Report on
Retrospective Research to Flood Risk in relation to WASH facilities

(June, 2012)

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Acknowledgement

This report on “Retrospective Research to Flood Risk in relation to WASH Facilities" has been an output of the comprehensive research study on past trend experiences retrospectively on Disaster related to flood in response to WASH facilities.

I would like to express sincere gratitude to the team members of this research study. The team members include Mr. Deepak Paudel, Mr. Dinesh Singh Malla, both from The Nature's Conservation Private Limited (NCPL), and Mr. Sarbagya Shrestha, Urban programme Officer of WaterAid in Nepal (WAN).

I would like to express sincere gratitude to the WaterAid in Nepal (WAN) for entrusting the responsibility of undertaking “Retrospective Research to Flood Risk in relation to WASH Facilities". My sincere appreciation goes to Mr. Ashutosh Tiwari, Country Representative, WAN for his valuable guidance. My appreciation, and sincere gratitude go to the team members of this research study that comprises Mr. Deepak Poudel, Mr. Dinesh Singh Malla, both from The Nature's Conservation Private Limited (NCPL), and Mr. Sarbagya Shrestha, Urban programme Officer of WaterAid in Nepal (WAN).

My heartfelt thanks also go to Mr. Deepak Paudel who led the study team in close coordination with me through his support and engagement in preparing this report by providing valuable contributions and meaningful feedbacks and supports.

We appreciate Dr. Keshav Prasad Sharma, Former Director General of Department of Hydrology and Meteorology (DHM) and Mr. Shayam Sundar Jnavaly, Former Vice-chairperson of Disaster Preparedness Nepal (DPNet Nepal) for their valuable inputs in the study.

I am very much hopeful that the content of this report would be instrumental for WASH stakeholders for them to engage in Disaster Risk Reduction and Management (DRR/M) in particular and for those actors who are already engaged in this domain of work on Disaster in general. The WASH sector would get benefit from the information collected so far, nevertheless, the content needs to be updated at certain time intervals. Based on the feedbacks and suggestions provided by the users, this report will be updated gradually.

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EXECUTIVE SUMMARY

Flooding occurs when the volume of water in a water body exceeds its total carrying capacity or when flood exceeds the capacity of a river channel. The expansion of flood submerges land and settlement. Glacier Lake Outburst Floods (GLOFs) in the Himalayas. Flash floods and riverin flood in the mountainous, hilly, Siwaliks and Terai regions are the typical nature of floods occurring in Nepal.

The Inundations resulting from riverine floods and flash floods in the river basins have natural as well as human-induced causes. The major natural triggering factors are intense rainfall in monsoon season, high relief, and deep and narrow river valleys. The severity of floods is uncertain in the country, the uncertainties increasing in recent years. Policy gaps, lack of coordination, inadequate knowledge in software and hardware of the Water, Sanitation and Hygiene (WASH) services regarding disaster risk reduction are some of the major factors responsible behind weak resilience of communities. In this backdrop, the study aimed to prepare a report on retrospective research on flood risk in relation to WASH facilities.
The study incorporates the development of the capacity of communities to cope with the flood related disasters and its associated risks. It covers several objectives, such as:

- Undertaking a retrospective study on flood-related disasters, with a focus on community preparedness, risk reduction, adaptation, and mitigation options through rapid scoping study and scientific review;
- Developing criteria and indicators to identify flood-prone zones that are vulnerable to disasters;
- Preparing guidelines for disaster preparedness plans in WASH domain for the flood disaster risk reduction at community level;
- Reviewing existing research related to disaster issues to identify any gaps with WASH sector in Nepal;
- Designing a pilot project for WAN's interventions through disaster Risk Reduction/Management (DRR/M) approaches for making WASH infrastructures resilient to disasters.

The overall outcome of the study is to identify the criteria/indicators for flood prone and flood vulnerability. In addition, the study includes the preparation of guidelines note for disaster preparedness plan for vulnerable communities for reducing risk securing WASH facilities. Integration of WASH and DRR, specific to flood disasters is also one of the key outcomes of the study. Such integration is to address effective WASH intervention, which ultimately reduce the flood disaster risk in the country.

The methodologies adopted in the study were: literature reviews, expert consultations, and field visits. Verification and rapid discussion with the focal desk of Water Aid Nepal (WAN) was adopted for the finalization of analytical structures. Comprehensive literatures review was useful to identify the criteria and the indicators useful for flood prone and flood vulnerability assessment. Literatures based identified indicators were verified on the basis of the formulation of the questionnaire for the field visit at community levels. The other tools used in the study were: focus group discussions along with the transect walk and, stakeholder discussion at project/ programme levels.

The study identified the indicators/criteria for the flood prone and for flood vulnerability in the Terai of the country. The key indicators for the flood prone are:

- 24-hr extreme rainfall frequency zone,
- Percentage of deep and narrow valley of the region,
- poor infrastructures hydrological designed near the bank,

- Frequently flooding zone,
- Frequency of flooding, duration & depth of flood,
- percentage of awareness level of people about flooding,
- poor access to basic water and sanitation facilities,
- losses of human and properties,
- Income level, and
- population density of the region

In order to ensure the reliability of identified indicators, it needs to be tested by piloting the project based on the assessment of the project sites. The assessment needs to be carried out by adopting the possible indicators defined in the study.

The study also identified the needs of the preparedness and post-flood disaster plans to increase the efficiency of WASH facilities in line with flood risks. For this, guidelines for the preparation of plans at community level have been developed for the partners of Water Aid Nepal. The guidelines are developed on the basis of Water Aid strategy[1] and the findings of this study.

The study highlights the need of close coordination among disaster risk reduction and WASH stakeholders. Such coordination is the key strategic approach in enhancing the services of the WASH facilities in flood prone region of the country.

The study had made a few recommendations on policy, implementation strategy and coordination as outlined below.

- Floods, flood vulnerability and flood risk need to be considered with WASH domain
- The flood hazards maps and flood forecasts developed by relevant government agencies should be available so WASH programmes can use the information as per the requirements.
- Community-based flood hazard map will serve the communities for identifying evacuation sites and safe routes. The map should be updated on regular basis whenever additional data are available.
- Construction of safe toilet and improvement of public health and hygiene including behavioral change
- Participation of women, and children ensured on activities related to the preparedness for emergency response with in WASH domain.
- Effective coordination in strengthening the facilities of WASH services before, during and after a disaster event. Funds need to be assured with a high priority for the districts at high risks.
- An especial guidance on flood resilience to include water and sanitation structures and non-structures services to address both the legal and policy sectors.
- Development of flood disaster friendly WASH facilities in close coordination with the disaster risk reduction stakeholders and the WASH stakeholders with urgency.
- Testing of the developed guidelines in the community and revisiting the guidelines on the basis of feedbacks from communities.

[1] Nepal Country Strategy 2010-2015, Water Aid

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BCPR	Bureau of Crisis Prevention and Recovery
CDO	Chief District Officer
CDRC	Central Disaster Relief Committee
CSA	Country Situation Analysis
CSSR	Collapse Structure Search and Rescue
DDC	District Development Committee
DDRC	District Disaster Relief Committee
DHM	Department of Hydrology and Meteorology
DIMS	Disaster Inventory/Information Management System
DM	Disaster Management
DMG	Department of Mines and Geology
DPNet	Disaster Preparedness Network – Nepal
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DUDBC	Department of Urban Development and Building Construction
DWIDP	Department of Water Induced Disaster Prevention
GAR	Global Assessment of Risk
GDP	Gross Domestic Product
GIS	Geographic Information System
GLOF	Glacial Lakes Outbrust Floods
GO	Government Organisaion
GoN	Government of Nepal
GPS	Geographic Positioning System
GRIP	Global Risk Identification Program
INGO	Internation Non-Governmental Organisation
ISDR	International Strategy for Disaster Reduction
KMC	Kathmandu Metropolitan City
KVERMP	Kathmandu Valley Earthquake Risk Mitigation Program
LDO	Local Development Officer
LSGA	Local Self Governance Act
MERMP	Municipality Earthquake Risk Mitigation Project
MFR	Medical First Responders
MoHA	Ministry of Home Affairs
MoLD	Ministry of Local Development
NADRM	National Authority for Disaster Risk Management
NCDRM	National Commission for Disaster Risk Management (NCDRM)
NGO	Non-Governmental Organisation
NDMF	Natural Disaster Management Forum Nepal
NRCA	Natural Calamity (Relief) Act
NRCS	Nepal Red Cross Society
NSDRM	National Strategy for Disaster Risk Management
NSET	National Society for Earthquake Technology – Nepal
SIERA	Systematic Inventory and Evaluation of Risk Assessments

UNDP	United Nations Development Program
UNICEF	United Nations Fund for Children
VDC	Village Development Committee
WAN	Water Aid Nepal
WASH	Water, Sanitation and Hygiene
WFP	World Food Program

1 INTRODUCTION

1.1 Authority

This study has been carried out in accordance with the scope of work for the study on "Retrospective Research on Flood Risk in relation to WASH facilities" agreed between the Water Aid Nepal and the Nature's Conservation Private Limited.

1.2 Objective and Scope of the study

The general objective of the study was to develop the capacity of communities to cope with the flood related disaster and its associated risk.

The specific objectives of the study were:

- Undertake a retrospective study on flood-related disasters, with a focus on community preparedness, risk reduction, adaptation, and mitigation options through rapid scoping study and scientific review;
- Develop criteria and indicators to identify flood-prone zones that are vulnerable to disasters;
- Devise techniques for hazard mapping with identification of evacuation routes for safe havens;
- Prepare guidelines for disaster preparedness plans in WASH domain for the flood disaster risk reduction at community level.;
- Review existing research related to disaster issues and to identify any gaps with WASH sector in Nepal
- Design a pilot project for WAN's interventions through Disaster Risk Reduction/Management (DRR/M) approaches for making WASH infrastructures resilient to disasters.

The Scope of the study included following areas of work:

- Development of indicators and criteria for flood prone and flood vulnerability
- Identification of gaps in WASH sector in line with flood disaster risk reduction
- Preparation of guidelines for the disaster preparedness plans for reducing the flood disaster impacts and for enhancing the capacity of WASH services in flood-prone area at community level
- Mapping of actors involved in disaster related issues to understand possible strategic role for WAN
- Field verification of the criteria and indicators for flood prone and flood vulnerability
- Development of networks and linkages with key stakeholders, networks related to disasters
- Devise a project for WAN in the area of DRR initiative in WASH domain
- Ways forward how WASH related infrastructures could be made disaster friendly

1.3 Methodology

The following methodologies were adopted in the study.

1.3.1 Literature reviews and Information collection

Several published and unpublished scientific reports, journals and texts books from different sources, such as International Center for Integrated Mountain Development (ICIMOD), Department of Hydrology and Meteorology (DHM), Department of Water Induced Disaster Prevention (DWIDP), United Nations

Educational, Scientific and Cultural Organization (UNESCO) and other concerned government and non-government organizations were reviewed to conceptualize the scope of the study. Reviewed literatures included the publications on flood prone and flood vulnerability, disaster scenarios, guidelines and polices. Relevant web linkages were browsed and the cornered agencies were visited during the literature reviews. The documents published by WAN were also reviewed to identify the role of organization to be involved in the disaster risk reduction through WASH interventions. The relevant literatures were used to identify information about appropriate parameters and indicators that reflect the characteristic of flood proneness and flood vulnerability from global to community levels. The information regarding the indicators for flood proneness and flood vulnerability has been summarized and listed in the report (Chapter 3).

1.3.2 Formulation and Adoption of the study analytical framework

A study analytical framework was developed by the study team. The developed framework was finalized jointly by the study team and the DRR-focal desk at WAN. The detail of the framework has been outlined below (Figure 1.1).

The study framework

Identifying and reviewing the key reports, publications regarding scientific and action based research on Flood Vulnerability including flood-prone characteristics based on spatial variation (Global, Regional, National and

Listing the factors or indicators for the flood-prone and flood vulnerability from the relevant literatures and also identify the coverage of the findings

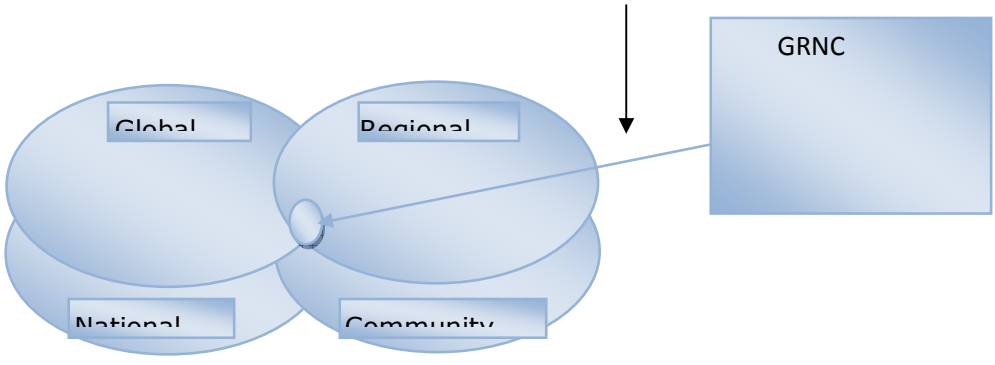
Screening the similar types of the listed factors or indicators by direct observations on the listed indicators

Classifying the listed indicators in different spatial variations (Four Sets)
Global (G) Regional (R) National (N) Community (C)

Grouping and Re-grouping the common types of indicators in intersection sets in such a way that every set contains the set-C - **(GRNC; GRC; RNC; GC; RC; NC)**

G R N C

GRNC GRC RNC GC RC NC



Identifying the indicators of WASH intervention in line with flooding

Indicators listed in the set GRNC

Verifying the listed indicators in the field and expert consultation Discussion

Finalizing the Indicators

1.3.3 Formulation of the questionnaire for field visit

Checklists, structured questionnaires for Focus Group Discussions (FGDs), key informants interview and interview with concerned agencies were formulated. The developed checklists and questionnaires were finalized in line with the perception of community and the concerned stakeholders about the flood-prone and characteristics of flood vulnerability in WASH domain. The final checklists with the list of the indicators identified from the literature reviews were used for the verification of the indicators in the field (Annex 1.1). Based on the discussions with the management and study team, a work-plan was prepared for the field work.

1.3.4 Selection of sampling Districts and River basins

The sampling districts were selected on the basis of selected criteria, such as flood vulnerability in terms of exposure, sensitivity and adaptation; scale of inundation, nature of floods (flash floods or sustained-sheet floods), historical floods and urban flooding. The vulnerable districts and the community were selected by reviewing the National Adaptation Plan for Action (NAPA) document and District Preparedness and Response Plans (DPRP) prepared by the respective District Disaster Relief Committee (DDRC). The selected districts and the communities are shown in Figure 1.2. The field visit report is given in the Appendix 1.

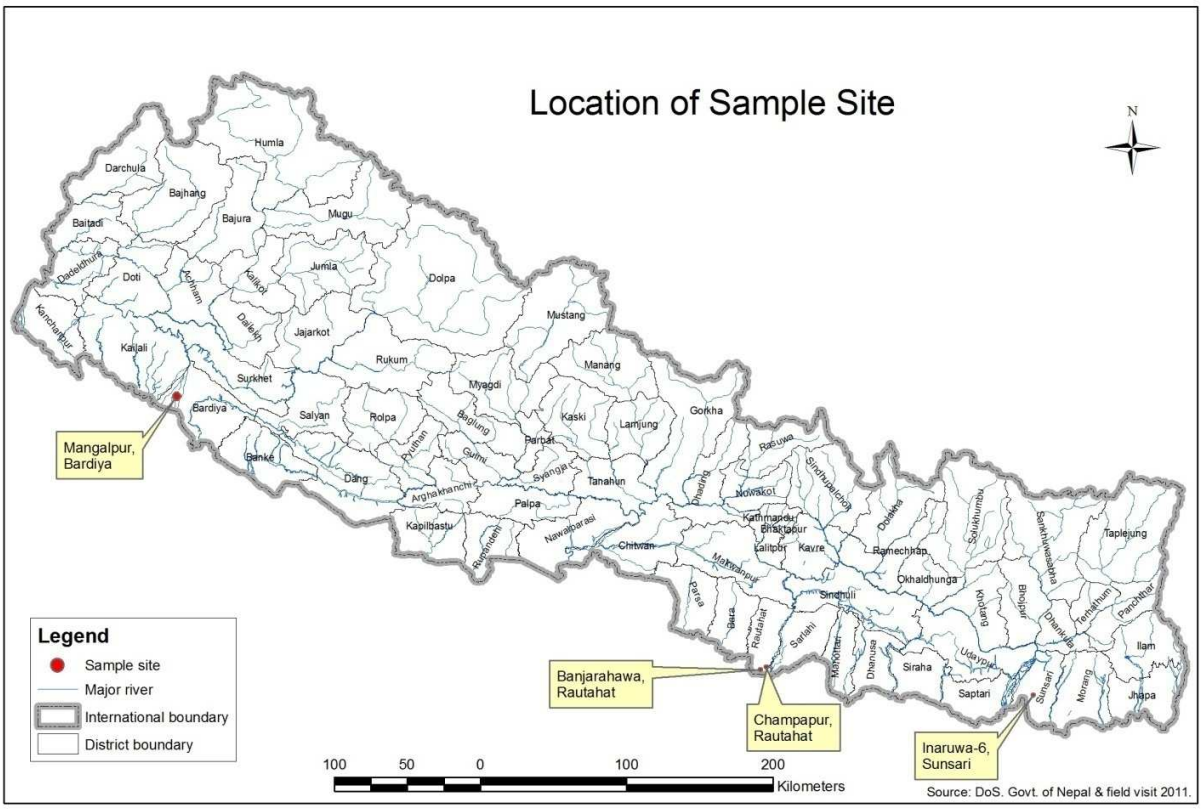


Figure 1.2: The Sites selections for the field visits

1.3.5 Field visit and verification of Indicators

The field visit in the selected districts and communities were carried out on the basis of activities such as transect walk; FGDs, observation on WASH intervention activities, Interaction with Key Informants, flood history assessment, visit to flood prone areas and Community Based Organizations (CBOs)/NGOs courtesy visit and interaction. The identified literatures based indicators for flood prone and flood vulnerability were brought into discussion systematically in FGDs and in interactions during the field visit. The detail of the field visit has been given (see Appendix 1).

