction (1996)
- Environmental Protection Act (1996)
- National Water Resource Strategy (2002)
- National Water Plan (2005)
- Three year Interim Plan (2008-2010)

8.1.4 Milestones in DRM in Nepal²³

Years	Initiatives/Activities
1982	Natural Calamity Relief Act (NCRA) promulgated- First legal initiative
1984	UNDP study about the threats of disaster and the need for foreign assistance conducted
1987	Disaster unit under the Ministry of Home Affairs (MoHA) established
1989	NCRA 1982 amended (first amendment)
1990	Strategy for training on disaster management prepared
1990	National committee to celebrate the decade of the 1990s as the decade of international
1991	Comprehensive disaster management plan prepared
1992	Second amendment of NCRA 1982 ratified
1993	Training of government officials in collaboration with UNDP organized
1993/94	Training on disaster management conducted by USAID and ADPC, Bangkok, organized as per request of MoHA
1994	Action plan prepared with the help of UNDP
1996	UNDP's disaster management capacity-building programme begun
2001	Department of Narcotics Control and Disaster Management under Ministry of Home Affairs (MoHA) established
2003	Disaster impact assessments of development projects made mandatory in the Tenth National Plan
2005	Participation in Hyogo Conference
2007	Drafts on acts, policies and strategies on disaster management in Nepal prepared
2008	National strategy for disaster risk management (NSDRM) prepared
2009	NSDRM approved by GoN

Source: GRIP

8.2 National strategy for disaster risk management 2009²²

The National strategy for disaster risk management is a written commitment of Government of Nepal to reduce the disaster risk as well as protection, growth, and promotion of national heritages and physical infrastructures. The NSDRM formulated in 2009, is based on Hyogo Framework for Action (HFA) 2005-2015. In this framework, five major priorities for implementation and related activities are defined along with the responsibilities of each sector line agency. The five priorities are as follows:

Priority Action 1: Put a vibrant institutional framework in place for its implementation by prioritizing disaster risk reduction at both the national and local levels;

Priority Action 2: Strengthen assessment, identification, monitoring, and early warning system on potential disaster;

Priority Action 3: Make use of knowledge, new ideas, and education for the development of safety and disaster resilient culture at all levels;

Priority Action 4: Minimize existing risk factors; and

Priority Action 5: Make disaster preparedness strong enough for effective response.

In order to meet these priority actions, strategic activities have been built to the extent possible by focusing on the challenging issues in context of Nepal. The following strategic activities are defined for the purpose:

8.2.1 Priority actions and strategic activities of HFA

Priority Actions	Strategic Activities
Priority Action 1	1: Establish and strengthen institutional system for DRM 2: Formulate/amend and enact policies and legislations for incorporation of extensive disaster risk management concepts 3: Mainstream DRR into national development 4: Integrate DRR and preparedness in development plans, programmes and regular activities of local development institutions for effective response to disasters. 5: Prepare and gradually implement various policies and protocols, standards, guidelines, Standard Operating Procedures (SOPs), and special national programmes for DRR 6: Establish a network of Emergency Operation Centers (EOCs) – one at the central level and additional other centers at district and municipality levels 7: Develop One-window mechanism for collection of resources, allocations, and sustainable financial resource management.
Priority Action 2:	8: Assess disaster vulnerabilities of different scales at different levels; develop a system of periodic updating; and disseminate such information publicly. 9: Establish and institutionalize authentic, and open GIS-based Disaster Information Management System (DIMS) at the central, district and municipal levels that encompass all disaster-related information 10: Establish a national system for hazard/risk monitoring and early warning to potential hazards 11: Prepare land-use mapping of urban and urban-oriented areas, update them periodically, and ensure institutional system for making use of such maps for land-use planning.
Priority Action 3	12: Amend/improvise National Education Policy, and strengthen its implementation aimed at making schools important centers for raising disaster awareness. 13: Make arrangement for imparting disaster education 14: Develop DRR training curricula for different target groups and conduct training programmes for all stakeholders 15: Develop and implement a comprehensive national programme for disaster related awareness raising and training. 16: Develop plans, programmes and facilitate the use of mass media for dissemination of information on disaster risk and risk reduction. 17: Develop/strengthen/encourage awareness raising programmes on DRM at the local level 18: Encourage and support NGOs, CBOs and other stakeholders for development and execution of awareness-raising programmes on disaster risk reduction and preparedness. 19: Integrate DRR concept into infrastructure development planning, and