1.3.6 Stakeholder Discussion and Gaps Identification

The issues regarding Water, Sanitation and Hygiene (WASH) in Disaster Risk Reduction (DRR) and Emergency Response (ER) were discussed in the Disaster Preparedness Network (DPNet) platform. The discussion was facilitated by Natural Disaster Management Forum (NDMF Nepal). About 30 participants represented from the key organizations including government and non-government agencies working in flood disaster risk reduction and WASH services participated in the discussion. The issues including the gaps and the problems of WASH services in flood disaster risk reduction (particularly in preparedness, emergency response and recovery phases) were discussed in the programme. The gaps in policy, coordination, technical knowledge/knowhow in WASH/DRR were some of the key findings of the stakeholder discussion.

1.3.7 Interpretation and analysis of literature and data

The procedure for the analysis of information regarding the classification of the indicators of flood vulnerability and risk reduction were adopted on the basis of facts documented in reviewed literatures[2]. The indicators were finalized by following framework (see the section 1.3.2). The Strength, Weakens, Opportunity and Threat (SWOT) analysis was carried out for the purpose of gaps identification. Based on the gaps and the study findings, guideline for preparing flood disaster preparedness and recovery plan to secure WASH facilities at community level has been prepared for WAN (Appendix 2).

1.4 Limitations

The following are the major limitations of this study.

- Only limited literature was available which could be useful to define flood vulnerability indicators. Since the indicators for flood vulnerability were usually expressed in climate change perspective. The scope of the study has the limitation in line with climate change perspective.
- Because of limited resources for the field work, the verification of the indicators for all the types of flooding was constrained.
- Satisfactory verification of the indicators for the flood prone and flood vulnerability were constrained by the availability of time for field work. Pilot programmes need to be carried out in order to address the WASH services in flood disaster risk reduction.
- The procedures adopted for the preparation of guidelines for the preparation of flood disaster preparedness plans in WASH domain were also constrained due to the inadequate of time and other resources available for this study.

[2] Normandin, et,all. (nd). City strength in time of turbulence: strategic resilience indicators and Tanguay, et,all. (2009).Measuring the sustainability of cities: A survey based analysis of the use of local indicators

1.5 Expected Output and Outcome

The expected output of the study is to prepare of a report of retrospective research by including the indicators for flood prone and flood venerability. The identification of criteria/indicators for flood prone and flood vulnerability are the major expected outcome of the study. The expected outcomes include the preparation of guideline notes for disaster preparedness plan for vulnerable communities. The plan has to be useful for reducing risk securing WASH facilities. In addition, integration of WASH and DRR specific to flood disasters is an area of assessment in the study. The integration is expected to address effective WASH intervention to reduce flood disaster risks in the country.

2 BACKGROUND

2.1 Context

Nepal, with an area of 147,181 sq. km. and about 28.5 million people (CBS 2011) lies in the sub-tropical to the alpine region. The geographical extension is between 26^0 22' to 30^0 27' N latitude and 80^0 12' to 88^0 12' E longitude. Altitude ranges from 60 meterto 8848 meter. The country is landlocked bordering India in the east, south and west and China in the north. Administrtively, the country is divided into five development regions and seventy-five districts. The districts are further divided into smaller administrative units called Village Development Comittees (VDCs) and municipalities VDCs/Municipalities are further sub-divided into wards.

2.1.1 Physiography

The country is topographically divided into five regions running from east to west, which are Terai, Siwaliks (Churia), middle mountain, high mountain, and high Himalayas (Figure 2.1 and Table 2.1).

Terai: The Terai is the northern part of the Indo-Gangatic plain ranging in elevation from 60m to 300 meter above mean seal level. It extends from the Nepal-India border in the south to the base of the Siwalik Hills in the north. The width of the Terai region varies from 10 to 50 km. It forms a nearly continuous belt from east to west along its southern border except near Koilibas and Chitawan. The northern border of the Terai is covered with dense forest. The Terai can further be subdivided into northern (Bhavar), middle , and southern zones.

Siwalik Ranges: The Siwaliks are the continuation of extra Himalyan hills known as 'Chure'. These hills have been formed from sediments produced by rising Himalayas during the last 40 million years. This is the youngest mountain range in the world. They rise steeply from the Terai along the whole of its northern flank. The highest point is about 2000m in west and 500 to 700m in east. The region is mainly covered by sterile soils formed largely from coarse grained sandstone, and as a result cultivation is very limited. Its slopes are highly eroded by wind and water and the forest density is lesser than the foothills.

Middle Mountains: Middle mountains lie between Siwalik range and high mountains. It includes the areas of Mahabharat Range and inter-mountain area. It is characterized by moderately high mountains, of which the peaks are between 1500m and 3000m and midlands of gentle slopes. The Mahabharat Range is formed of older and harder rocks than the Siwaliks and hence is much less eroded. It consists of dense forests with different tree species. Runoff from the northern slopes of the Ranges passes south through four major rivers : Koshi, Gandaki, Karnali, and Mahakali- which cut deep, narrow gorges. Geologically, it is a region of mainlymetamorphic sedimentary material.

Figure 2.1: Physiographic Region of Nepal

High Mountains: The region is characterized by high mountains with steep slopes and narrow valleys. The elevation of most of the river valleys is over 2000m. In this region, the mountains tops are commonly above 4000m. Less steeply sloping areas in lower range are under terraced cultivation. Steeper areas are mostly forested. The zone lies between the middle mountains and the high Himalayas.

High Himalaya: High mountain zone in the north rises beyond 4000m amsl (above mean sea level). This zone contains not only the highest peak of the world (Mt. Everest or Sagarmatha-8848 m amsl) but also the highest number of peaks over 8000m altitude. This zone is extremely rugged terrain with very steep slopes and deeply cut valleys. It is the source of water for the millions of people living in Nepal and north India. All the major rivers of Nepal originate from this area.

Table 2.1: The main characteristics of Physiographic regions of the country

S. N.	Physiographic regions	Elevation (m)	Occupy (%)	Occupy (km^2)	Geological natures
1.	Terai	60-300	14.19	20034	Quaternary alluvium
2.	Siwaliks	300-1500	12.89	18198	Tertiary sand stone, silt stone, shale and Conglomerates.
3.	Middle Mountains	800-2500	19.86	28039	Phyllite, quartzite, Limestone and islands of granites
4.	High Mountains	2200 -4000	29.49	41634	Gneiss, quartzite, and mica schists
5.	High Himalaya	Above 4000	23.65	33389	Gneiss, schist, limestone and Tethys sediments.

Source: Land Resource Mapping Project, Geology Report, 1986

2.1.2 Climate

The climate of Nepal is characterized by monsoon circulation dominated by easterly winds during summer (from June to September) and westerly wind (from October to May). The summer monsoon lasts from June to September with a large amount of precipitation. The major climatological zones of the country are: subtropical in the Terai and the Siwalik; warm temperate in the middle mountains; cool temperate in the high mountains; alpine in the higher mountains; and arctic above the snow line (5000 m).

2.1.3 River System

There are about 6000 rivers and rivulets in Nepal out of which 100 rivers are more than 160 km long and 1000 rivers are more than 10 km long. The river drainage density of 0.3 km/km^2 is an indication of how close the drainage channesl are and succeptible to floods (Shankar, 1985 and DPNet, 2009). Rivers of Nepal, based on their sources of dry season discharge, can be categorized as: major, medium and minor. For hydrological studies, Nepal is divided into seven drainage basins: the Kankai River Basin, the Koshi River Baisin, the Bagmati River Basin, the Narayani River Basin, the West Rapti River Basin, the Karnali River Basin, and the Mahakali River Basin. The country has four major River Systems and five medium tributires of the Ganga. The major river basins are: Mahakali, Karnali, Narayani, and Saptakoshi that originate from the glaciers in the Himalayan region. Medium river basins in the country are: Babai, East Rapti, West Rapti, Bagmati, Kamala, Kankai, and Mechi. Medium rivers originate from Mahabharat or middle mountain range The Rivers of the minor river basins originate from the Siwaliks (Figure 2.2).

Figure 2.2: The River Network of Nepal

2.1.4 Disaster hot spot

Regionally, Hindu-Kush Himalayan Region (HKH-Region) is a flood prone region of the world. The region includes Nepal, India, Pakistan, Bhutan, China, Afghanistan, Bangladesh and Myanmar. The most common type of observed events in HKH-Region during the past three decades (1979-2008b is flood which accounts for 36% of the events (Figure 2.3)[3]. Nepal is regarded as a disaster hotspot because of vulnerability of the population to the frequent occurrence of floods. Landslides and earthquakes. The country's social context characterises with low level of development, low level of institutional capacity for prparednes and higher level of poverty. All these factors contribute toincrease the vulnerability intensifying the impact of dissasters (NDR, 2009:16). By global standards, Nepal ranked 23rd in the world in terms of the natural hazard-related deaths in two decades from 1988 to 2007 with total deaths reaching abouve 7000 (IFRC, 2007).

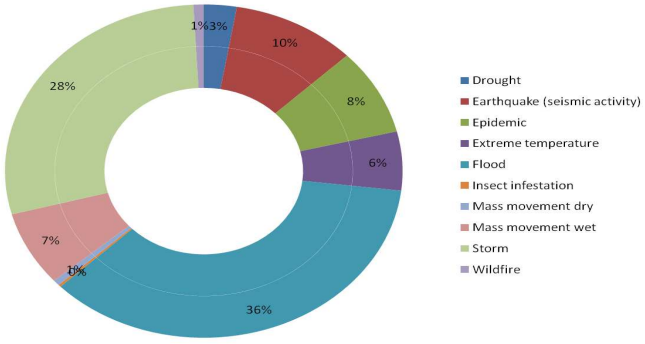


Figure 2.3: Prevalence of Flooding in HKH region

The major natural and human induced hazards in Nepal are summarizedin Table 2. Nepal is ranked in seventh position regarding deaths resulting from floods, landslides and avalanches; eighth position for flood

[3] Source: "EM-DAT: The OFDA/CRED International Disaster Database

related deaths alone; forth position in climate change vulernability, eleventh position in earthquake vuelrnabiliy and thirteeth position in flood vulnerability. Further, a UN Report (2008) shows that out of 75 districts in the country, 49 districts are prone to floods and/or landslides, 23 districts to wild fires and one to wind storms (NDR, 2009). A NSET document (2010)[4] reports that a total of 64 out of 75 districts are prone to disasters types (Upreti, 2007).

Being one of the least developed countries of the world, Nepal faces serious threats from disasters, which occur over 900 every year in average (NDR, 2009:15). Available records of of the last three decades (1971-2006) show that the climate-induced disasters acoounted for almost 25 percent regarding deaths, 84 percent regarding adversely affected people and 76 percent in case of economic losses (NDR, 2009). In addition to disaster vulnerability scenerio, Nepal's vulnerability to disasters is compounded by rapid population growth, and development of haphazard and unplanned settlements. The studies also indicate that 90% of Nepalese people are constantly exposed to more than two disasters in a year. It is noted that there are 1.06 reporting in average of natural disaster events per day in Nepal (NSET, 2010). Besides, thecountry has lost, in average, around 300 people, displaced 20 thousands of people and incurred a loss of national property equivalent to US $ 8 million due to floods and landslides every year (Paudel, D., 2006)[5].

Table 2.2: Types of Hazards in Nepal

Types of Hazard in Nepal	Region
Natural Hazards	
Earthquake	All of Nepal
Flood	Terai (sheet flood), middle hills
Landslide and landslide dam breaks	Hills and Mountains
Debris Flow	Hills and mountain, severe in areas of elevations greater than 1700 m that are covered by glacial deposits of previous ice-age
Glacier Lakes Outburst Floods (GLOF)	Origin at the tongue of glaciers in higher Himalayas, flood flow reach up to middle Hill regions
Avalanche	Higher Himalayas
Fire (forest)	Hills and Terai (forest belt at foot of southern-most Hills
Drought	All over the country
Storms/ Hailstorm	Hills
Human-induced Hazards	
Epidemics	Terai and Hills, also in lower parts of Mountain region
Fire (settlements)	Mostly in Terai, also in mid-Hill region

[4] Project Report on Systematic Inventory and Evaluation for risk Assessment, Country Situation Analysis-Nepal submitted to Global Risk identification Programme and submitted by NSET Nepal

[5] An Overview of Hydro-climatic disaster and its Risk Reduction in Nepal. Proceedings of the Workshop on Flood Forecasting Management in Mountainous Areas, Department of Hydrology and Meteorology, 12-14 June, 2006, Kathmandu

Accidents	Urban areas, along road network
Industrial/technological Hazards	Urban / industrial areas
Soil erosion	Hill region
Social Disruptions	Follows disaster-affected areas and politically disturbed areas

Source: NSET (2005); Dixit, 1996[6] (with modifications)

2.2 Floods in Nepal

Flooding is a situation of spilling water from a river or spring when water flow exceeds its carrying capacity leading to overflow of rivers or streams from their natural or artificial banks, inundating adjacent low lying areas. In short, a flood is a 'great flow of water, causing overflow and inundation'(Chamber, 1981 & Fleming, 2002). Floods are natural events resulting from high rainfall and can be made worse as a result of land use changes (Fleming, 2002).

2.2.1 Causes and Types of Flood

The major triggering factors of flooding in Nepal are: highly concentrated rainfall in monsoon season, high relief, steep mountain topography, and deep and narrow river valleys. Rainfall in summer monsoon triggers flooding in all ecosystems zones of the country from South-North. A topographical cross-section shows different types of flooding in different ecological zones: flood & debris flow in Terai-Churia range, landslide & flood in Middle Mountain and GLOFs & landslide in high mountain range (Figure 2.4).

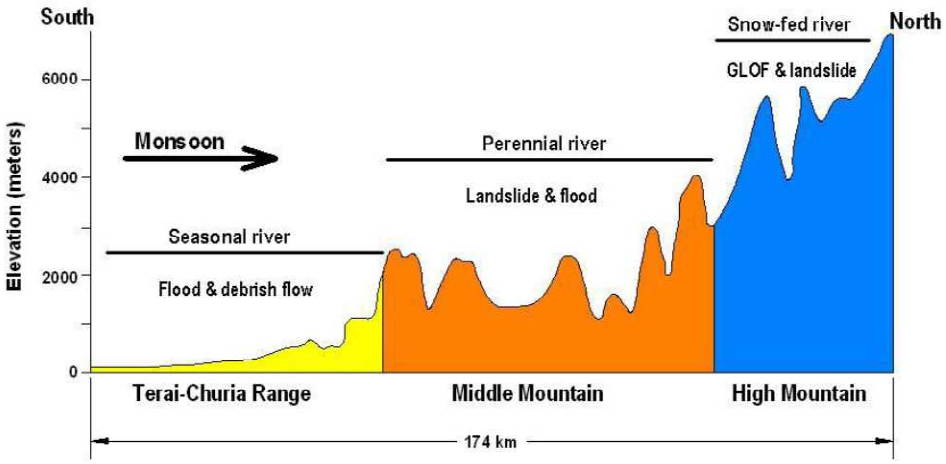


Figure 2.4: South (Birgunj)-North (Langtang-Himal) Topographical cross-section showing different types of flooding and Nature of rivers in all types of ecological zone (Source: CRED, 2009[7])

[6] Ajaya Dixit, Floods and Vulnerability: Need to Rethink Flood Management Natural Hazards, Volume 28, Number 1 / January, 2003 DOI: 10.1023/A:1021134218121

[7] Working Paper: Disaster Category Classification and peril Terminology for Operational Purposes, Common accord, Center for Research on the Epidemiology of Disasters (CRED) and Munich Reinsurance Company (Munich, RE)

Rainfall Variability and Severity

The rainfall in the country varies greatly from place to place because of the topographical variation. Impacts of intense and widespread precipitation during the monsoon depend on the geographical situation and topographical elevation. The precipitation variation with respect to elevation has been shown in Figure 2.5 and Figure 2.6. Precipitation is generally concentrated in the regions below 500 m. Precipitation is relatively low in High Mountain and High Himalaya. It indicates that the occurrence of flooding in the Terai and Churia is comparatively higher than in high elevation zones.

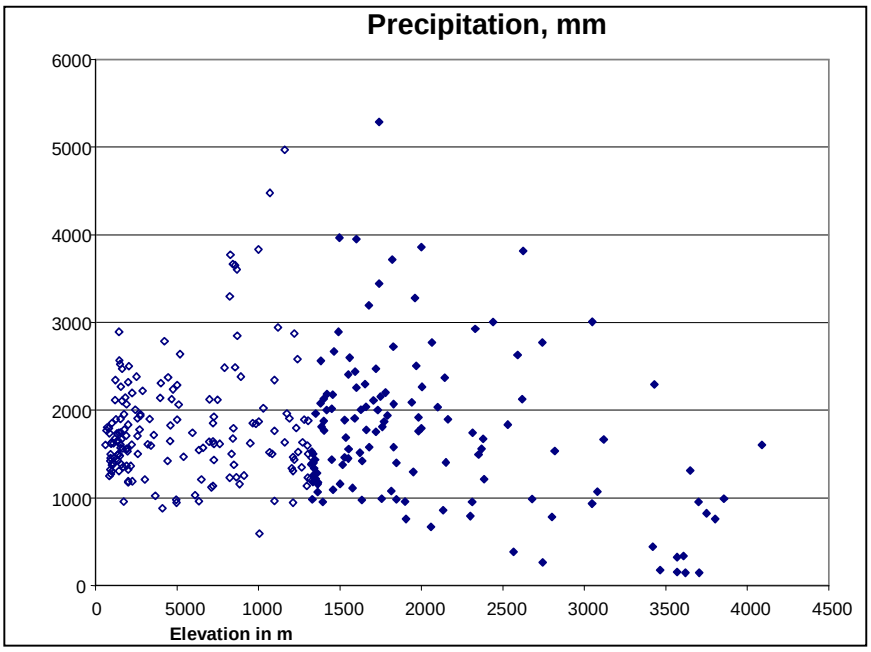


Figure 2.5: Attitudinal variation of Annual Precipitation

Furthermore, in the context of variability of the monsoon, the study (Sharma,2003) compares the sever rainstorms of 1880,1993 and 1994 and shows that the 1880 and 1993 storms were severe in terms of local intensity and 1924 storm was the severest in terms of widespread heavy precipitation. The scale of disaster also depends on the nature of the distribution of severe rainstorms. About 80% of the total average annual rainfall occurs during the summer monsoon in the country.

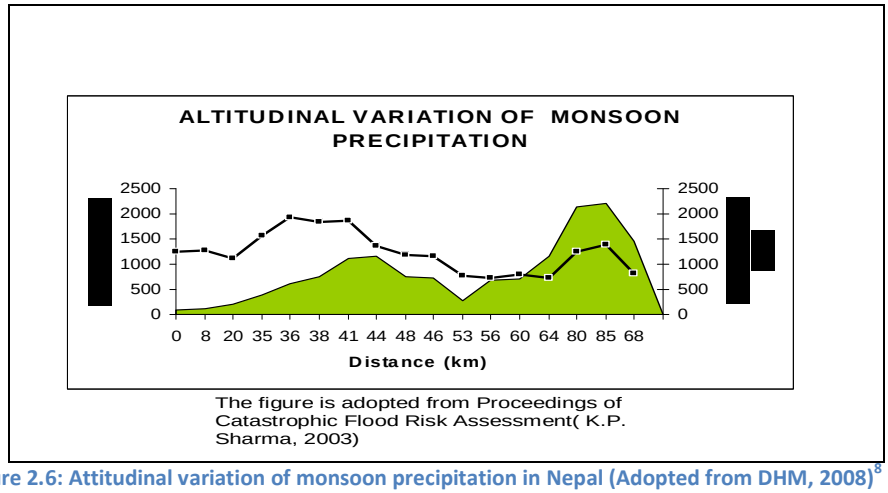


Figure 2.6: Attitudinal variation of monsoon precipitation in Nepal (Adopted from DHM, 2008)[8]

Extreme rainfalls trigger flash floods in Siwalik and Plain regions of the country. Siwaliks and the Terai belt, although receiving annual rainfall lesser in amount compared to some typical mountainous areas, they generally receive high 24 hour rainfall. Maximum and minimum of 24 hour extreme rainfall was found to be recorded in Hetauda (482.2 mm) and Mustang (51 mm) respectively (GoV,nd)[9]. The highest extreme rainfall pockets are located in the foothills of Mahabharat and Siwaliks in the Central Development region and in the foothills of Siwalik in the Western Development region (Figure 2.7).

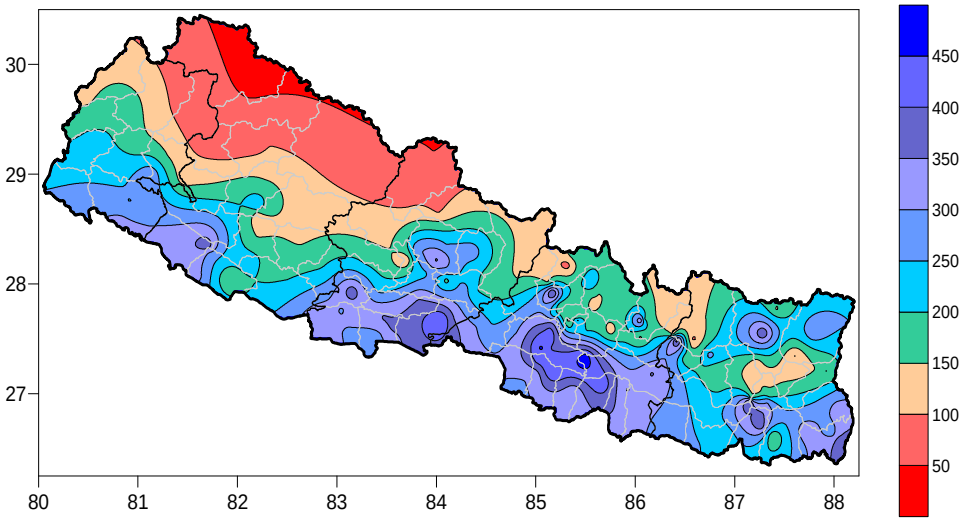


Figure 2.7: 24-hour Extreme Rainfall variation in Nepal

Types of floods

Due to s complex physiographical terrain of the country, the types of flooding are not particularly defined in literatures. Various publications and reports have highlighted the types of flooding in a different manner.

[8] DHM (2008). Study on Review of Hydrometric station network of Nepal, Final Report Submitted by Nature's Conservation Pvt Ltd. to Department of Hydrology and Meteorology, Babarmahal, Kathmandu

[9] GoN (nd). National capacity self-assessment for global environment management, Nepal Thematic Assessment Report: Climate change, Ministry of Environment, Science and Technology, Government of Nepal.

The types of floods in Nepal are classified on the basis of the factors triggering a flood. For example, DHM, 2010 highlighted five types of flooding which are as follows

Floods due to Rainfall and cloudburst: due to a sudden cloud outburst, localized disastrous flood occurs frequently in the foot hill of mountainous and siwalik regions in monsoon season. This type of flood is common in the Sourthern Terai bels, inner Terai and in the valleys.

Glacial lake outburst floods (GLOFs): The floods due to outburst of glacial lake in high Himalayan region of the country are known as GLOFs. About 2323 glacial lakes have been identified above 3500m amsl in the country. Of these, (ICIMOD, 2001) identified 20 glacial lakes including 16 lakes in Koshi basin and 4 in Gandaki basin as potential hazards in the country.

Landslide dam outburst floods (LDOFs): The floods due to the outburst of temporary lakes in high and middle mountain areas of Nepal are called LDOFs. The temporary lakes are usually formed due to blockage of river flow when landslide occurs along the river banks. Such blockage of the river flow is common in narrow valley where the slopes are steep on both sides of the river.

Floods triggered by the failure of infrastructure: The floods due to failure of infrastructures like check dams, embankments, bridge, barrage, etc are termed as floods triggered by the failure of infrastructures. Such floods usually occur in those areas where infrastructures on or along the rivers are poorly designed or poorly maintained

Sheet flooding or inundation in lowland areas due to an obstruction imposed against: this type of flood is common during summer monsoon in lowland areas in the Terai region. Such floods usually occur as a result of obstruction in the natural flow due to the infrastructures developments, such as, roads, culverts, check dams, embankments etc.

The chronology of major flood events in the country has been listed in Box 1.

Box 1: Chronology of Major Floods in Nepal

- 1954 flood in Koshi River
- 1968 Flood in Budhigandaki-Lukubeshi-LSOF
- 1978 flood in Tinao Basin
- 1980 flood in Koshi River
- 1981 flood in Lele Lalitpur
- 1981 flood on the Bhote Koshi River- Zhangzangbo glacial lake located in Tibet-GLOF
- 1981 Flood in Butwal-IFOF (Infrastrucutre Failure Outburst Flood)
- 1982 Flood in Sunkoshi River-Barhabise-LSOF
- 1982 Flood in Balephi Khola in Sindhupalchok-LSOF
- 1984 Flood in Sindhuli, Makwanpur and Udayapur-Riverine Flood
- 1985 Flood in Tadi River Basin-cloudburst
- 1985 Flood in Trisuli River-Hydropower-LSOF
- 1985 GLOF on Dig Tsho Lake in Dhudkoshi-GLOF
- 1986 Flood in Flood in Gyangphedi Khola-Nuwakot-LSOF
- 1987 Flood in Sunkoshi Basin-submerged in central and eastern Terai-1 m
- 1989 Flood in Central Region-Clustburst-Chitawan and western region-Inner Terai-Butwal,Parasi
- 1990 Flood in Rapti River-Chitawan-IFOF
- 1993 Flood in Central region-1336 human lost, 73000 hhs affected, Pritivi highway damaged, Kulekhani 1 and 2 Power stations damaged-Rs. 5 billion total loss-RF, IFOF
- 1996 Flood in Larcha River-IFOF
- 1998 flood in syangja
- 2002 Flood in Bagmati in KTM
- 2007 Flood in Kailai and Banke
- 2008 Flood in Kanchanpur, Kailali, Bardiya, Koshi (IFOF)

2.2.2 Flood Prone Areas

Flood prone areas of Nepal can be classified as: Erosion Prone Areas; Sedimentation Prone Areas; and Inundation Prone Areas[10]. Erosion prone areas are the zones where bank erosion and river cutting causes heavy damage to cultivated lands, houses, roads and other physical properties during the monsoon season. Such areas lie mostly along the banks of a river. Sediment prone areas are the deposit zones where rivers deposit suspended

[10] Manual for Community-Based Flood Management in Nepal, ***Asia Pacific J. Env. Dev.*, 11**(1&2), 2004, pp. 227-304

sediment and bed-load originated in the mountain and Siwaliks. Massive deposits in some river sections can change river course widening channel cross-section in some instances. The area is usually covered with course sand in channels and cultivated lands in the Bhabar zone and Plain regions. Inundation Prone Areas (IPA) is plain lands where fine sediments gets deposited. In some cases the fine sediments containing crops nutrients help to increase crop yield The spreading flood water submerges agricultural land, settlements and development services. Flood management in IPA depends on the frequency, depth, and duration of floods.

There are different flood depths that cause the severity of flood impacts, such as: more than 60 cm (Severe), 60 to 30 cm (Moderate) and less than 30 cm (Normal) Similarly, regarding duration of standing floodwater, duration more than 30 hours (Severe), 12 hours to 30 hours (Moderate) and less than 12 hours (Normal).

A flood plain can include full width of narrow stream valleys, or broad areas along streams in wide, flat valleys. In addition, a channel and flood plain are both integral parts of the natural conveyance of a stream. A flood plain carries flows in excess of channel capacity (Chow et.al. 1988). In this regards, flood frequency indicates the extension of flood plain and its management. U.S. Federal Emergency Management Agency (FEMA) provides a standard national procedure by considering the 100-year flood as the base flood for the purpose of flood plain management measures.

2.2.3 Flood Hazard, Flood Vulnerability and Flood Disaster Risk

2.2.3.1 Flood Hazard Mapping and Evacuation Route

Flood hazard maps show areas which could be flooded in different scenarios. A literature review shows that flood hazard mapping in Nepal is still in preliminary stage (Box 2). Most of the flood protection work is carried out at local level without considering basin/watershed scale processes. Most of the literature produce prepared hazard maps by delineating flood hazard areas by locating flood prone areas identified in the past. There are some studies that have applied different models for flood risk assessment. They are not uniform nor they use similar standards. The scope of work are in model applications are mostly extended to basin scale.

The Department of Water Induced Disaster Prevention (DWIDP), the lead agency of water induced disaster management, has the mandate for water induced disaster prevention activities (WRS, 2002). There are nine activities listed in the strategy, which include establishment of water induced warning systems and hazards/ vulnerability mapping. , These key activities were supposed to be undertaken in at least 20 priority districts by 2010 and over the country by 2017 (NWP, 2005). In order to carry out this work, DWIDP is working for the preparation of water-induced hazard maps. Other government and non-government organizations, such as ICIMOD and DHM are also working in the field of flood forecasting, developing warning systems and hazard mapping. However, because of constraints in essential data, a reliable hazard map is still a challenge.

Some flood hazard maps prepared by DWIDP are given below. DWIDP has prepared flood hazard maps of different districts and river basins, which include Rupandehi District, Bagmati River Basin, Kamala River Basin, Rapti River Basin, Rangun River Basin, Tinau River Basin, Aandhi Khola River Basin, Kankai River Basin, and Trijuga River Basin. The maps (Figure 2.8 and Figure 2.9) show flood and landslide hazards. These maps do not show provide essential flood information such as, depth of inundation, land use pattern, developed infrastructures, evacuation routes and evacuation area (Baral, M. DWIDP, 2009)[11]. Flood hazard mapping

[11] www.dwidp.gov.np

should be done by including all the important information of flood hazard mapping for smaller area so that communities can take advantage of such maps.

Box 2 : A study ICHARAM (2005) pointed out the challenges including the problems of the flood hazard mapping in Nepal (Modified by this study)

- Lack of quality in data, compatibility consequence on accuracy of flood hazard mapping,
- Hydro-metrological data: DHM has established many measuring stations throughout the country. Hydro-meteorological data are available for many river basins. However, lack of resources, poor access to advanced techniques, inadequate equipment and lack of accountability are causing problems in the reliability and consistency in data. Recently, DHM has begun the telemetry, automatic recording and disseminating systems for a few hydrological and meteorological data
- Satellite images, land-use and topographic maps: DoS, a government authority to preserve and revise satellite images, land-use maps and topographic maps of Nepal. High quality satellite images, precise land-use map and high resolution topographic maps are not available for developing and modeling flood hazard maps. At present there are many changes in land use pattern which are not taken into account. Old topographic maps (prepared in 1995) lack of updating with recent information.
- Digital elevation model (DEM): Generally GIS based DEM of the study area are available for free download from the internet. DoS is also providing DEM but these data are not as precise as available in the market. Availability of precise DEM is another problem to develop accurate flood hazard maps at different scales.
- Lack of investment for precise data generation.
- Concept of flood hazard mapping and non-structural countermeasure works are somewhat new in Nepal,
- So far, we don't have reliable flood hazard maps. There are limited practices in early warning and evacuation. Departments and publics have limited awareness regarding the benefit of flood hazard mapping.
- Investment of Nepal Government on pre-disaster preparedness activity is far from sufficient. Limited resources re made available by the government for initiation such activities.
- Low priority on hydro-meteorological observation, data collection and research activity which are essential for inundation analysis, flood hazard mapping and development of early warning system. However, early warning system has been considered in high priority in NSDRM and it reflects in the National strategy for Early Warning system which has been drafted by the government.
- Flood hazard maps developed by different departments are not useful enough for dissemination,
- Lack of availability of precise data and appropriate software for inundation analysis and flood hazard mapping,

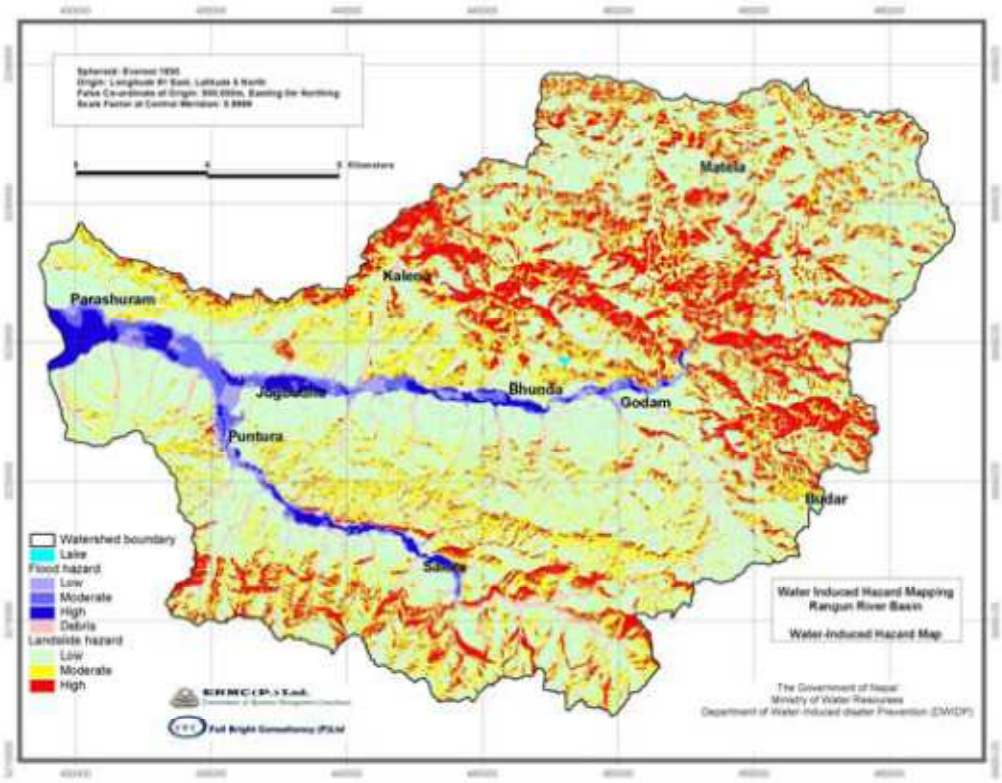


Figure 2.8: Integrated water induced hazard map of Rangun River basin (source DWIDP, 2009)