Priority Action 4	execution processes 20: Assess, protect, and strengthen critical public services, life supporting structures, and physical infrastructures 21: Develop and implement, on a priority basis, special DRR programmes for the most vulnerable groups of the society, the marginalized and Dalit groups, women, handicapped, disadvantaged groups, children, and elderly people. 22: Incorporate DRR measures into post-disaster recovery and rehabilitation processes. 23: Develop and promote alternative and innovative financial instruments for addressing disaster risk reduction
Priority Action 5	24: Develop and execute National Integrated Disaster Response System (NIDRS). 25: Develop and implement Emergency Response and Preparedness Plan including gradually setting up Emergency Operation Centres (EOCs) throughout the country. 26: Establish and/or strengthen storage and pre-positioning capacities at strategic locations (centre, district, municipality and villages) for storing food, medicines, other relief supplies and rescue tools and equipment. 27: Establish a robust communication system that can be used during emergency situations as well as during preparedness phase 28: Establish an efficient transport and logistics management mechanism 29: Enhance emergency response capacities of communities at the VDC level. Besides, identify volunteers for the purpose and mobilize schools and communities for imparting them necessary training

Long-term Vision

Long-term vision of this strategy is to establish Nepal as a Disaster-resilient community

Long-term Mission

Long-term Mission of the Strategy is to provide guidance and ensure effective management of development initiatives and implementation of the concept of effective preparedness on mitigation and disaster risks reduction, and incidence of calamities.

Based on the above five priorities, Sector-wide, institution-wide, and phase-wise arrangements are made for DRR. Following are the agreed principles for implementation arrangements made in the process:¹⁹

- Garner active and collective participation of vulnerable people and communities;
- Empower communities through awareness raising activities with full knowledge of risk potentials, and firm belief and commitment towards necessary measures;
- Promote necessary knowledge, skill, and processes for risk reduction;

- Maintain sustainability through community and institutional capacity development for targeting factors of disaster; and
- Make appropriate legal, policy, and institutional arrangement for disaster preparedness, mitigation, and reduction and recovery.

8.2.2 Authorities responsible for implementation of disaster prevention and response¹⁹

8.2.2.1 Major implementation strategies adopted by policy and decision making authorities:

Authorities	Responsibilities
Office of the Prime Minister and Council of Ministers	-Directing, coordinating, and facilitating the preparation of national policy and strategy for reduction of natural and non-natural disasters -Facilitation of the rescue, relief, reconstruction, and rehabilitation works by operating the Prime Minister's Relief Fund
National Planning Commission (NPC)	- Formulations of long-term, periodic, and annual disaster management plans -Compilation of disaster resources from bilateral, multilateral and international sources for reconstruction of disaster damaged infrastructures and rehabilitation of the affected - Preparing projects, their execution, and monitoring and evaluation at the policy level.
Water and Energy Commission (WECS)	- conducting studies on rivers and streams for the development of water resources in the country through its rational utilization. - controlling water induced disaster by bringing out a long-term water resource policy.
Central Disaster Relief Committee (CDRC)	-Arrangement and coordination for pre-monsoon preparation and other disasters possible at any time as provisioned in the Natural Calamities (Relief) Act, 1982.
Ministry of Home Affairs	- Rescue and relief measures through the arrangements of Disaster Relief Committees at central, regional, and district levels. - Conducting national and international meetings and conferences on the disasters issues. - Drafting the Bill and regulations on Disaster Management, and their execution
Ministry of Irrigation (MoI)	- Formulating and execution of the policy on water induced disasters control, and floods and river training.
Ministry of Forests and Soil Conservation (MoFSC)	- Mitigation of natural disasters like floods and landslides through formulation of policies on National Forestry Policy, and Soil Conservation - Hazards control through Environmental Impact Assessment (EIA) of development projects.
Ministry of Environment (MoEn)	- Disseminating information on potential GLOF based on disaster risk analysis upon conducting scientific studies and research on glaciers and glacial lakes. - Mitigation of natural disaster through seasonal estimation about rainfall and drought by using weather forecast techniques. -Installations of flood forecasting centers for early warning systems.

Ministry of Science and Technology (MoST)	- Development of geographical, social and environment friendly science and technology as per the necessity of the country.
Ministry of Health and Population (MoHP)	- Training to health personnel as preparedness on disaster, and makes arrangement of medicines, equipment, and treatment to the people hurt and wounded in the post-disaster the rescue operation. - Diagnosis of epidemics and applies as necessary the preventive and curative measures
Ministry of Local Development (MoLD)	- Raising public awareness on disaster through local entities, and mobilization of such entities in emergency rescue operations in the disaster situation
Ministry of Physical Planning and Works (MoPPW)	- Conducting hazard risk analysis prior to implementation of any development project - Circulate and implement the seismic resistant buildings construction guidelines
Ministry of Industries (MoI)	- Conducting Geo-hazards Mapping Study in view of the fragile geo-surface of the country; conducting study, and preparing seismic zone maps
Ministry of Education (MoE)	- Development of curriculum providing knowledge and information on disaster, mitigation preparedness, rescue and relief and their application - Carrying out construction of earthquake resistant school buildings, and raising awareness programs through teachers and students.
Ministry of Agriculture and Cooperatives (MoAC)	- Policy preparation and implementation so that agricultural production does not decline due to high or inadequate rainfall, and onset of drought
The Ministry of Energy	- managing the disaster risk by bringing together mechanisms, conducting dialogues, and entering into international bilateral and multilateral treaties and agreements.
Regional Natural Calamities Relief Committee (RNCRC)	- Carrying out rescue and relief operations and coordination throughout the country with the help of Regional Natural Disaster Committee

Source: MoHA, 2009

8.2.2.2 Major implementation strategies adopted by departments:

Departments	Responsibilities
Department of Hydrology and Meteorology	- Collection and dissemination of information related to hydrology and meteorology, and monitoring, analysis and forecasting of weather.
Department of Water Induced Disaster Prevention (DWIDP)	- Effective prevention measures against water induced disasters - Conducting studies and research on floods, landslides, and earthquake.
Department of Mines and Geology	- geological research; collection and dissemination of geo-science related information; taking geological calamities mitigation measures; operation of seismic measurement stations; collection of earthquake data; and preparation of geo-hazard mapping.
Department of Health Services	- controlling epidemics; providing health services in emergencies; and providing first aid medical services in the event of disasters.
Department of Local Infrastructure and	- facilitating implementation of infrastructure development program by avoiding environmental degradation as the local level.

Agricultural Roads (DoLIDAR)	
Department of Soil Conservation and Watershed Management	- maintaining ecological balance, and checking soil erosion through conservation and development of important watersheds.
Department of Urban Development and Building Construction	- Sustainable urban development, organized settlements, and safe building Construction
District Natural Disaster Rescue Committees	-Rescue, relief, rehabilitation ,(drinking) water supply, health, and education at local level
DDCs, Municipalities and VDCs	- Mainstreaming disasters risk reduction, management of district level periodic plans and information on disasters - First Responder to disasters

Source: MoHA, 2009

8.2.2.3 National Non-government Organizations (NGOs)

Non-government Organizations in Nepal are doing appreciative work in national disaster risk management task. They usually play a vital role in mitigation, reduction, preparedness, and countering disaster, as well as, in the operation of new policies, plans, and programs; community-based risk management; and raising public awareness. NGOs are jointly working with government sector to achieve goals.

Nepal Red Cross Society (NRCS), a member of the Central Disaster Rescue Committee, and local level NGOs are working at the grassroot level. NRCS is an organization oriented to services of humanity with its wide Network from the center level to community level. The institution has been actively working while remaining close to communities in liberal, transparent, and participatory manner for immediate search, rescue, and relief in the disaster-hit area/s. It also works actively in the distribution of relief materials, disaster risk reduction, and preparedness.¹⁹

8.2.2.4 UN Agencies and INGOs

UN agencies such as UN Office for the Coordination of Humanitarian Affairs (UNOCHA), United Nations Development Program (UNDP), World Food Programme (WFP), World Health Organization (WHO) and International Nongovernmental Organizations (INGOs) are also involved in disaster management as well as humanitarian assistances. They have been working for disaster risk reduction, preparedness, and prevention in the area of humanitarian services. UNDP has been providing assistance in the policy reform areas. UNOCHA helps in facilitating customs procedures for making international assistance simple, smooth, and effective in the situation of emergencies. Similarly, other international organizations like UN International Strategy on

Disaster Reduction (UNISDR), Asian Disaster Reduction Center, Asian Disaster Preparedness Center, SAARC Disaster Management Center are bearing some responsibilities in term of DRR.¹⁹

8.2.3 Progress towards implementation of Hyogo framework of Action (2009-2011)²⁴

Priorities for action	Core Indicators	Level of Progress Achieved*
1. Ensure that disaster mitigation is a national and a local priority with a strong institutional basis for implementation.	1, 3, 4	3
	2	2
2. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.	1, 2, 3, 4	3
3. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.	1, 3	2
	2, 4	3
4. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.	1	3
	2, 3, 4, 5, 6	2
5. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.	1, 2, 3, 4	3

Source: MoHA*2: Some progress, but without systematic policy and/ or institutional commitment.

*3: Institutional commitment attained, but achievements are neither comprehensive nor substantial

8.3 Water Resources Strategy (WRS 2002) to reduce water induced disaster³⁸

In order to mitigate the water induced disasters, Water Induced Disaster Prevention Technical Centre (DPTC) was started within the Ministry of Water Resources with the agreement of Government of Nepal and Japan. The center started its service in 7th October 1991 and continued for 7.5 years with the technological support of with the technical co-operation/assistance from Japan International Co-operation Agency (JICA). To institutionalize the objectives and progress of the DPTC, the Department of Water Induced Disaster Prevention (DWIDP) came into existence from 7th February 2000 under the Ministry of Water Resources along with 7 divisions and 5 sub-division offices to address water-induced disasters throughout the country.

The Government's main documents like WRS-2002 and the National Water Plan-2005, have been used to develop the guidelines for addressing the issues on water induced disaster mitigation measures, 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 major role to implement the risk reduction actions and

coordinate with other agencies working in same field. Based on these strategic visions, Water Induced Disaster Management Policy - 2006 has been formulated with following policy provisions:

- (a) To mitigate water induced disasters and reduce loss of lives and properties,
- (b) To improve institutional strengthening of DWIDP
- (c) To build network with the related organizations and agencies to cope with possible disasters.