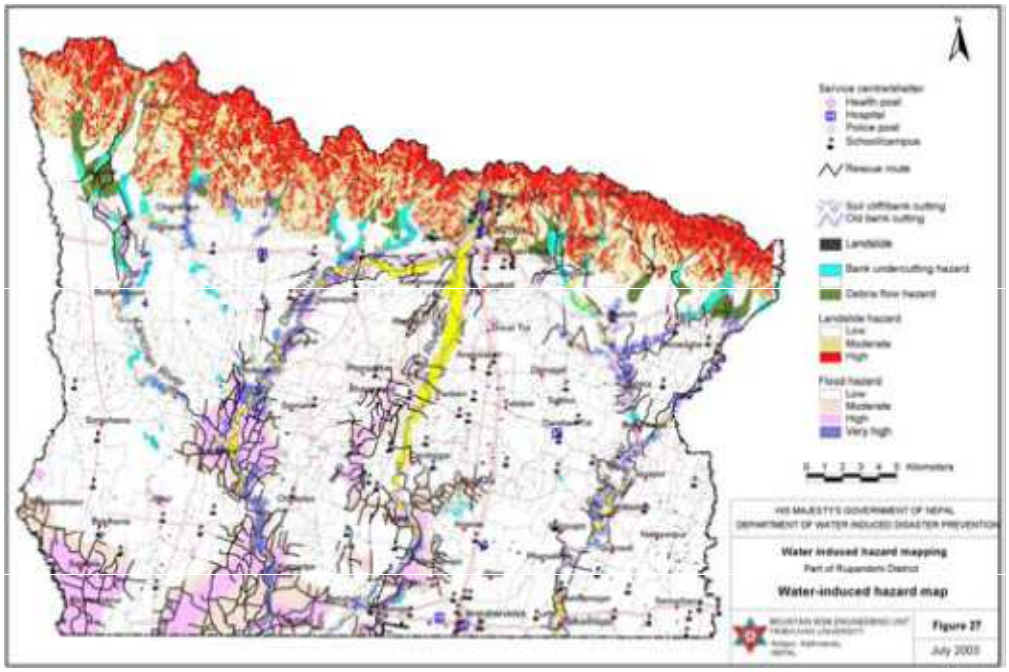


Figure 2.9: Flood Hazard Map of Rupandehi District (DWIDP, 2009)

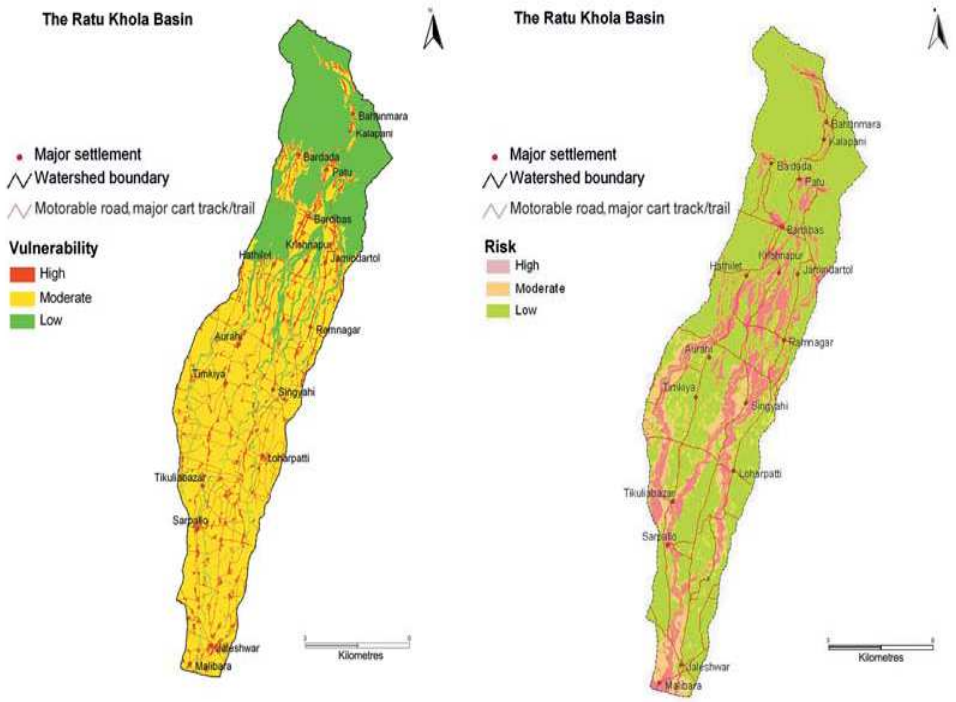


Figure 2.10: Flood vulnerability and Flood risk maps of Ratu Watershed

DHM has developed flood warning and danger level maps of a few river basins, such as Narayani River Baisn, West Rapti River Basin, East-Rapti River Basin, Koshi River Basin, Kankai river Basin, Karnali River basin and Babai River Basin. Some reports of these studies were available during the literature survey. In summary, the flood forecasting studies of different rivers carried out by DHM has highlighted modeling aspects hydrologic analysis for flood forecasting including inundation depth and its duration in downstream. Such techniques were applied for defining warning level and danger level of flows at respective DHM gauging sites. For examples, high danger level map or Inundation map of Narayani River Basin in downstream is defined when flows exceed 20,000 cumecs (10m gauge reading) (Figure 2.11). Similarly, high danger level map or Inundation map in downstream areas is defined when flow exceeds 10,000 cumecs (7m water level) on West Rapti River at Kusum (Figure 2.12). ICIMOD has prepared flood vulnerability and flood risk maps of Ratu watershed by incorporating community experiences on floods and hydrological models with Geographic Information System (GIS) (Figure 2.10).

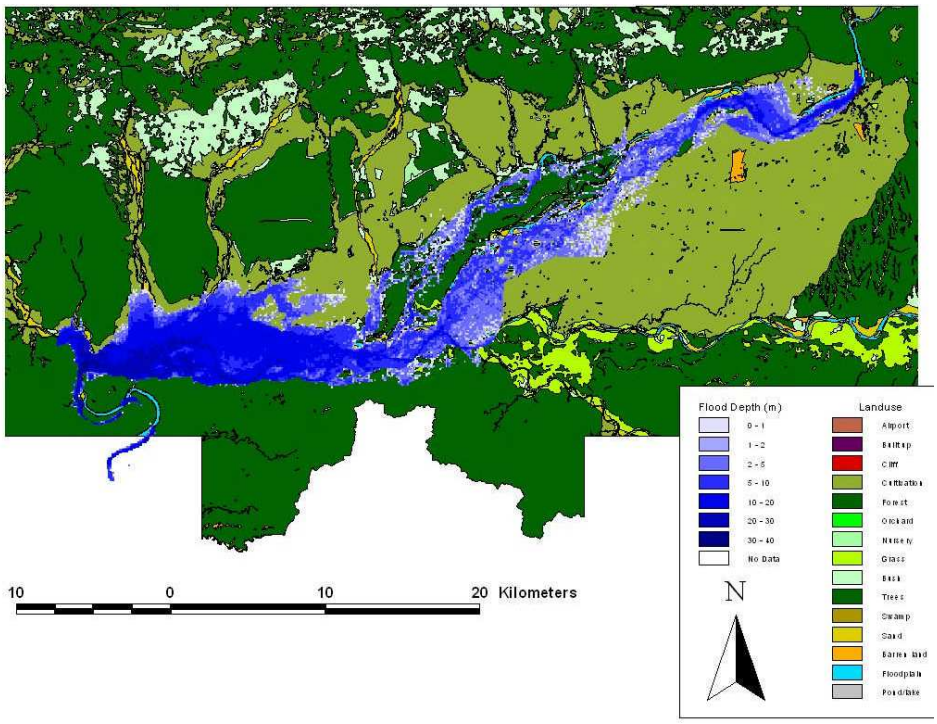


Figure 2.11:Flood Inundation Map of Narayani River Basin

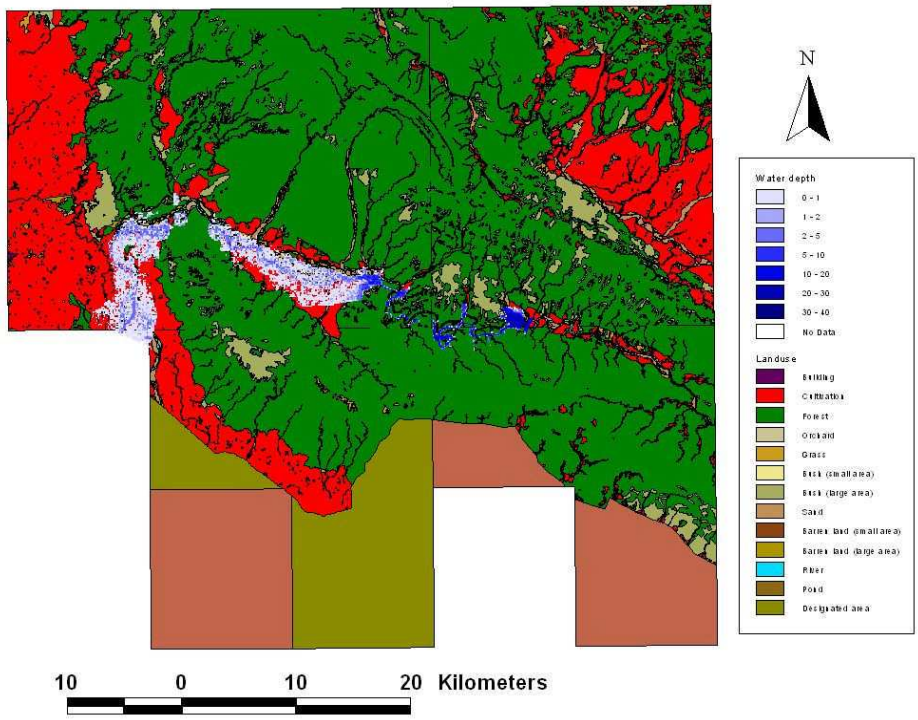


Figure 2.12 Flood Inundation Map of West Rapti River Basin[12]

[12] DHM (2010). Determination of Flood Danger level in flood forecasting stations, Department of Hydrology and Meteorology, Government of Nepal

The maps produced by the department are basically for the purpose of flood forecasting to save the lives of people in downstream floodplains. To some extent, the flood inundation maps (Figure 2.11 and Figure 2.12) are applicable in selecting the sites for community development project, such as the WASH scheme. . However, many constraints and challenges need to be assessed while using such maps for selecting sites for the project. Similarly, the accessibility of such maps is difficult in public domain.

Several flood hazard maps discussed above are questionable for full acceptance and practicability in the field. High level of expertise and technologies are required for flood hazard mapping applicable for the communities. It is only possible when science-based technology and community experiences are integrated in the process. In this regards, a guideline highlights that a good flood hazard map is one that is simple and community-friendly, based on the community's level of understanding rather than a high-ended digitized GIS[13]. Furthermore, a good practice is to have the community people draw their own maps, zooming in on specific areas within the community and then confirmed through actual ground surveys. Community-based flood hazard map will serve as a means for identifying evacuation sites and routes. The map should be updated whenever necessary. Accordingly, guidelines for flood evacuation need to be developed.

2.2.3.2 Flood Vulnerability

In general, flood vulnerability is a situation of susceptibility to loss from flood events. Furthermore, vulnerability is a human condition or process resulting from physical, social, economic, and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard (UNDP, 2004)[14]. The flood risk is neither practically nor economically feasible to eliminate, the most suitable approach for dealing with flooding therefore be the risk management (Fleming, 2002 pp27). Technical approaches are available for relatively accurate prediction of some criteria that pose risk to flood. Such criteria are: flood zone (where flooding will occur), timing of flood, lead time, magnitude of flood, extent of flooding, duration, rate of rise, flood depths, velocities and damage. The accuracy of timing of occurrence of flood is uncertain.

Flood risks become dynamic due to increasing pressures on development, limited resources, climate change and increasing sophistication of society. Based on the IPCC model-vulnerability is the function of exposure, sensitivity, adaptive capacity. Flood vulnerable map by districts is given in Figure2.13.

[13] http://kidlat.pagasa.dost.gov.ph/ffb/CBFFWS_Guidelines.pdf
[14] http://www.apfm.info/pdf/flood_mapping/21Approaches_to_flood_vulnerability_assessment.pdf

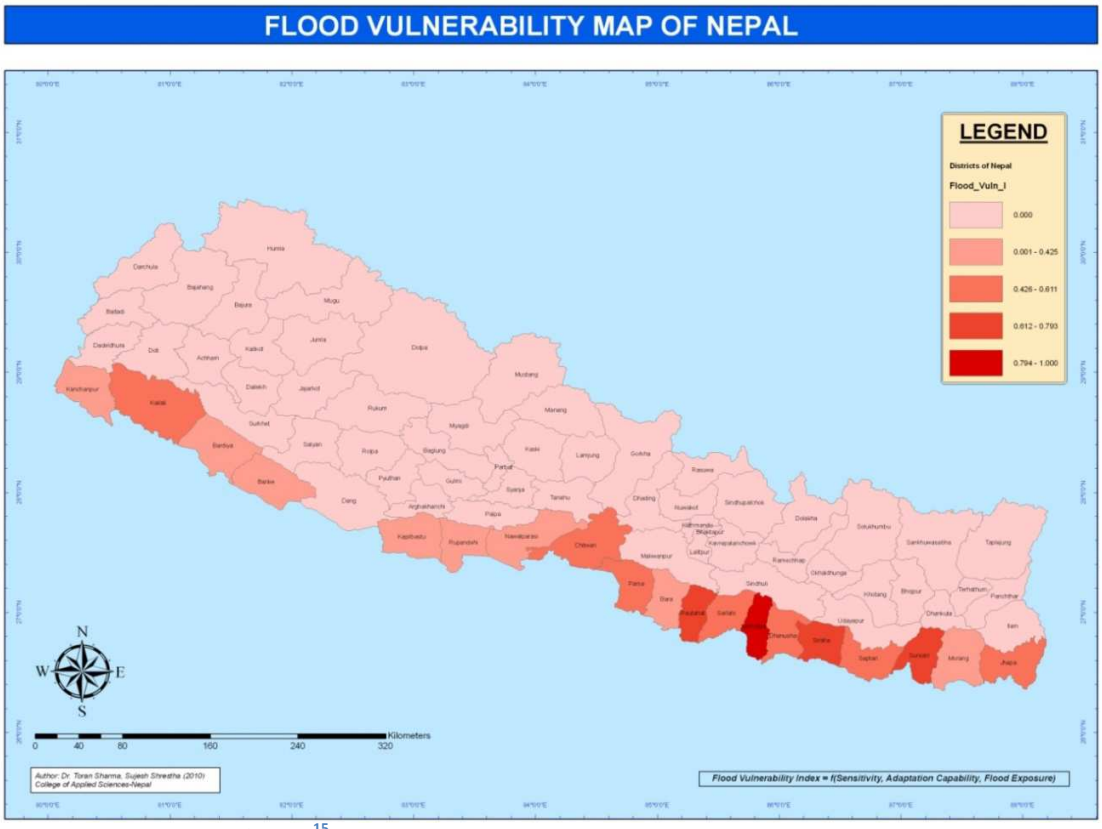


Figure 3: Flood Vulnerability Map of Nepal[15]

The flood vulnerability has been assessed by districts in the National Adaptation Programme for Action (NAPA) by considering several indicators (Table 2.3). The degrees of flood vulnerability ranking by district are given in Annex 2.1. The selected indicators are: population density, ecology/protected area & forest coverage area (in terms of sensitivity); occurrence, death, Injured population, property loss, rainfall exposure point of view); socio-economic-human development index, human poverty index, gender development index, human empowerment index; infrastructures-road length, area, landline phone and population technology-irrigation coverage area (in terms of adaptation).

Table2.3: The degrees of flood vulnerability by Districts

Degree of Flood Vulnerability	Districts
Very High	Mahottari
High	Rautahat,Chitwan,Parsa,Saptari,Siraha,Sunsari,Dhanusha,Bara
Moderate	Sarlahi,Nawalparasi,Kailali,Jhapa,Morang,Kanchanpur,Bardiya
Low	Banke,Kapilbastu,Rupendehi
Very Low	Accham,Arghakhanchi,Baglung,Baitadi,Bajahang,Bajura,Bhaktapur,Bhojpur,Dadeldhura,Dailekh,Dang,Darchula,Dhading,Dhankuta,Dolakha,Dolpa,Doti,Gorkha,Gulmi,Humla,Ilam,.....

Source: NAPA, 2010

[15] GoN (2010).

2.2.3.3 Flood Disaster Risk

Flood disaster risk is the combination of the probability of a flood event and potential adverse consequences to human health, the environment and economic activity associated with a flood event. Figure 2.14 shows all types of disaster occurrence for the period of 1983-2010 and highlights two major natural disasters-Flood and Landslides (about 35 % of the people killed due to flood and landslide). Disasters related to epidemics have the highest level of percentage. Likewise, the trend of people killed only due to flood for the period of 1980-2011 is seemed to be decreased in the country (Figure 2.15).