WRS-2002 has developed 10 strategic outputs to contribute the overall national goal as "living conditions of Nepalese people are significantly improved in a sustainable manner" by obtaining short term, medium term and long term purposes. "Effective actions to manage and mitigate water induced disasters are functional"- is one out of ten outputs that is concern of DWIDP.

The WRS has also identified the indicators with specific dates and targets that can be used to accomplish the mentioned strategic output related to disaster, that are:

8.3.1 Water Induced Disaster Targets

- By 2007, high prone disaster zones are recognized by type and are marked on district maps;
- By 2007, emergency relief materials are available in all five regions;
- By 2017, infrastructures for minimizing risk from possible disaster are put into place in 20 districts;
- By 2017, established and functioning early warning systems throughout the country;
- By 2027, reduced social and economic losses to the level of other developed countries.

8.3.2 WRS-2002 activities for the strategy to achieve the targets:

1. Preparation and implementation of a water-induced disaster management policy and plan.

Water induced disaster management policy 2006 was already enforced by Government of Nepal. DWIDP plays a role as an important hub for coordination of various stakeholders for managing water induced disaster policy and plans. The organization involved includes: including Ministry of Home Affairs, Department of Hydrology and Meteorology, Department of Irrigation, Department of Soil Conservation and Watershed Management.

2. Conduct risk/vulnerability mapping and zoning.

DWIDP has prioritized its areas according to the flood risks and is preparing flood risk maps to evaluate the risks. However, the department has already made significant progress towards GLOFs along with the little progress being made in flood risk maps. Likewise, researches in landslides and preparing their flood risk maps are in the process with some works already completed.

3. Strengthen the disaster networking and information system.

However, there are some progress made in the above activities, the department is not being successful in keeping up information and early warning systems as a whole.

4. Establish disaster relief and rehabilitation systems.

With the help of local government and NGOs including MoHA, NRCS etc., DWIP is planning to prepare disaster relief plan on the basis of each priority area. The plans will include:

- Preparations for emergency response, rescues and relief,
- Procurement and storage of relief supplies,
- emergency shelter planning and foods for victims and
- Facilities for disaster response rehearsals and drills.

5. Carry out community awareness/education on disaster management.

With the technical support of DWIDP, the assigned organizations carry out community awareness and education on disaster management. The education and awareness campaign will be carried parallel with disaster relief or rehabilitation system.

6. Activate Inundation Committee (s) with respect to neighboring countries.

The flooding caused by construction of barrages towards downstream of Nepal is being major issue of concern. But, the committees under Ministry of Irrigation are not effectively dealing with the issue. However, DWIDP is playing a vital role to solve this issue in effective manner.

7. Prepare and implement floodplain action plans.

The floodplain action plans will be done in three phases. First phase is focused on identifying and prioritizing high-risk areas and developing disaster management plans. Secondly, better management of floodplains will be carried out and finally economic opportunistic activities including fisheries enhancement, recreation or aggregate extraction will be carried out. These activities will enhance economic activities over disaster.

8. Implement disaster reduction/mitigation measures.

Every year thousands of people are at flood risk and much more are evacuated due to flood triggered by infrastructure failure. In such prone areas some civil engineering and or bio-engineering actions will be applied to resolve feasibility of the structure. Economically feasible schemes will be taken into consideration for implementation.

9. Strengthen institutional set-up and capacity.

DWIP works in coordination with concerned institutions to reduce the water-induced disasters that is being threat to many people annually. The department have proposed some changes with DHM, MoI and MoHA to strengthen the institutional set-up and built up its capacity to deal with water-induced disaster.

8.3.3 Different Programs and projects under DWIDP

A. Disaster Prevention Program

- i. River Training Project (Central Level)
- ii. Study based, Disaster Prevention
- iii. Master Plan based Disaster Prevention Work
- iv. People's Embarkment Program
- v. Landslide Management
- vi. Institutional Infrastructure Development

B. Disaster Mitigation Support Program (DMSP)

- i. Education and public awareness campaign
- ii. Development of appropriate and cost effective technology
- iii. People's participation in disaster mitigation

- iv. Preparation of water induced hazard maps of the watersheds
- v. Institutional development
- vi. Survey and loss estimation
- vii. Emergency rehabilitation - Model site development
- viii. Development of information technology and its dissemination
- ix. Organizing seminars and trainings
- x. Preparation and amendment of policies and regulations
- xi. Watershed/sub-watershed management

C. India Supported River Training Program

D. River Terrace, Settlement/Bazaar Protection Program

8.3.4 The Water Induced Disaster Management Policy 2006

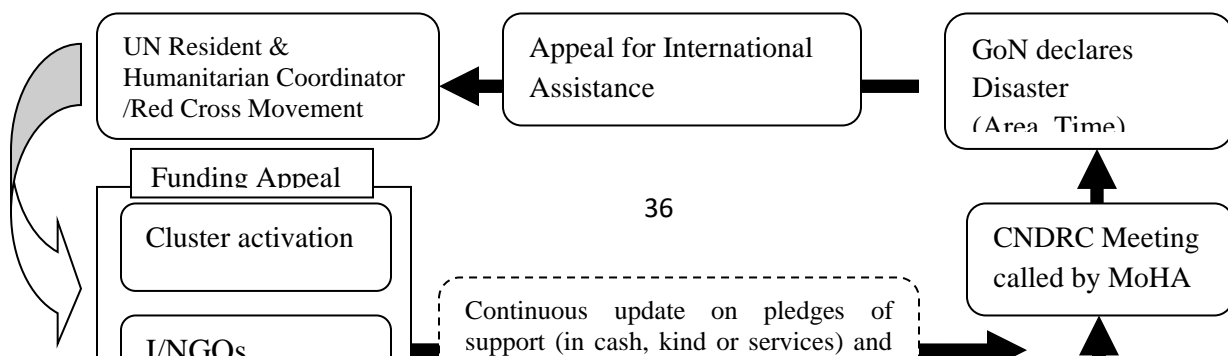
Government of Nepal has approved "Water Induced Disaster Management Policy 2006" on 21 March 2006. In this policy following subjects are highlighted.

- (a) Emergency protection
- (b) Mitigation of Water Induced Disasters
- (c) Conservation of Natural Resources
- (d) Flood plains Utilization
- (e) Institutional Management and Development

8.4 National Disaster Response Framework (NDRF) ³⁶

The NDRF is a comprehensive document with clear and quick guideline for national response to large and medium scale of disasters in Nepal. The framework has guideline for effective and comprehensive response to the disasters. It addresses the national, regional, district and local levels in terms of disaster preparedness and response. Basically, the framework illustrates two major parts. One part describes the response to be taken to disasters from 12 hrs- a month time frame. The next part focuses on the roles and responsibilities Government and Non Government agencies involved in disaster risk management in Nepal.

8.4.1 National and International Assistance and Coordination Structure during Emergency



Source: MoHA

8.4.2 The coordination Cluster

Name of Clusters	Cluster leads (Government)	Cluster Co-leads (Humanitarian Agencies)
Health	MoHP	WHO
WASH	MoUD	UNICEF
Shelter	MoUD	IFRC/UNHABITAT
Food Security	MoHA	WFP/FAO
Logistics	MoUD	WFP
CCCM	MoUD	IOM
Education Protection	MoE	UNICEF/SC
Protection	MoWCSW	UNHRC/UNICEF/UNFPA
Telecommunication	MoIC	WFP
Nutrition	MoHP	UNICEF
Early Recovery Network	MoFALD	UNDP

Source: MoHA

8.4.3 Agencies coordination structure for disaster response activities

Timeline	Operational Activities	Responsible Lead Agencies
0-1 Hour	Give early information on earthquake	National Seismological Centre

	Provide instruction on response to fire incidences	DDC, Municipality and VDC Offices
	Public reporting on the extent of disaster and rescue efforts	MoHA/NEOC
	Establish the emergency information system and disseminate the information from the electronic media	MoIC, MoHA
0-7 Hours	Disseminate early information on waterborne disaster	Dept of hydrology and meteorology
	Prepare situation report	CDO/DDRC
	DDRC meeting	DAO/DDRC
	Emergency meeting at MoHA	MOHA/NEOC
	NEOC starts activates as per its SOP for emergency management	MoHA/NEOC
	Develop emergency communication system and disseminate regular information for the public awareness through radio, TV, SMS etc.	NEOC/REOC/DEOC
	CNDRC meeting	MoHA/NEOC
0-24 Hours	Information about post disaster epidemics and its response	EDCD
	Coordination for animal disease control and management	Dept. of livestock
	Information about Nuclear Biological and Chemical Hazard and rescue of the victims of such hazard.	Ministry of Science, Technology and Environment
	Coordination with national and international stakeholders for potential support	MoHA/CNDRC
	Mobilize NEOC as disaster response focal point	NEOC
	Deploy Search and Rescue teams for immediate rescue of the survivors	DEOC and security forces
	Provide first aid to the injured	Red Cross/hospitals
	Evacuation for treatment to severely injured victims	MoHA/hospitals
	Fire extinguish or control	Municipality
	CNDRC Meeting and emergency declaration	CNDRC/Cabinet
	Initial Rapid Assessment (IRA)	DDRC/DEOC
	Activation of UN Cluster	UNHCR
	Appeal for National and International Assistance	Cabinet
	Establish Media Management Center within NEOC/REOC/DEOC	NEOC/REOC/DEOC
	Airport Security and Air traffic management	CAAN
	Restore road communications	Dept. of Road
	Evacuation and crowd management, communication, dead body handling of foreign tourist, diplomats, and others from the affected areas	MoFA
24-48 Hours	Management of transportation facilities for search and rescue materials and equipment	DoTM
	Availability of basic food items for survivals and IDPs	MoCS
	Registration and facilitation of International Humanitarian	MoFA/SWC