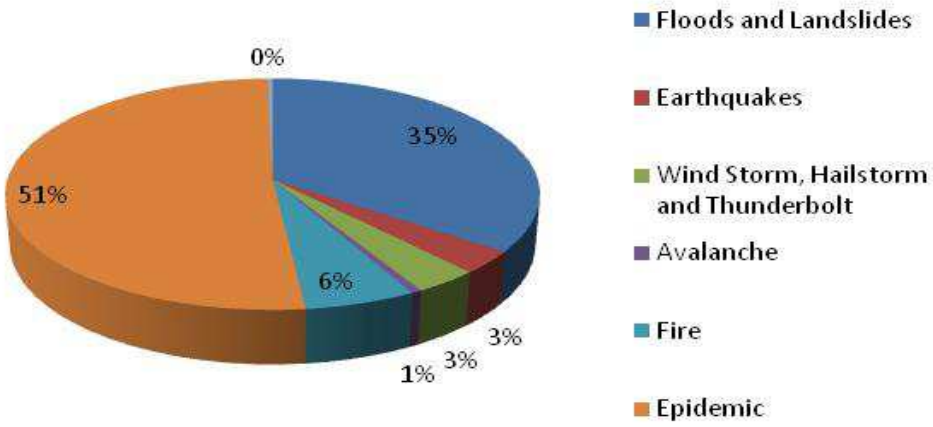


Figure 2.14: Flood and landslide is prevalent natural disaster in Nepal (1983-2010)[16]

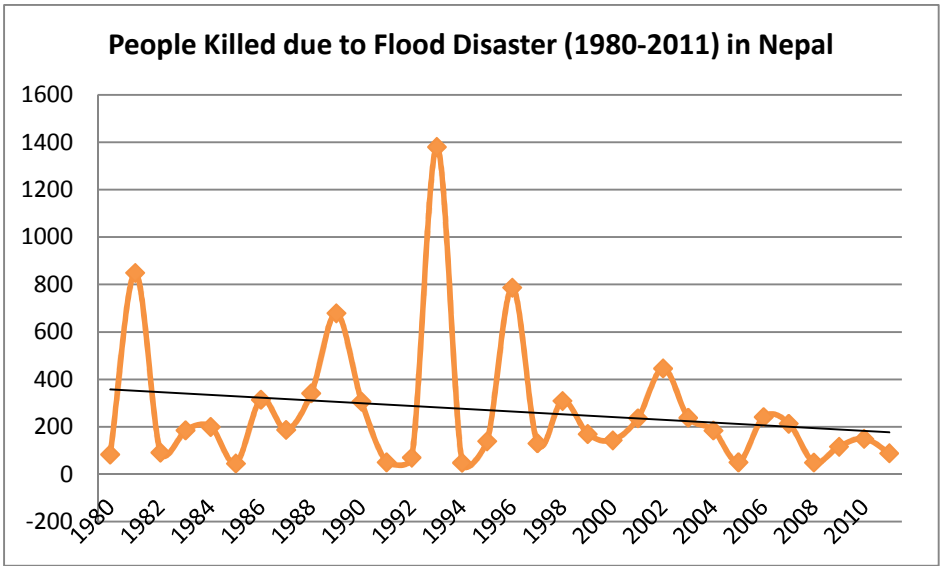


Figure 4: Trends of people killed due to flood disaster over the last three decades in Nepal (Data source[17])

[16] DWIDP Disaster Bulleten, 2011
[17] http://www.emdat.be/search-details-disaster-list; DHM, 2004 and Paudel, D., 2001

Recently, a major flood hit the southern region of the country in 2007. About 13 districts were highly affected due to flooding (Figure 2.16). The affected districts were: Saptari, Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, Bara, Parsa, Nawalparasi, Rupandehi, Banke, Bardiya and Kailali. Many water sources, such as tube wells were submerged in flood water. Water treatment measurements, such as bottles of water guard, bleaching powder, aqua tablets were distributed to the flood affected population. Flood water exacerbated sanitation problems by considerably reducing the space available where people can go for defecation. This particularly affected women and the elderly.

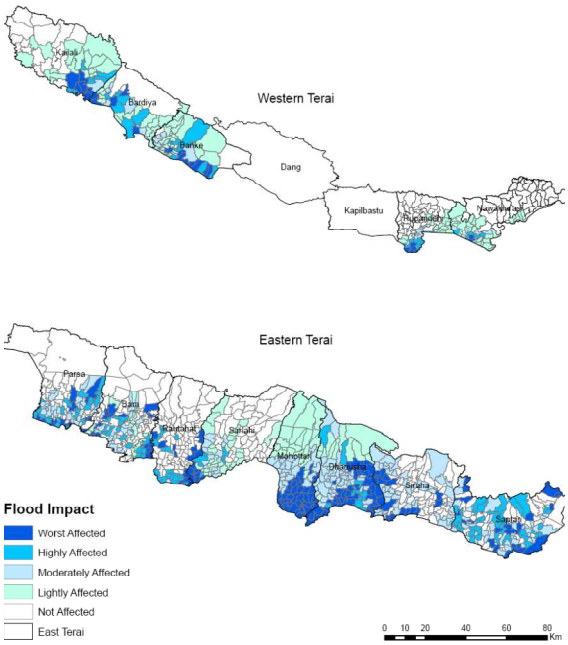


Figure 5: Flood affected areas in Western and Eastern Terai region in 2007[18]

Based on the historical events during the period (1971-2009), on the basis of number of events, deaths, injuries, affected population and properties damaged, the following districts are ranked in different classes of flood risk. Out of total districts of the country, the districts (20 Districts) lie in the Terai region (Table 2. 4).

Table 2.4: Ranking the flood prone Districts in Terai Region in Nepal

Ranking by Flood Disaster	Districts	Ranking by Flood Disaster	Districts
1	Sarlahi	11	Jhapa
2	Rautahat	12	Nawalparasi
3	Chitawan	13	Bardiya
4	Saptari	14	Rupandehi
5	Dhanusha	15	Kailali
6	Mahottari	16	Kanchanpur
7	Sunsari	17	Dang
8	Parsa	18	Bara
9	Siraha	19	Banke
10	Morang	20	Kapilbastu

[18] Inter Agency Rapid Flood Assessment, WEP-UNICEF-Save the Children Alliance, Nepal, August, 2007

Source: UNOCHA, 2010 (DesInventor Data Base)

2.2.4 Flood Disaster Risk Reduction in Nepal

In the history of disaster management in Nepal, the country is considered as one of the first countries in South Asia to have created a policy and legal environment for disaster risk management. The Natural Calamity (Relief) Act, 1982 emphases disaster response and provides the responsibility of the government to provide relief to the victims of the disaster-events. However, there is lack of specific institutional and legitimate mechanisms to address entire phases of flood disaster risk reduction in the country. At the same time, some efforts have been continuing for the purpose of nationwide disaster management.

2.2.4.1 Policy, Legal System and Institutional Mechanism for Disaster Risk Management

The Natural Calamity (Relief) Act, 2039: The act performs a mission to formalize disaster response as a responsibility of the government. Government is responsible to provide relief to the victims of the disaster-events. It designated authorities at the centre and at district levels to coordinate the rescue and relief efforts of various response agencies. The act does not have any instrument to correspond to the current concept of mainstreaming disaster risk management.

Local Self Governance Act, 2055: The act presents environmental friendly local development in line with decentralization approach. Inter-linkages between development process, environment and natural disaster are emphasized in the act. The act provides the authority to the local government agencies DDCs, VDCs/NPs. In contrast, budget for the disaster management is not allocated in the local government even though the act gives responsibilities to them. As a result, the implementation of the environmental friendly approaches is not effective at local level.

National Action Plan on Disaster Management 1996: This Action Plan consists of four components: National action plan on Disaster Preparedness, National action plan on Disaster Response, National action plan on Disaster Reconstruction and Rehabilitation actions, and National action plan on Disaster mitigation.
The following preparedness key activities are included in the plan

- Measures related to national policy and planning for making institutional arrangement, providing legal framework, adopting national policy and plan on disaster management.
- Measures related to geological, hydrological and meteorological hazard assessment and environmental engineering studies.
- Measures for Infrastructure specific and hazard specific preparedness.
- Measures related to strengthening fire-fighting capabilities in fire prone areas.
- Measures related to awareness raising, training, rehearsal, simulation activities.
- Measures related to the establishment of disaster management information system and stockpiling of emergency supply materials

So far as the actions regarding disaster response is concerned, the following key response activities are prepared with the assumption that about 15000 families would be affected by disaster every year.

- Evacuation, search and rescue
- Communication and Transportation
- Temporary settlement

- Health, nutrition and sanitation

Regarding actions plans on disaster reconstruction and rehabilitation, the national action plan emphasized the following actions.

- Develop standard damage assessment format for all types of natural disasters
- Formulate permanent committee for the formulation of rehabilitation and reconstruction planning, guidelines etc.
- Implement income generating programmse for sustainable rehabilitation
- Provide loans to the disaster victims with subsidized interest rates
- Carryout regular capability assessment and inventory preparation at various levels

On the subject of mitigation plans, the following key activities are included in the National Action Plan.

- Allocate funds in national budget for disaster management and mitigation programmes
- Form special disaster cell in the organizations at every key disaster related agency

Water Resources Strategy, 2002 and National Water Plan, 2005: the water resources strategy sets the following nine strategic activities for short-term, medium-term and long-term targets in order to address water induced disaster management in the country.

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

The National Water Plan highlights that the national strategic targets for water induced disaster management would be implemented by 2017. The plan also expects that social and economic losses due to water induced disaster would be reduced to the levels experienced in other developed countries by 2027. Making water-induced disaster management system fully functional, effective and responsive activities are expected in the national water plan.

National Strategy for Disaster Risk Management Nepal (NSDRM), 2009: The strategy (NSDRM) has been developed on the backdrop of the Hyogo Framework for Action (HFA) 2005-2015 and also on the ground reality of the country. Mainly 29 strategic activities under the five priority actions of HFA have been emphasized in the strategy (Table 2.5).

Table2. 5: List of strategic activities prioritized in the NSDRM for DRM

Priority Action of HFA	Strategic Activities
1. Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation	1: Establish the institutional system for DRM 2: Formulate/modify and enact policies, rules, regulations for incorporation comprehensive disaster risk management concepts 3: Mainstream DRR into national development 4: Integrate DRR and preparedness for better response in the development plans, programmes and regular activities of local Development institutions (DDCs, VDCs and Municipalities etc.) 5: Prepare and gradually implement various policies and protocols, standards, guidelines, hazard-specific Standard Operating Procedures (SOPs) and hazard-specific special national programmes for DRR 6: Establish a network of Emergency Operation Centers (EOCs) one at the central level and others at the district and municipality levels 7: Allocate resources and One-door system for the development of sustainable funding mechanisms
2: Identify, assess and monitor disaster risks and enhance early warning	8:Assess disaster risks due to different natural hazards and vulnerabilities at different levels and different scales; and develop a system to periodically update and make it publicly available 9:Establish and institutionalize an authentic, open and GIS-based Disaster Information Management System (DIMS) at the central, district and municipal levels to cover all disaster-related information 10: Establish a national system of hazard/risk monitoring and early warning to specific hazards 11:Prepare land use maps focusing on urban and urbanizing areas, and develop a system for periodically updating and using it for land use planning
3:Better knowledge management for building a culture of safety and resilience	12: Develop/modify the National Policy on education and implement it so that it gives recognition to schools as important centers for propagating disaster awareness. 13: Teach about disaster education 14: Develop curricula on DRR training for different target groups and implement training programmes for all stakeholders 15: Develop and implement a comprehensive national programme for disaster awareness 16: Develop plans, programmes and facilitate for use of mass communication media for dissemination of information on disaster risk and risk reduction 17: Develop/strengthen and encourage awareness raising programmes on DRM at the local level 18: Encourage and support NGOs, CBOs and other stakeholders For developing and implementing awareness-raising

	Programmes on disaster risk reduction and preparedness
4:Reducing the underlying risk factors	19: Integrate disaster risk reduction consideration into infrastructure development planning and implementation 20: Assess, protect and strengthen critical public facilities and physical infrastructures 21: Develop and implement, on a priority basis, special DRR programmes for the most vulnerable segments of the society – the marginalized and Dalit groups; women; the handicapped; disadvantaged groups, children and the elderly 22: Incorporate disaster risk reduction measures into post-disaster recovery and rehabilitation processes 23: Develop and promote alternative and innovative financial instruments for addressing disaster risk reduction
5:Enhance preparedness for effective response	24:Develop and enact National Integrated Disaster Response System 25: Develop and implement emergency response and preparedness plan, including setting up a system of emergency operation centers throughout the country 26: Establish and/or strengthen warehousing and pre-positioning capacities at strategic locations (centre, district, municipality and villages) for storing food, medicines, other relief supplies such as 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, identify volunteers and empower them by mobilizing schools and communities

Source: NSDRM, 2009

Further, the strategy focuses on the following sectors for disaster risk reduction in the country. Water and Sanitation is one of the sectors given in the national priority in DRR.

- Agriculture and food security
- Health
- Education
- Shelter, infrastructure and physical planning
- Livelihood protection
- ***Water and sanitation***
- Information, communication, coordination and logistics
- Search and rescue, and damage and needs assessment

Challenges including issues and gaps of each sector are highlighted in NSDRM. The challenges in water and sanitation sector are presented in Chapter 3. Some strategic activities/actions related with WASH in HFA are highlighted in Table 2.6.

Table 2.6: Main strategic activities of the sector-Water and Sanitation

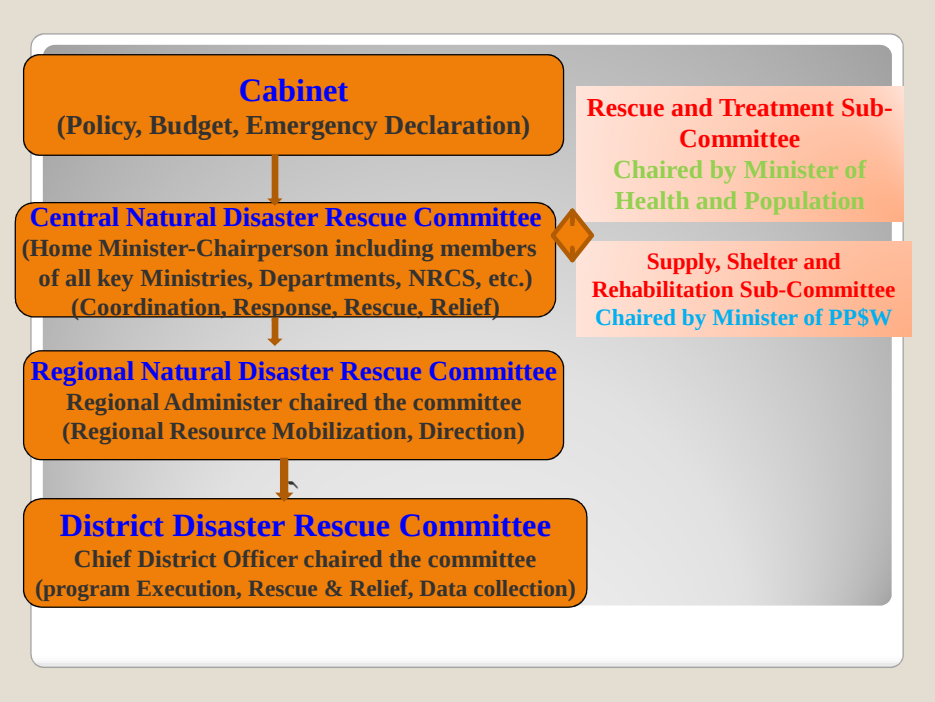
Priority Action of HFA	Strategic Activities
1. Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation	• The existing government policies and strategies for the water and sanitation sector need to be amended to reflect the urgency and importance of DRM finding ways to address it including clarifying the DRM roles and responsibilities of concerned government agencies. Such policies and laws should be responsive. • Dissemination and integration of existing or the amended policies into practice should be given priority especially by supporting the local governments in establishing such programs. • Incorporate disaster risk reduction and emergency response management for the water and sanitation sector in the district development plan. This should include a 1. WAT/SAN emergency preparedness plan for provision of emergency water and sanitation 2. Restoring the WAT/SAN facilities post disaster including identify a convenient and safe location for locating water storage during emergencies • Update the Policy for water and waste management as per this strategy
2: Identify, assess and monitor disaster risks and enhance early warning	• Ensure that disaster risk assessment of water and sanitation systems is carried out and feasible options identified for uninterrupted water/sanitation services is assured by developing contingency plan and implementing mitigation measures. • Identify for each city the disaster risk to the sanitation system and prepare alternate plans especially for disaster emergency period • Prepare disaster preparedness and emergency response plan at the central level and for each municipality. • The DDC should ensure that emergency response plan for each VDC also includes emergency planning for uninterrupted water supply and sanitation system. • Propagation of the risk management and response plan of action to all concerned stakeholders is needed.
3:Better knowledge management for building a culture of safety and resilience	• Conserve and save water sources (intake of drinking water lakes etc). • Monitor water quality (according to WHO standards or national standards). • Promote local level water treatment procedures at the household level or point of-use-PoU (like screening, sand and coal methods, and SODIS method). • Disseminate information to the general public on water and sanitation and promote the use of existing local knowledge on water and sanitation

	• Train people, community & local persons in the provision of emergency water and sanitation facilities. • Increase awareness among the community to safeguard water / sources and have effective sanitation systems.
4:Reducing the underlying risk factors	• Accord priority for water and waste management. Increase storage capacity of drinking water in city and rural areas. • Promote local level water treatment procedures at the household level and the use of low cost technology for water treatment at point-of-use and sanitation facilities. • Adopt water resources mapping and comprehensive water quality monitoring. • Protect and conserve water sources and have in-built system to repair damaged pipes, wells, tube wells etc. • Monitor water quality according to set standards. • Budget allocation, allocation of human and other resources for DRM needs to be made at all levels, as part of a Contingency Plan to address disaster scenario.
5:Enhance preparedness for effective response	• Utilize and conserve water flowing away from traditional sources as stone spouts and use them during emergencies. • MOLD should ensure that all DDCs integrate WAT/SAN issues in the District level disaster risk management plan which itself should go into the district periodic plan. • Establish Disaster Risk Mitigation warehouses at central & regional levels so that a minimal provisioning of life saving WATSAN supplies at District/town levels are prepositioned.