	Communities (IHC) and relief consignments	
	Visa fees and custom duty exemptions at entry points (land or air) to IHC	DC and DI
	Coordination and deployment of relief consignments	NEOC/DEOC
	Electricity services to be made available to hospitals/health centers/medical centers/IDP Camps, schools	NEA
	Establishment of field hospitals at affected site	EDCD
	Water Supply, Sanitation and Hygiene facilities to be provided to hospitals, medical centers, IDP Camps, Schools, Other types of Settlements	DWSS
	Waste disposal for general solid waste, biological and hazardous waste produced	SWMC
	Maintenance of Law and Order around Warehouse, IDP Camps, personnel, humanitarian convoy, protect property and security in affected areas	MoHA
	Registration and tracking of affected families; issuance of Victims ID card and maintain database at districts and central level	DDRC
	Restoration of telecommunication services as soon as possible	MoIC
48-72 Hours	Rapid assessment of existing hospitals, schools, health facilities along with bridges, roads and others for structural damages	MoHA
	Debris Management (collection and disposal) including dead animals	Municipality/VDC
	Collection and management of animal carcass	Municipality/VDC
	Distribution of immediate lifesaving relief materials to the survivors as per the agreed standards	CDO/DDRC
72Hours-7 Days	Proper management of dead body including cremation and issuance of death certificates	DDRC
	Special protection arrangement at the camps and distribution sites for the protection of women, children, elderly, disabled	MoWCSW
	Multi-Cluster Initial Rapid Assessment (MIRA) Activation	UN OCHA
	Distribution of non-food items such as cooking utensils, fuel, clothes, blanket, family kits, baby kits, hygiene kits	NRCS
7Days-2 weeks	Set up of temporary shelter in the pre-determined safe and open/evacuation sites for displaced families	MoUD
	Monitoring of SAM children in the camps	MoHP
	Vector borne disease control in the open/evacuation sites	EDCD
	monitoring and reporting of humanitarian response and relief	DDRC

	Ensure safe environment for survivors particularly the vulnerable groups, and control gender based violence	DWDO
	Psychological rehabilitation to person with mental trauma	MoHP
	Social support to unaccompanied children, disabled and elderly who have lost their supporting family members; and reunion of their lost members or relatives	MoWCSW/DWDO
2weeks-1month	Cash or other assistance to affected populations	DDRC
	Re-start schools to help children feel secure and help them to go back to normal life	Dept of Education
	Provide minimum essential services and security at the hospitals, schools etc in the camp sites	DUDBC
	Conduct Early Recovery Assessment and Plan Development Covering key sector including shelter, livelihood etc.	DUDBC
	Document the lesson learnt on search and rescue efforts, immediate relief, camp management and rehabilitation efforts and prepare an analytical report	MoHA

Source: MoHA

8.5 Nepal Risk Reduction Consortium Flagship Programmes³⁷

Government of Nepal has formulated Nepal Risk Reduction Consortium (NRRC) in February 2011 that is supported by the donor communities. The NRRC is an exclusive body which brings together the Government of Nepal, the financial organizations of the Asian Development Bank and World Bank, development partners and donors, the Red Cross and Red Crescent Movement, and the United Nations as members in the Steering Committee of the NRRC. The consortium is based on five priorities known as “Flagship Programmes”. Out of 29 programmes in National Strategy for Disaster Risk Management (NSDRM) 2009, five key priorities are taken into consideration by the flagship programmes.



School and Hospital Safety Structural and



Emergency Preparedness & Response Capacity



Flood Management in the Kosi River Basin



Integrated Community-Based Disaster Risk



Policy & Institutional Support for Disaster Risk

Operational Aspects
of Making Schools
And Hospitals
Earthquake Resilient

Reduction

Management

Table 5: NRRC Steering Committee

NRRC Steering Committee Members	
Government Ministries	Partners
Ministry of Home Affairs	Resident and Humanitarian Coordinator
Ministry of Finance	UNDP
Ministry of Physical Planning & Works	UNOCHA
Ministry of Federal Affairs & Local Development	ADB
Ministry of Health & Population	WHO
Ministry of Irrigation	DFID
National Planning Commission	IFRC
Ministry of Education	USAID
	World Bank, AusAID, ECHO, DEPNet, NRCS
	Embassy of Japan

Table 6: Flagship Programmes and five-year budget

Flagship Programme: 5 Year Budget (US millions)*			
Flagship	Coordinator	Government Lead	Amount
1. School and Hospital Safety	ADB & WHO	Ministry of Education & Ministry of Health and Population	57.1
2. Emergency Preparedness and Response Capacity	UNOCHA	Ministry of Home Affairs	55.2
3. Flood Management in the Kosi River Basin	World Bank	Ministry of Irrigation	26.2
4. Integrated Community Based Disaster Risk Reduction	IFRC	Ministry of Federal Affairs and Local Development	44.3
5. Policy/Institutional Support for Disaster Risk Management	UNDP	Ministry of Home Affairs	13
Total			195.8

* This budget reflects the estimated amount required under each flagship and the funding that has been tracked in each flagship.

9. DISCUSSIONS

With the fragile land and complicated geo-physical structure, a country between the mountains has been hot spot for disasters since 1930s. Nepal is considered as highly recurrent country in terms of natural disaster with 30th place (World Bank, 2005) in terms of flood. In Nepal, after epidemics, water induced disasters mainly floods and landslides has higher impact in life of the people and they are the main cause for loss of property every year. The frequency of disaster mainly floods and landslides are higher in the country that kills thousands of people every year. Adverse geo-climatic conditions, massive rainfall, cloudburst, GLOF, soil erosions, snowmelts are some common natural causes for flood and landslide in Nepal. Likewise, deforestation, water leakage, road construction, infrastructure failure are triggering factors for floods and landslides. Among these factors, confined rainfall during monsoon season has got higher negative impact in life of people, due to which every year hundreds of people die and thousands are displaced and is adversely affecting socio-economic of the country as a whole. In average, every year water-induced disaster alone kills 278 people, damages 67 houses, affects 2892 families, affects 7618 land and causes economic loss of Rs. 762 (approx. USD 7855670) million.

Various kinds of disasters including droughts, earthquake, epidemics, extreme temperature, floods, landslides, storms and wildfire have been encountered in Nepal since 1934 with flood being the major cause of highest number of displaced people and economic loss (table 1). This may be due to higher frequency of the flood that take place annually. In the other hand, lack of knowledge about disaster among the people and lack of provision of mitigation measures adopted by the Government of Nepal could be the fact for 3,598,175 affected people and damage of property (1,038,242,000\$).

According to Ministry of Home Affairs Nepal, ranking of floods and landslides prone districts in Nepal, Kailali district in Terai region is placed in first rank for floods and Nuwakot district in mid hilly region is placed in first rank for landslides. Districts in Terai regions are vulnerable to floods while districts in mountainous and hilly regions are vulnerable to landslides. Analysis conducted

by ICIMOD in 2013 has listed out districts that are highly affected by floods and landslides. The ranking of disasters and analysis of vulnerability caused by these disasters can help in planning the mitigation measures on the priority basis. Lack of resources in the country could be the cause for not being able to carry out the processes.

Different kinds of floods including flash flood and GLOFs are in the first position to create devastated affect in various part of Nepal in comparison to other kinds of events in terms of affected people and economic loss. Altogether 41 flood events in the history has killed 6450 people being highest in 1993 with the total death of 1048 i.e. 16.24% of total deaths that took place from 1954-2014 (See figure 5 & 6). According to ICIMOD, same flood had affected about half a million people from 73,000 households causing enormous loss of national economy. Total affected people and total damaged economy due to flood since last 60 years were 3598175 and 1038242000\$ respectively (figure 8). According to INFORM (46), physical exposure to flood in Nepal is the highest. Nepal has acquired 10 point out of 10 in terms of physical exposure to flood.

Despite floods, landslides are the next major cause that impact more people nationwide every year. Natural phenomena like rainfall is one of the major cause for landslides, however the phenomena has been increased by human activities like deforestation, rapid urbanization etc. Desinventar dataset (figure 9) shows that 4476 deaths due to landslide from 1971 to 2011 with highest death of 15.65% in the year 2002 followed by deaths in the year 2001(9.3%), 1993(8.5%) and 2003(7.7%). Higher numbers of deaths and displaced were from eastern and central part triggered by heavy monsoon rains that had been lashing the country. Some of the districts highly affected by then landslides (44, 45) were Dipsung and Sikundel villages of Khotang district and three remote villages of Makwanpur district. Landslide has also damaged and destroyed thousands of households during 40 years of period. The highest number of houses damaged is seen in 2010, which covers 59.67% of total damage. Similarly, total destroyed houses were 18491, out of which 4339 (23.46%) were seen in the year 1996. Besides, landslides are responsible for damage of infrastructure, crop land and livestock annually. Total numbers of people affected were 574020. During the monsoon season, the country's mountainous terrain makes it vulnerable to landslides and flash floods, which claim hundreds of victims every year. The construction of infrastructures should be properly planned and evaluated to avoid possible effects and consequences from floods and landslides.

Latest landslide that took place in Sindhupalchok district few months ago and a flood in Darchula district a year ago (case-study) gives a clear view of delay in institutional response capacity of the nation. If response time is shortened, the loss of lives and properties can be minimized by some amount.

According to Index for Risk Management (INFORM)(46), INFORM risk, Hazard & Exposure, vulnerability and Lack of Coping Capacity are 5.2, 5.5, 4.1 and 6.4 respectively, with 10 being the worst. There is a decreasing trend in INFORM risk, Hazard & Exposure and vulnerability but lack of coping capacity has remained as it is since last 3 years. The INFORM risk index is relatively very high as it falls in red mark. The neighboring countries (India and Bangladesh) also fall in very high index, but, China and Bhutan have medium INFORM risk index. The coping capacity of the country has not been able to progress since last couple of years. Lack of coping capacity of Nepal is 6.55, which is relatively poor. In many disaster prone rural areas where there are limited resources, the community people can be centralized by the government for coping disaster by promoting their own actions. This may be effective in managing the disaster response in case of delay in response by the authorities.