Source: Adopted from NSDRM, 2009

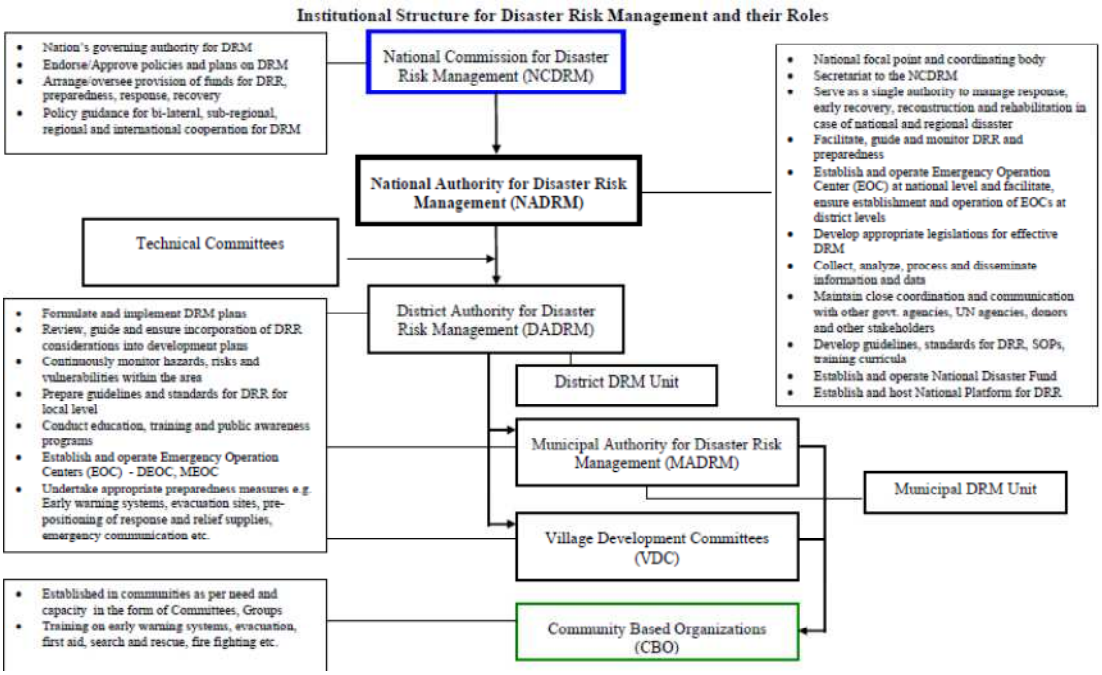
Existing and Proposed Institutional Mechanism

The existing institutional system for disaster risk management in Nepal is based on the Natural Calamity (Relief) Act 2039. According to the act, at the central level, it constituted the Central Disaster Rescue Committee (CDRC) with the Minister of Home Affairs as the Chair. The CDRC would meet as and when necessary to address the needs of the affected population and on matters related to all sectors (e.g. food, health, shelter, water and Sanitation, etc.) when a disaster occurs. Likewise, Regional Disaster Rescue Committee (RDSC) has been established at regional level according to the act to coordinate the emergency response when a disaster affects in a region. District Disaster Relief Committees (DDRC) has been designated at district level to coordinate relief and preparedness activities. DDRC is chaired by the Chief District Officer (CDO) and Local Development Officer is the member-secretary of DDRC. The governmental existing system is outlined in a diagram below.



Proposed institutional mechanism

National Council for Disaster Management (NCDM) will be the apex body for disaster management under the chairmanship of Prime Minister of Nepal. The council may include all cabinet ministers including ministers of Communication, Defense, Home Affairs, Foreign Affairs, Finance, Education and Social Welfare, Chief of the Army Staff, Inspector General of Police, Inspector General of the Armed Police, and representatives of Civil Societies. Likewise, National Disaster Management Authority (NDMA) will serve as the national focal point under the NCDM for facilitating and monitoring implementation of disaster risk management strategies in Nepal. NDMA will be the single authority to manage response, early recovery, reconstruction and rehabilitation in case of national or regional disaster. For institutionalized operations, all stakeholders including government department or agencies and emergency responders will work through and form a part of NADRM for the stated period. Several committees will be established at central level for the effective implementation of all the phases of disaster management cycle. The committees are as follows: Preparedness Management Committee, Rescue and Relief Management Committee, and Reconstruction and Rehabilitation Management Committee. Preparedness Management Committee under the coordination of Ministry of Local Development will be formed to coordinate all the activities of preparedness in order to reduce the loss of lives and properties. Rescue and Relief Management Committee under the coordination of Ministry of Home Affairs will coordinate the response activities when a disaster hits.



Hyogo Framework for Action (HFA): Nepal's signing of the Hyogo Framework for Action (HFA) in 2005 set the stage for its consideation of DRR on a holistic basis. This step was necessary as Nepal is vulnerable to the increasingly variable and intense impacts of weather, which is likely to be amplified by climate change. The likely scenario is a rise in the incidence of climate-related disasters.

2.2.4.2 Non-government Agencies and Networks and Current Practices

Several international agencies have also practiced disaster mitigation within the sectoral development programms in Nepal. Among them, UN and international agencies include UNDP, UNICEF, UNOCHA; Oxfam-GB Nepal, NRCS, Inter Agency Sectoral Committee (IASC), Action Aid Nepal, Practcal Action Nepal, CARE Nepal, Mercy Corps and Lutheran World Federation. Associated local partners have been involvend in community-based DRR interventions in Nepal for over a decade. Some local organisation are also involved in training and implemenntaion of DRR components.

The Nepal Red Cross Society (NRCS) is engaged in assistance to vulnerable groups in collaboration with Government agencies forvulnerability reduction and disaster mitigation. Initially the NRCS was involved in disaster relief; however, it has subsequently broadened its scope to get involved in mitigation aspects as well.[19] NRCS has been active in getting prepared for delivering assistance and adressing an overall disaser management cycle. NRCS also mobilizes its organisation and volunteers at appropriate levels to carrying out disaster response. It has an advantage of s grass root institutional mechanism, which are located at district to community levels in some areas. NRCS has extensive network collecting disaster information from the district. It also represents through DDRC at district level as well as through CDRC at central levelThe current practices of flood disaster risk reduction in the coutnry are as:

- Livelihood approach
- Bio-engineering and Catchment Management Approach
- Preparedness and Awareness
- Early warning and Evacuation

[19] http://www.nrcs.org/core-area/disaster-management.php

3. DISCUSSION, ANALYSIS AND FINDINGS

This chapter deals with discussion about the findings of the study. It includes the identification of flood prone and flood vulnerability indicators, challenges, gaps and learning on WASH services, flood disaster risk reduction and enhancement of community resilience through sustainable WASH Interventions.

3.1 Flood Prone and Flood Vulnerability Indicators

3.1.1 Conceptualization of Indicators

In general, an indicator is a variable of an operational representation of an attribute (quality, characteristic, property) of a system (G.Gallopin,1997) [20]. Furthermore, an indicator is understood as a tool or a method to measure something in a way that adequately represents what is measured (Robert Joumard & Henrik Gudmundsson, 2007). Organization for Economic Cooperation and Development's (OECD) generally approved definition can be given as, 'An indicator is a parameter or a value derived from a parameter, which points to, provides information about, and describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with parameter value'[21]. According to OECD/DAC, an indicator is, "A quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, to reflect changes connected to an intervention, or to help assess the performance of a development actor" (DAC Glossary of Key Terms in Evaluation, May 2002). The English Language Dictionary describes an indicator as, "An instrument which gives you information." According to the definition adopted by USAID, an indicator is, "A variable, whose purpose is to measure change in a phenomena or process" The European Commission describes (planning) indicators as, "A description of the project's objectives in terms of quantity, quality, target group(s), time and place". Tanguay et al(2009)[22] define that a variable observed become an indicator only once its role in the evaluation of a phenomenon has been established. For example, the number of unemployed is a datum or key variable in economics. Once it is determined that an increase in the number of unemployed express negative economic performance for a given territory, this number becomes an indicator.

Regarding the definition of the indicators mentioned above, there is no literature highlighting the concept of flood prone and flood vulnerability in terms of indicators. However, very few literatures have discussed the characteristics of flood prone and flood vulnerability by highlighting the features of flood prone area and vulnerability to flood risk. In addition to the concept of indicators of flood prone areas, some scientific factors such as flood frequency and elevation are selected as indicators that determining potential flood-prone areas (Southeast Michigan Council of Government, 1995)[23]. So far flooding is concerned, it has three components:

- Exposure to flooding-being the natures and degree to which a system is exposed to significant climatic variations like quantity, magnitude, frequency and seasonality of high water ;

[20] Gallopin, Gilberto Carlos (1997). Indicators and Their Use: Information for Decision Making. Introduction. pp 13-27 in: Moldan, B & Billharz, S. : Sustainability Indicators. Report on the project on Indicators of Sustainable Development. Wiley, Chichester 1997.
COST 356 – EST: Towards the definition of a measurable environmentally sustainable transport: Functionalities of indicators and role of context

[21] http://www.unep.org/Pearl/Login/OP/BLOBS/FullText/PEARLFullTextBLOB_6660_2630.pdf

[22] Tanguay, G. et al (2009) Measuring the Sustainability of Cities: A survey-Based Analysis of the Use of Local Indicators (http://www.cirano.qc.ca/pdf/publication/2009s-02.pdf)

[23] http://www-personal.umich.edu/~sarhaus/Floodprn.pdf

- Sensitivity to flooding is mainly determined by the share of socio-ecological systems, located in the flood-prone areas (sensitivity-being the degree to which a system is affected, either adversely or beneficially by climate-related stimuli); and
- Adaptive capacity to flooding is determined by the ability/possibility to protect the system against flooding (being the ability of a system to adjust to climate change, to moderate potential damages to take advantage of opportunities or to cope with consequences).

Likewise, vulnerability to flooding is determined by the extent to which the human-ecological system can (or cannot) be protected against flooding (expressed as % change of current and expected future causalities in comparison with a baseline)[24]. Examples of possible indicators for flooding in line with the component-Exposure are: severity, duration, return periods and timing of flooding events due to increase of precipitation and river discharge above some threshold level. Likewise, number of people, infrastructure, crops, livestock, forests, and industrial production capacities located in flood-prone area are the possible indicators of the component sensitivity to flooding. Similarly, the possible indicators of flood vulnerability are: relative vulnerability for flooding, people flooded, total flood damages, and flood damages in different sectors.

The above discussions show that the indicator of flood-prone areas is related with the exposure to floodings. It means that the characteristics of exposure in land-river ecological system are the indicators of flood-proneness. Such characteristics are different for different nature of floodings. This study intends to identify the indicators of flood-prone areas of riverine floods in the Terai region of Nepal. In a similar manner, flood vulnerability indicators are conceptualized in line with the indicators of sensitivity to flooding. That is, the characteristic of sensitivity of flood-prone areas gives indicators of flood vulnerability

3.1.2 Indicators for Flood Prone Areas

On the basis of literatures review, about 49 indicators for flood prone areas are identified (Annex 3.1). Of these, 14 indicators were verified in all three visited sites. Based on the inputs during field-level interactions, two additional indicators were identified. Thus, about 16 indicators are determined for flood prone areas (Table 3.1). The lists of indicators for flood prone areas are listed with some threshold value based on community experiences (Table 3.1). The characteristics/indicators for flood prone areas based on literatures and field based are listed in annex (Annex 3.2).

Table 3.1: Field based flood prone indicators (based on all three visited basins during the study)

The Indicator	Threshold value based on Community Experience	Remarks
Rainfall Concentration (Intense rainfall) in monsoon	Continuous rainfall in upstream area (if large catchment) standing for 3-4 days (riverine flood) Continuous rainfall for half an hour in upstream area-around Bhabar zone Continuous rainfall in upstream foot hill of Siwalik area for 2-3 hours (Flash Flood)	
Deep and Narrow (River valley)		

[24] http://www.climwatadapt.eu/vulnerabilityindicators

Obstructions in Flood Path		
Poor Infrastructure design near river banks		
Area where Frequently floodings occur	Twice a year, in general	
Main river channel changes frequently	Rivers originating in mountainous areas change its main course in every 5-10 years in Plain region Siwalik originated River changes its main course every year in Bhavar and plain region	
Land area adjacent to river		It depends on many other factors
Low land area		When flood water level exceeds the natural bank level of river and spills over the banks towards low level area
Weak warning system		
Water level excess to drainage carrying capacity		Sedimentation is one of the factors that decelerate drainage carrying capacity
Flood level marked in river banks		Flood level marked is hardly seen in plain region but can be known through local elderly individuals/ communities
Wide river flow during rainstorms but shallow depth in dry season	Siwaliks originated river 1-2 km wide	Sedimentation deposition area
Sandy soil		Flood water does not stay for a long time in sandy areas but such areas are frequently flooded
Rapid formation of sub-channels		Geo-morphologically sensitive Plain/Bhavar region
Region devoid of embankment/protection measures and natural vegetation in one side of a river		Usually the exposed sites are more prone to floods
A catchment delivers high discharge but constriction in downstream areas		Narrow outlets usually present in Nepal-India boarder in the case of Siwalik originated rivers

The threshold values on the basis of community experience are highlighted in the table (Table 3.1). The indicators, such as rainfall intensity and frequency of flooding could get influenced by climate change. As a result, flood prone regions may have alterations from time to time. Current global climate change models indicate that the magnitude and frequency of extreme events could increase due to climate change. Seasonal patterns and return periods are projected to be modified as well (Kundzewicz et al. 2008). In addition, a study by CESR (2010)[25], highlights significant changes in flood return periods. For example, 1-in-100 years flooding might become 1-in-50 years flooding. The consequences of such changes may be observed in most of the flood prone areas.

3.1.3 Flood Vulnerability Indicators

Literature shows that flood vulnerability is the function of exposure of a system (flood prone-river system), sensitivity of human activities in the flood prone area and adaptive capacity of the system to reduce the impact of flooding. The lists of literature reviewed regarding flood vulnerability in the study are given in the annex (Annex 3.3). The practice of defining vulnerability comes from natural hazards, such as floods. The extent to which a system (human-ecological system) is susceptible to floods due to exposure and/or perturbation, in conjunction with its ability (or inability) to cope, recover, or basically adapt[26]. Moreover, flood vulnerability indicators include natural and social science indicators. The vulnerability indicators identified from literature are classified into four groups/sets: Global (G), Regional (R), National (N) and Community (C) (Annex 3.4) and regrouped into six subsets (GRNC; GRC;RNC; GC; RC; and NC) (Annex 3.5). Eight indicators fall on subset-GNRC (Figure 3.1).

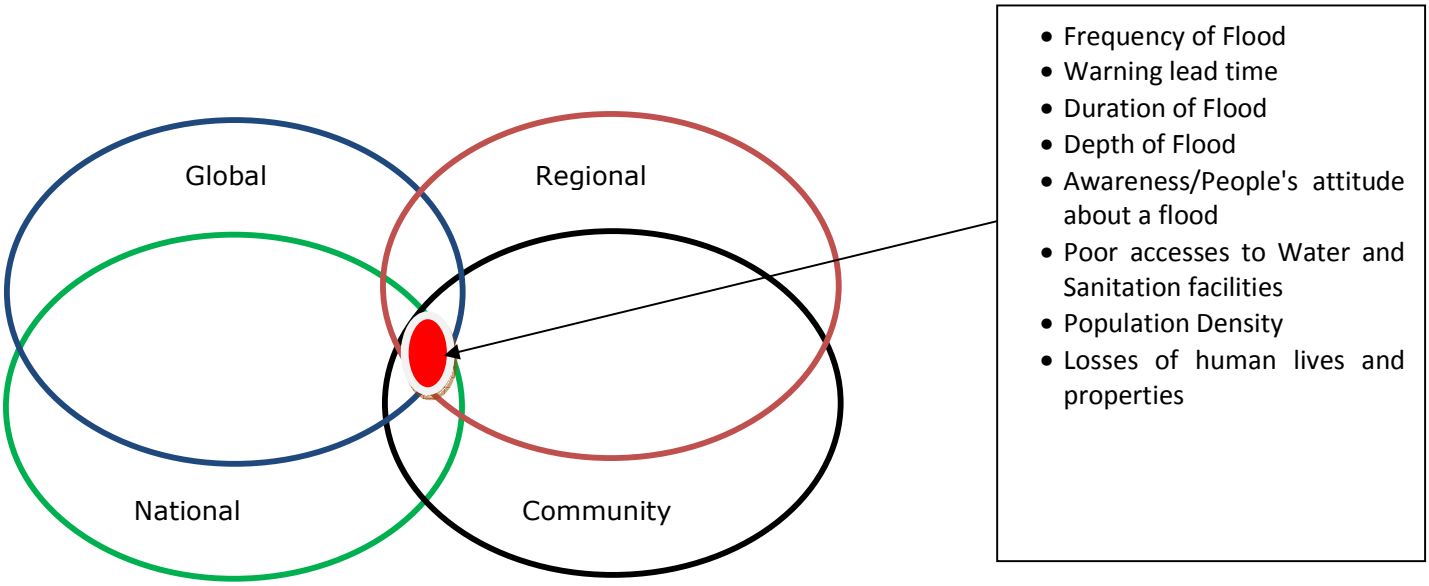


Figure 3.1 Intersections of all the classified Indicators for flood vulnerability corresponding to WASH at Community Level.

[25] Background document on Vulnerability Indicators for the project Climate Adaptation-modeling water scenarios and sectoral impacts, Center for Environmental Systems Research (CESR), European Commission European Commission Directorate-General Environment Unit D.1. Water *ENV.F.2 (BU-5 00/122)*

[26] http://unescoihefvi.free.fr/vulnerability.php

The indicators based on literature were verified in the field as described in the methodology. About 13 indicators have been identified in all three visited places. Of these, some indicators are concurrent with the indicators obtained from the literatures (Table 3.2 and Table 3.3).