The data from International databases i.e. EM-DAT and DesInventar are compared with the dataset received from Ministry of Home Affairs, Government of Nepal, which is the focal Ministry to collect and compile all disaster related data. The data includes deaths records due to floods from 1983-2013. The fluctuation of data records can be seen in different sources almost all the year. The reason for the fluctuation may be due to under-reporting or over-reporting of the data. The variation in data source may also play an important role in this fluctuation.

Looking at the legal policy measures, Nepal's disaster management legal documents are Natural Calamity Relief Act, 1982 (42) and National Strategy for Disaster Risk Management, 2009 (19). These documents have illustrated disaster management strategy through various institutional frameworks from central level to local level. However, the existing law does not clearly direct the presence of foreign assistance during the time of disaster. Meanwhile, there is also a lack of law to minimum standards to be maintained in the disaster relief goods and services. The policy is typically tilted towards response activities; but there is still need for disaster mitigation and preparedness approaches. In a report published by NRCS (43), provisions for making international appeals are not clearly made and most of the time ad hoc decisions are made for disaster response. The report has highlighted the gap in current legal procedure and need for comprehensive legal

framework. The paper also focuses on the need for early warning system in the country and in trans-boundary region.

Early Warning System (EWS) is being adopted as risk reduction project in Nepal. However, the institutional framework doesn't look as transparent as it needs to be. The policy focus on EWS is as yet variable in implementation.

Government of Nepal is still working to get new Disaster Management Act and National Disaster Response Framework (36). The drafts have been prepared and proposed for their legal approval. These documents seem to have much broader approach to disaster management, coordination and collaboration along with responsibilities for implementation by the selected authorities. They have clearly mentioned the role and working area of aid agencies which were lacking in previous laws. With the long-term vision in managing disaster risk in the country, Government of Nepal has begun the Nepal Risk Reduction Consortium (NRRC)(37) in collaboration with development and humanitarian partners, including Ministries, UN agencies, NGOs, donors and international financial institutions. The consortium has five priorities known as flagships. Besides its technical limitations, this is regarded as one of the successful programs in Nepal from the output and outcomes indicators it has achieved. Long-term implementation of such programmes can help Nepal gain disaster-resilience community.

10. CONCLUSION

Geographically, Nepal is complicated country in terms of geo-physical structure due to rugged and fragile geomorphic conditions, high peaks and slopes, variable climatic conditions, increasing population, poor economic status, unplanned settlements, low literacy rates and very rural topography. Disasters like floods and landslides often occur in the country which seriously affects the every-day life of people and cause enormous damage of physical properties. Every year, such disasters cause fatalities and destroy houses, technical infrastructure, agricultural lands and crops throughout the country.

In Nepal, floods and landslides are the most frequent and deadliest face of disasters after epidemics. However, flood is at the top for loss of lives and damage of properties. Intense rainfall during monsoon season is regarded as one of the main triggering factors of landslides because most landslide disasters in the country occur in monsoon period every year making loss of lives

and properties in a great number due to large and medium-scale landslides throughout the country. Floods usually take place in lower plain regions and landslides in hilly and mountain regions.

Nepal is prone to water induced disasters with highly affected community every year due to increased frequency of hazards and vulnerability. Floods and landslides are caused by natural process but may be increased by human activities like poor infrastructure constructions. Identification and analysis of flood and landslide prone areas and their causative factors can help to mitigate and minimize loss of lives and properties in significant amount. In the other hand, disasters can be mainstreamed with the development works to avoid future destruction caused by poor constructions of infrastructures.

In terms of risk index, Nepal is still lacking behind in terms of Hazard & Exposure, vulnerability and coping capacity to disasters. Physical exposure to flood is relatively the worst hazard observed. All in all, the disaster risk index needs an improvement.

National level of data sources for disasters is not yet systematically established. There is still fluctuation in recording and reporting of data to and from various sources. For the appropriate hazard and vulnerability analysis and establishment of early warning systems, there is an urgent need for standard uniform source of information.

Previous legal documents don't give a broad spectrum for disaster cycle management. They are limited to some of the components like transparency, cooperation, collaboration and implementation. Regardless, newly proposed disaster management act and disaster response framework seem to fulfill the limited components observed in previous legal documents by formulating appropriate policies on disaster risk reduction. Nepal risk reduction consortium flagship programme is one of the successful programs which has been playing vital role in addressing risks from natural disasters.

Hazards cannot be stopped and are always prevailing. The hazards are said to be disaster when there is a great possibility of vulnerability or less coping capacity with them. Lastly, the findings of this report on water induced disasters: floods and landslides in Nepal may be very useful in reducing the loss of lives and properties due to landslides in various vulnerable areas of Nepal.

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