Table 3.2: Field based indicators for Flood Vulnerability in relation with WASH facilities (concurrent in all the three sites visits)

The Indicators	Threshold values (Community Experience)	Remarks
Frequency of Flood	For comparatively small catchment Major flood: Once in three years- Minor flood: Thrice in a year-)	
Lack of Early Warning system (lead time)	Flash flood due to cloud-burst: within 20 minutes after extreme rain in area 2-km upstream of community settlements	
(Attitude) People's perception on Flood		Encroachment of the flood prone region for survival
Poor access to WASH		Technical gaps in the design of toilet structures to avoid flood risks Flood level in settlements are not considered while installing water pump and toilet facilities Increase vulnerability due to weak WASH resilience services during and after flood
Depth of Flood and Duration	Flood water standing Flood depth 70-100 cm: 3-7 days Flood depth 30-70 cm: 1-3 days Flood depth < 30 cm: < 1 day	
Income source types	Labour work-mostly Farm based-moderately Sustainable livelihood source-lowly	
Education status	Illiterate-mostly Literate with informal education-moderately Formal education-Lowly	
Characteristic of Settlement (types, materials,..)	Kachhi-Mostly Wooden-moderately Concrete with pillar system-lowly	
Distance from River	500 m-Mostly 500 m -1km-moderately Greater than 1 km lowly	

Excessive rainfall		
Poverty (economically deprived castes)	Dalit, non-dalit residing in flood prone areas with poor economic status- mostly Non-dalits -moderately	
Isolation from Government Priority	Lack infrastructures and flood impact mitigation mechanisms	
Loss of people and properties in the past		

Table 7: Indicators for Flood vulnerability (Field based and literatures based)

Field based	Literatures based	Dimension/ Parameters	Threshold values (community experiences)	Remarks
Frequency of Flood	Frequency of Flood	Natural	For comparatively small catchment Major flood: Once in three years- Minor flood: Thrice in a year-)	
Duration of Flood	Duration of Flood	Natural	Flood water standing for more than 3 days Flood water standing between 1-3 days Flood water standing for less than 1 day	3-7 days depends on many other factors- dams/accesses to responding agencies...
Depth of Flood	Depth of Flood	Natural	Having depth between 70-100 cm Having depth between 30-70 cm Having depth less than 30 cm	30 cm=1 foot
Excessive rainfall				
Lack of Early Warning system (lead time)	Warning lead time	Physical		Flash flood due to cloud-burst: within 20 minutes after extreme rain in areas 2-km upstream of community
Settlement distance from River		Socio-physical	500 m-mostly 500-1km-moderately Greater than 1 km lowly	
People's perception on Flood (Attitude)	Awareness/People's attitude about a	Social		Encroachment of the flood prone region for

	flood			survival
Poor access to WASH	Poor accesses to Water and Sanitation facilities	Socio-physical		Technical gaps in the design of toilet structures to avoid flood risks Flood level in settlements are not considered while installing water pump and toilet facilities Increase vulnerability due to weak WASH resilience services during and after flood during and after flood
Income source (types)		Economic		Labor work-mostly Farm based-moderately Sustainable livelihood source-lowly
Education status (Illiteracy)		Social		Illiterate-mostly Literate with informal education-moderately Formal education-lowly
Characteristic of Settlement (types, materials,..)		Socio-physical		Kachhi-mostly Woden-moderately Concrete with pillar system-lowly
Poverty (economically deprived casts)		Socio-economic		Dalit, non-dalit residing in flood prone with economically poor-

				Mostly Non-dalit-moderately
Isolation/deprived from Government Priority/services		Governance		Lack of development infrastructures and Flood impact mitigation mechanisms
	Population Density			
Deaths of people and losses of properties	People and property loss	Social		No of deaths of people and amount of losses of properties

3.2 Flood Disaster Risk Reduction in WASH Domain: Gaps, Challenges and Learning

3.2.1 The WASH Scenario

From the administrative records, existing coverage of water and sanitation services in Nepal is approximately 80% and 43% respectively. The national target is for universal access to water and sanitation by 2017. Presently about 5.5 million people do not have access to adequate improved water services and 16 million lack adequate sanitation facilities. The current Three Year Plan (2011-2013) targets access to basic water service for 85%, sanitation for 60% and medium to high quality of water services for 15 %. Although improved water supply has been reported at 80%, about 43% of the water supply schemes are not fully functional (GoN, 2011).

Natural disasters, especially floods and landslides decelerate the accessibility to safe water and sanitation in disaster prone areas. . Access to safe water and sanitation is considered a component of human right as declared by the United Nations. To improve the conditions of vulnerable populations to disaster risks, every organization working in disaster management, livelihood promotion and community development should work on the provision of water and sanitation services. Water and sanitation programmes provide an integral link from disaster management to long-term organizational development. It is important to ensure that the target population should have access to safe/potable water along with reliability and sustainability of water supply systems.

Water

Access to water is basic human right, essential to life and human dignity. Lack of access to sufficient and safe water are key contributors to health problems.. Everybody has right to sufficient and safe water for consumption, personal hygiene, cooking and other domestic uses. The rights include adequate water storage facilities, such as containers to ensure that water can be stored safely (without risk of contamination) until needed. Local and international standards should be adhered to with regard to the regular testing and monitoring for quality of water at the source, transport, and at central and household storages.

There are three types of water sources to meet overall requirements (Table 3.4). There are some issues associated with each of these sources that should be considered while providing water and sanitation services.

Atmospheric Water (rain Water, cloud water): may be a useful supplement for individual needs. As a main source of water, it is generally not suitable because of its unpredictable availability. Rain water is more suitable in areas with sufficient rainfall distributed throughout a year and if there is suitable shelter and household storage facilities.

Surface Water (river, spring, and lakes/ponds): If the only available source is surface water, great care must be taken to protect it. People or animals should not be allowed to enter the upstream sources and intake points of a river. Contamination of surface water by rain, runoff from latrines or open defecation areas can be a severe problem. Surface water sources include seasonal streams, rivers and ponds. All of these sources have potential contamination and disruption due to floods. In emergencies the only immediate solution may be to use these sources with water quality monitoring system and with appropriate treatment measures (i.e., sand filtration or chlorination.

Ground Water (tube-wells, wells): includes infiltration galleries, boreholes, wells and springs. Springs with sufficient flows are the ideal source for groundwater and water supply schemes. The quality of spring water is usually good, but should be tested for confirmation.

Table 8: Source of water, water supply and specific to Flood-prone districts

Districts	Main source of water	Quality issues	Common system used for water distribution	Percentage Coverage with 'Safe Water'	Typical structure for water supply management
Eastern, Central and Western Terai (Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusa, Mahottari, Sarlahi, Rautahat, Bara, Parsa, Chitwan, Nawalparasi, Rupendehi, Kapilvastu (15))	Ground water using shallow hand pumps and dug wells. In some urban areas deep boreholes are also used.	Ground water may have excess iron and in some cases some arsenic.	Hand pumps and public wells.	79.4	Water Users Committees, Municipal authorities, NWSC, DWSS
Mid and Far Western Terai (Dang, Banke, Bardiya, Kailali, Kanchanpur (5))	Ground water using shallow hand pumps and dug wells. In some urban areas deep boreholes are also used.	Ground water may have excess iron and in some cases some arsenic.	Hand pumps and public wells.	82.93	Water Users Committees, Municipal authorities, NWSC, DWSS

Adopted from UNICEF ,2008)*[27]

Sanitation and Hygiene

Access to adequate sanitation facilities reduces the likelihood of illness within an affected population. It reduces the likelihood of faeco-oral diseases (such as cholera) and exposure to disease-bearing vectors,

[27] UNICEF (2008). Report on WASH cluster capacity mapping in Nepal, UNICEF, Kathmandu Nepal

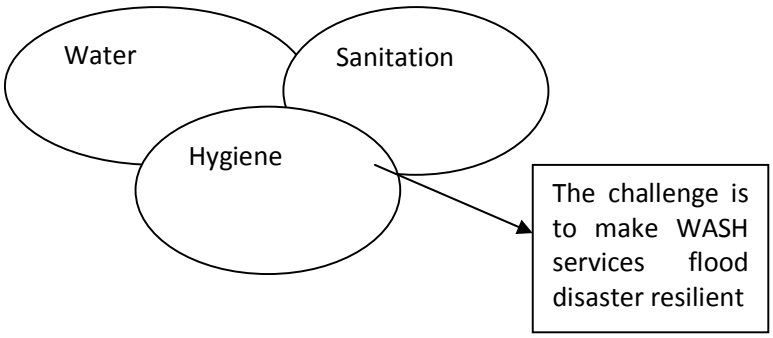
which can result in large number of deaths in relatively short time frames. It also establishes conditions that allow people to live with dignity and comfort. Sanitation programmes in an emergency usually concentrate on four key areas: drainage, excreta disposal, vector control, and solid waste collection and disposal. The combination of good water and sanitation programmes in an emergency situation will protect the health of people through the promotion of good personal and environmental hygiene. The overall status of the sanitation and hygiene are summarized in Table 3.5.

Table 9: An overall scenario of sanitation status in flood prone districts in Nepal

od Prone tricts	mary means of Faecal disposal	rcentage coverage ng improved rines	mary means of bage disposal	gest itation oblem
stern, Central d Western rai-	latrines and some improved rines. In rural areas open fecation is still prominent.	1	lividual Households d local authorities in oan areas	en fecation
d and Far estern Terai-	latrines and some improved rines. In rural areas open fecation is still prominent.	1	lividual Households d local authorities in oan areas	en fecation

WASH components and Intervention in line with disaster risk management

Water supply, (Source, Accessibility, Quality, Reliability)
Excreta disposal
Hygiene Promotion
Vector control
Solid waste management and Drainage
Emergency WASH Structure (Raised)



3.2.2 At Policy Level

Policy gaps have been discussed in WASH-centered perspective into two ways: WASH Policy in view of DRR and Emergency Response; and DRR policy in line with WASH facilities.

WASH Policies in view of DRR and Emergency Response

Sanitation and Hygiene Master Plan (SHMP) addresses the national goal of achieving basic sanitation for all by 2017. The Master Plan is developed as a key strategic document based on wider sectoral learning and proven approaches.A unique feature of the Master Plan is its recognition of the multi-stakeholders' collaboration and campaign approach in total sanitation promotion. It also recommends the introduction of different strategic coordinating bodies at central, regional, district, municipality and Village Development Committee (VDC) levels that allow comparison and learning across districts/regions. The Master Plan emphasizes emergency preparedness to control epidemic and diarrhea that may occur during emergency and aftermath of water related disasters. Some key provisions for emergency preparedness in the master plan(GoN, 2011)[28]. are: establishment of sanitation fund at district level; prepositioning of chlorine and emergency medicine and the raw materials of toilets construction in the districst; and mobilize trained facilitators and volunteers for emergency sanitation and hygiene. The master plan further identifies the key actions to respond emergency situation as: link existing emergency cluster of humanitarian aid agencies with government emergency coordination and response systems; make WSSDO and DTO fully accountable and responsible for co-ordination of preparedness and response; allocate budget for capacity building and emergency preparedness; assess vulnerability by using scenario planning; and study climate change impact on WASH sector.

District Water, Sanitation and Hygiene Coordination Committee (D-WASH-CC) the successor of District Water Supply and Sewerage Coordination Committee (DWASSCC)[29] represents a coordination platform and mechanism for information collection and sharing, planning, implementation and monitoring and evaluation by developing inter-sectoral linkages among the agencies working within a district. The DWASSCC is chaired by Local Development Officer (LDO)/District Development Committee (DDC). WASDO becomes Member Secretary of DWASSCC where CDO plays advisory role in the committee. Similarly Village/Municipality Water Supply, Sanitation and Hygiene Coordination Committee (V/MWASSCC) plays coordination and implementation roles in village/municipality by following the same modality.

At national level, Environmental Sanitation and Natural Disaster Management Section, Department of Water Supply and Sewerage (DWASS) plays coordination role in National Disaster Relief Committee (NDRC). The department is one of the members of NDRC; but NDRC is usually active during disaster response but not during post disaster period.

National Sanitation Policy and Strategy (1994) stresses coordination among concerned stakeholders, such as health, education, water supply and local development programmes; but it does not give a priority for the coordination with district level organizations working in disaster preparedness and emergency response. Likewise, Rural Water Supply and Sanitation National Policy and Strategy (2004) highlights the strategies to achieve a the target of providing100% coverage of both water supply and sanitation by the year 2017. On the other hand, the national policy does not assess the potential impacts due to disasters on WASH services

[28] WASH Sector Status Report
[29] Sanitation and Hygiene Master Plan, 2010

that may decelerate the targets. Likewise, Urban Water Supply and Sanitation Policy (2009) emphasize DDRC to be a forum for WASH coordination. Further incorporates Water Supply and Sanitation Divisional Office (WASSDO) to lead the district level WASH cluster in case of the outbreak of disease. The policy does not, however, addresses the coordination mechanism between WASH cluster and DWASS CC in pre and post disasters. Three Year Interim Plan (2007/08-2009/010) and Three Year Plan Approach Paper (2010/11-2012/13) incorporate environmental friendly WASH facilities including the concerns related to child and gender friendliness.

So far as national provision for the rehabilitation of WASH services is concerned, Rural Water Supply & Sanitation Strategy (RWSSS) guides that 20% of the national rural water supply and sanitation fund should be allocated for rehabilitation and repair of the existing water supply systems. This provision tends to direct towards the regulation of the WASH services; but the allocated investments hardly enough for the sustainability of the services. Attention to environmental impacts, adequate funds for operation and maintenances and rehabilitation are needed to sustain the services. In addition to the sustainability of the services, risk assessment, especially in flood disaster prone districts, needs to be carried out before providing the services. The assessment could help to reduce the cost recovery for the services. Some recommendations regarding WASH services in emergency are given in WASH report (Nepal WASH sector Status Report, 2011). Based on the report, WSSDO needs to be strengthened through financial, technical and human resources.

DRR policy in line with WASH intervention

As discussed in the previous section, WASH services in disaster risk reduction has not been sufficiently practiced in Nepal. The WASH cluster in the country has been working since 2008 in emergency response when cluster approach was initiated in addressing emergency situations. The cluster approach was adopted for the coordination of humanitarian agencies in Koshi flood in 2008. WASH cluster becomes active only when disaster-related emergency situation occurs. Furthermore, key achievements of WASH in emergency response have not been institutionalized and are not integrated in government plans and programmes. Institutionally, WSSDO leads the cluster for coordination under the supervision of DDRC in emergency response period. When emergency period ends, WASH cluster is almost inactive. In addition, WSSDO, at district level, has not been fully committed with accountability and responsibility to coordinate the cluster members in pre and post disaster periods. It lacks a strong mechanism to coordinate during the emergency. WSSDO does allocate fund to address the humanitarian needs required for saving lives of the vulnerable population.

, The example from the emergency response carried out in Koshi flood shows that humanitarian agencies have initiated provisions of WASH preparedness interventions at national and district levels. Disaster Preparedness and Response Plans (DPRP) have been formulated with cluster approach- in 65 districts including flood prone districts in Terai region of the country. WASH cluster is one of the key clusters in the plans. The roles and responsibilities, resource availability at local level and gaps identification of the resources are highlighted in the plans to respond emergency situation for reducing loss of lives. . There are several limitations, such as resource constraints, inadequate time to implement the plan (the plans usually in practice are formulated when the monsoon enters in the country), lack of commitment of District Level Support Agency (DLSA), DDRC, WASH cluster members, for the implementation of the plans, and lack of local elected body-authority at village and district levels.

DPRP are prepared using the Guidance note of MOHA[30]. Involvement of the WASH cluster for the assessment of flood risk is almost insignificant in the flood prone districts. As a result, the flood vulnerability assessment has not been carried out in a systematic manner. Water purification measures, sanitation kits, and essential live saving supplies are attempted in preparedness in few districts; but ensuring the quality of the services are questionable in practice. Key challenges of WASH facilities in DRR are highlighted (Box 2).

Box 2: Challenges of the Water and Sanitation Sector (Adopted from NSDRM,2009)

- The entire water and sanitation sector is not disaster-sensitive except in a highly vulnerable situation: of the WAT/SAN services are being impacted by disaster and restoration of services is expected to be lengthy and difficult.
- The fact that Drinking water is a lifeline system is not factored in the sector program. Consequently, failure of the water system is expected to trigger a chain reaction in a post disaster scenario. For example, lack of water will seriously impair the performance of hospitals and health institutions apart from the possible triggering of water-borne diseases following a disastrous event.
- There is lack of concrete contingency plan in the sector..
- No plan exists for water supply in vulnerable urban areas. Successful cases of WAT/SAN preparedness, as done by the Lalitpur Sub-Metropolitan City, should be replicated by the other municipalities.

In summary

In line with disaster management, DDC is the member secretary of District Disaster Relief Committee (DDRC) and WSSDO is the Cluster lead of WASH for preparedness and emergency response. Despite this arrangement, there is a gap between DDRC and DWSSCC to coordinate the agencies within a district to make WASH services resilient to disasters risk. In order to address such gaps, WSSDO in a close collaboration with DDC, could play decision making role for the effective coordination. The decision role can be given to the district level development planning processes. An effective coordination can contribute in strengthening the facilities of WASH services before, during and after a disaster event. The fund needs to be established with a high priority in those districts which are at high risk to flood disasters. Likewise, guidance of flood resilience sanitation structures and non-structures services need to be addressed both in legal and policy sectors. WASH Master Plan has not guided yet to ensure the resilience of WASH services to disaster risks. Disaster risk assessment needs to be incorporated into policies so that it can ensure resilient WASH services to disaster risks.

3.2.3 At Implementation level

Water, sanitation and Hygiene, in line with disaster risk reduction and emergency response, are new approaches in practice at implementation level in the country. Water and sanitation progrmmes was initiated in more focused approach in late 1990s. Likewise, in the context of Nepal, emergency WASH programme in flood disaster response was implemented in major flood events, such as, Koshi flood and Kailali Flood. The WASH services were carried out when outbreak of diarrheal disease occurred in a emergency camp in the Koshi basin (24 deaths were reported in the event due to the outbreak two weeks

[30] MoHA, 2011. Guidencnce note: Disaster Preparedness and Response Planning 2011, Government of Nepal, Ministry of Home Affairs, Disaster Management Section

after the flood hits[31]). The outbreak included suspected cholera and other diarrheal diseases due to some key weakness/lacks in the events (Box 3).

Box 3: Weakness in Koshi Flood Response

- Rescue operation was affected by high-level visits in flooding areas.
- Due to the lack of security, robberies were reported in camps and flooded areas.
- There was no effective counseling in time where the situation s was full of tension, fear, hopelessness and mental disorders.
- The rescue and relief operation were affected by poor transportation facilities.
- ***The main causes of deaths of children and elderly were the lack of proper shelter, drinking water, sanitation, and awareness programmes in the flooded areas.***
- ***Negligence due to ignorance, traditional beliefs and practices***
- Electricity supplies were affected in the flooded areas and to some extent in the remaining parts of Nepal.
- Lack of preparedness and recovery plan in line with WASH sector

The Koshi flood-2008 was a historical event where WASH services was carried out in comprehensive manner when diarrhea outbreak occurred at the sites and camps. Furthermore, integrated interventions-WASH services were adopted by District Public Health Office (DPHO) with the support of Oxfam Nepal through the Public Health Promotion (PHP). After carrying out the detailed baseline survey, public health programme was implemented providing capacity building to the local communities. Implementation of PHP interventions was an effective approach in controlling further losses from the outbreaks. The programme was said to be a model for replicable approach in flood disaster emergency response. Based on the experience, safe toilet construction, public health and hygiene, behavioral change through the participation of women, men and children were found to be necessary interventions within the WASH domain.

A few gaps were identified during the implementation of WASH services in preparedness and recovery phases, which are:

- Knowledge gap about the nature of flood risk in terms of depth and duration in the field;
- Non-uniformity in the built structures (raised hand-pumps by more than one meter but the community shelter building raised only by about one feet although both structures were in the same place within two meter apart (see Appendix 2);
- Hardly adopted SPHERE Project guideline in maintaining the location of septic-tank and water sources;
- Adopted poor sustainable measures addressing WASH services with sustainable livelihood programmes in post disaster period.

DRR intervention including WASH services in right based approach is one of the remarkable considerations in development processes. The right based approach empowers the affected community/vulnerable groups reducing their vulnerabilities using REFLECT (Box 4). The Regenerated Freirean Literacy through Empowering community Techniques (REFLECT) approach has been initiated by Action Aid Nepal (AAN) in DIPECHO project since 2007 for disaster preparedness and disaster risk reduction. The key features of the REFLECT approach are the utilizing community's inheriting strength to mobilize and empower the vulnerable groups, linking their struggle to cope with disasters to their ability to access and exercise their human rights.

[31] DPNET & Oxfam (2010). Disaster Risk Reduction in Nepal: Some Good Practices, Disaster Preparedness Network Nepal, Kathmandu

Box 4: Case Study about use of REFLECT in *Mushiwat Bahash Kendra* (Mushiwat Advocacy Center) in Inarwa Municipality-6

A REFLECT approach was adopted in the Mushiwat Management Committee at Khikripatti Community in Inarwa Municipality-6 in Sunsari District by AAN under the DIPECHO project in 2009-2010. The community (Muslim and Dalit) were aware about the basic WASH services. Increased level of knowledge about the sanitation and hygiene made the community able to undertake responsibility themselves in taking care of sanitation and public hygiene during the whole disaster cycle. On the other hand, ,all the communities have poor access to improved toilet facilities in practice due to a lack of sustainable income generating activity. The case study shows that hygiene education and sensitization on use of safe water and sanitation facilities need to be integrated in sustainable livelihood income generating activities in practice.

3.2.4 SWOT Assessment

Strength

- Health is a national priority
- DRR is regular phenomena of the country
- Most of areas are flood prone
- Schools lead Total Sanitation Programme
- Community lead Total Sanitation Programme
- Disaster Preparedness and Response Plan
- Large number of teams re involved in DRR which can be readily mobilized for emergency response
- WASH is a technically sound team
- The humanitarian clusters of Active member of Association of International NGOs' Task Group for Disaster Management (AIN TGDM)
- There are several recognized International NGOs in Nepal
- Country has Enhanced Contingency Plan simulated annually among the country teams

Weak

- Household level survey
- Joint monitoring
- Technical expertise, monitoring and capacity building
- WASH in Gender
- National Standard and code
- Integrating DRR and WASH activities
- WASH Risk Assessment
- Inadequate stock piling of emergency relief items
- Inadequate human resources for EFSL (emergency food securities and livelihood) response
- Majority of DRR workers in country are new and have limited exposure to major disasters
- Limited logistics capacity
- Regular involvement of local level NGOs that have limited capacity to respond to category 2 disaster or even to category 3 disasters in other districts
- Majority of the people and community are not aware of their responsibility during major disasters
- Lack of DRR act in comprehensive approach
- Gap sin coordination

Opportunity

- Emergency shelter, Transitional shelter, Permanent shelter with WASH facilities
- MGD target
- Sanitation and Hygiene Master Plan
- Disaster Preparedness and Response Plan with WASH focus
- Socially, culturally and climatically appropriate issues
- WASH based DRR Advocacy
- Collaborative environment to work together (UNICEF, NRCS…)
- Increasing roles with increasing disaster events in the country

Threats

- Sustainability (short-term programme & incomplete project cycle-specific focus on response and preparedness-to some extent)
- Duplication – same activities in different way
- Coordination – working together in same district and gap in coordination
- Lack of awareness and sensitization on WASH Standards (National and International)
- Political instability in the country
- Absence of pro-people Disaster Management Act
- Inadequate resource with the government to respond to major crises
- High risk associated with disasters due to country's high vulnerability coupled with limited capacity for effective response

3.3 Resilient WASH in Flood Disaster Risk Reduction

3.3.1 Pre-Flood: Preparedness

3.3.1.1 Capacity building, Assessment and Dissemination

Training for Preparedness

- Construction methods for flood resilient WASH structural services
- Developing community-science based flood warning system and evacuation plan
- Strengthening DWASSCC/ VWASSCC and WASH-Cluster stakeholders
- Reducing surface and ground water contamination
- Establishment and decision for sustainable WASH modules in the community as per the community needs and location
- Strengthening local capacity for regulating technical guidance and supporting and maintaining critical WASH infrastructures on a regular basis

Training for Effective WASH services in Emergency Response

- Drilling for effective coordination among all the stakeholders of WASH
- Minimizing public health risk
- Cleaning and managing process of WASH services
- Pre-positioning of WASH services handling during flood

Knowledge Dissemination and Awareness Rising

- Sharing key outcomes of the Flood Hazards maps developed by government agencies
- Knowledge dissemination on application of flood hazards for effective WASH services

- School community participation including children, volunteers, and local community for awareness raising on basic WASH facilities

Pre-positioning of emergency WASH services

- Provision of safe drinking water—installation of tube well or other pipe water arrangement
- Materials for making temporary latrines
- First Aid medicines especially for water borne diseases; treatment with basic medicines such as paracetamol, Jevanjal. Chlorine tablets, Oral re-hydration powder etc.

Preparing Evacuation Plan and Ensuring accessibility of Water and Sanitation Services

- Based on the flood prone indicators especially like flood water depth and duration in a region, the community should be evacuated in time to minimize loss of life and valuable properties
- The evacuation activities should be consistent with flood warning and forecasting in the region
- Identify safe escape routes to temporary refuge or community shelter places
- Clarify the roles and responsibilities of local people, local leaders/volunteers, CBOs etc to involve in evacuation from danger to safe places.
- Carry out the works like raising the level of escape route/paths, means of accessibility of getting toilet service and water source
- Provide appropriate equipment and tools such as boats, ropes, empty drums for floating, rubber tubes, stretchers and water storage tanks/plastics devices needed for the evacuation
- Offer basic training on evacuation, rescue operation and emergency medical care.

3.3.1.2 Preparation of pre/post-flood disaster plans in WASH domain

Participatory Assessment of WASH services in flood resilience perspective

- Assessment of Flood Hazard, vulnerability and coping capacity using Participatory Vulnerability Capacity Assessment (PVCA) for the assessment of existing services of WASH interventions

Identifying Flood Prone Area

- Identification of flood prone area is necessary for the enhancement of WASH services. The indicators of flood prone are given in the annex. The technical interventions of water and sanitation services and software measures of WASH facilities need to be protected from flood risk and regulated after a flood

3.3.2 During-Flood: Emergency Response

Specific Actions

- Evacuation priority should be given to the vulnerable groups (disabled persons, old persons, women, children etc)
- Monitor health and hygiene conditions of the people with high priority to potable water and basic medicines
- Monitor the sanitation situation and incidence of water related diseases
- Coordinate with WASH cluster lead and DWASSCC and V-WASH-CC

WASH Promotion Programme

- Regular household visits by community health volunteer (CHV).
- Poster distribution.
- Street drama.
- Rally using play cards and banners.

- Demonstrations (hand washing and ORT preparation/ treatment).
- WASH Information Centre and ORT Corner (operational 6 hours per day).
- Weekly education sessions targeted to children in the protection "safe space".

3.3.3 Post-Flood: Relief and Recovery

3.3.3.1 Assessment and Preparation of post-disaster plan

A detailed assessment of post flood WASH needs is required to be carried out. This assessment should include pre-flood data of improved and traditional water and sanitation facilities along with the post flood inventories of water and sanitation facilities, both improved and traditional. The assessment will give a baseline of water and sanitation facilities and services for early recovery. Early recovery district level action plan needs to be developed to achieve district level targets by the end of early recovery.
A comprehensive coordination mechanism during early recovery among the stakeholders including communities, UN Agencies and other humanitarian organizations, NGOs and government organizations at all levels to provide support to implementation. Experience sharing and knowledge management needs to be carried out by DWASSCC.

- Conduct Post Disaster Need Assessment (PDNA) in WASH perspectives;
- Prepare immediate and intermediate rehabilitation plan by including specific roles and responsibilities ;
- Restore hygiene and sanitation facilities
- Start repair and maintenance of water sources and sanitation infrastructures involving local communities;
- Coordinate with DWASHCC, WASH cluster and DDRC for external help for restoration of other facilities such as houses, infrastructures and communication
- Ensure availability of potable water and basic sanitation services/tools
- Assess the market for WASH items in rehabilitating flood disasters (Table 3.6)[32]
- Assess the flood vulnerability by adopting suitable indicators (Table 3.3)

[32] UNICEF (2008).

Table3.6: An overall scenario of sanitation status in flood prone districts in Nepal

Item	Description	Availability
Pipes and Fittings	HDPE GI PVC DI / CI	HDPE and GI manufactured in Nepal in adequate quantity. PVC also manufactured in Nepal. DI / CI pipes and fittings need to be imported from China and India
Borehole screen and Casing	MS PVC	MS screens and casing pipes are manufactured and are available in Nepal and are also imported from India.
Cast iron shallow hand pump sets	No. 4. No. 6, Improved No. 6	Some manufactured in Nepal, but mostly imported from India and available in all major markets with spare parts.
Other improved hand pump sets	India Mark II and III	Imported from India, Spare parts not readily available in local market.
Drilling Rigs		Several companies provide drilling services. New rigs are mostly imported from India.
Submersible pumps		Mostly imported from India, but can also be procured from China and other European countries.
Bleaching powder and other disinfectants		Imported from India.
Toilet Pans	Cement cast, Fibreglass, Ceramic	Mostly manufactured and available in Nepal. Some better quality ceramic pans are imported from India.
Pit Rings	Cement	Manufactured and available in Nepal
Soaps		Manufactured in Nepal and are readily available
Detergents and Liquid Disinfectants		Imported from India
Mosquito Nets		Imported from India

3.3.3.2 Adopting Flood disaster friendly WASH Programmes and technology

Poor economy, weak social & political networks at community level, and lack of physical infrastructures are the key underlying causes of vulnerability to disaster risk in the country. In this regards, HFA developed by the UNISDR for 2005-2015 aims to build the resilience of nations and communities to disasters. Priority action-Four of HFA highlights the assessment and reduction of underlying causes of the disaster risk both in national and community levels. The underlying causes of disaster risk are basically concerned with dimensions of vulnerability. In order to reduce the vulnerability mostly in the water and sanitation sector, possible solutions such as disaster mainstreaming in planning, integrated management of risks preparedness and response with recovery need to be indicated in WASH project at community level.

Flood disaster friendly water and sanitation technology for flood prone area need to be given a high priority both at household and community levels. The flood disaster friendly latrines especially in inundation region need to be promoted at household and community levels.

Examples for flood friendly water and sanitation structures are illustrated in Figure 3.2 which demonstrates:

- Direct earth stabilized Raised Pit Latrine: the latrine can be promoted on a high land considering the highest flood level);
- Disaster friendly-eco latrine: This type of latrine can be used both at normal and flood disaster periods and is normally constructed at a higher level due to its storage chamber by considering the highest flood level and average flood level for excreta preservation to ensure preventing water pollution due to flood water;
- Tube well at the slope of River Bank/Raised land used as flood shelter: This type of water source can be installed on the slope of the river embankment or any high land temporarily used as flood shelter.

Figure 3.2: Flood Friendly Water and Sanitation structures in Flood prone area

(From left: a)Earth stabilized raised pit step latrine; b) Disaster friendly Eco-latrine; c) Tube well at the slope of River bank; and d) Tube well in flood inundation zone

4. CONCLUSIONS AND RECOMMENDATION

Conclusions

Flooding is a situation of spilling water from a river or spring when water flow in a river exceeds its carrying capacity. Typology of Floods in Nepal depends on the water flow in different classes of Rivers passing into High Mountain-Middle Mountain - Terai ecological zones. The flood in high mountain ecosystem is dominated by GLOFs-flash flood and riverine flood depending on the source and origin of a river.

Floods in the Terai ecological zone are inundation floosd or sheet flood and riverine flood/flash flood originated in Hill and Siwalik regions. In view of flood disaster, flash flood and riverine flood/ inundation flood are severe in terms of their impacts in plain region of the country. The major natural triggering factors are intense rainfall in monsoon season, high relief, and deep & narrow river valleys with fragile geology. The death rates has been in decreasing trend over the period of 1980-2010 but the severity due to flood is uncertain in the country. Likewise, the gaps in policies and coordination are the key challenges particularly in WASH services. Lack of legal authority and uncertainty of the allocation of funds in the existing institutions are key constraints in enhancing resilient WASH in flood disaster risk reduction.

The severity of disasters depends on human interventions in flood prone region and the vulnerability of the region. Thus flood proneness and flood vulnerability are the key features addressed in the study in terms of their multi-dimensions with the indicators. Consideration of the indicators is important in an assessment for any community development programme, such as water, sanitation and hygiene facilities. Management based on indicators helps to reduce flood risks so that the beneficiaries of the program could get the outcome continuously even a flood hits the region. In order to increase the efficiency of WASH facilities, the preparedness and post-flood disaster plans need to be addressed in flood prone regions of the country. Such requirements have been considered in the study by developing the guidelines for the preparation of preparedness plan and post flood disaster plan. The outputs can be used by the partners of Water Aid Nepal at community level on the basis of Water Aid strategy[33] and the study findings. Likewise, adopting flood disaster friendly WASH facilities in closed coordination with the disaster risk reduction stakeholders and the WASH stakeholders are the key strategic approach in enhancing the services of WASH facilities in flood prone region of the country.

Recommendations

Based on the conclusions and the study findings, the following points may be considered as the recommendations of the study.

- The context of floods, flood vulnerability and flood risk need to be considered in WASH domain
- The flood vulnerability indicators, particularly depth of flood, duration of flood, percentage of access to WASH services in a community, percentage of literacy, income sources and accessibility should be addressed for the sustainability of water and sanitation services.
- Flood hazard maps and flood forecasting developed by the authentic agencies should be made available in public domain so that those maps can be used in WASH programmes.
- Community-based flood hazard map will serve as a means for identifying evacuation sites and routes and for community development planning purposes. The map should be updated whenever necessary.

[33] Nepal Country Strategy 2010-2015, Water Aid

- Safe toilet construction and public health and hygiene, including behavioral changes should be promoted.
- Participation of women, men and children are necessary interventions that need to be focused on the preparedness for the better emergency response in WASH domain.
- Effective coordination is essential in strengthening the facilities of WASH services before, during and after a disaster event.
- Fund needs to be established with a high priority for districts at high risks to flood disasters.
- Guidelines for flood resilient water and sanitation structures and non-structures services need to be developed and incorporated in legal and policy sectors.
- Developed guidelines should be tested in the community and be revisited as per the needs.
- Flood disaster friendly WASH facilities in a close coordination with the disaster risk reduction stakeholders and the WASH stakeholders need to be adopted with high priority.

Annexes

Annex - 1

Flood Vulnerability Ranking analyzed with reference to Indicators/Criteria

*(For Flood Prone with 5 different contexts mentioned as below***)**

1. *Flood Vulnerability Ranking*
2. *Indicators/criteria for Flood-prone specify to Nepal context based on literature reviews and professional consultations*
3. *Indicators/criteria for Flood-prone based on the field and literatures*
4. *List of key literatures reviewed in the study*
5. *Classification of Flood vulnerability by spatial variation (Four Groups)*
6. *Regrouping the Indicators for flood vulnerability in relation with WASH*

Annex - 2

Guideline for Preparing Flood Disaster Preparedness and Recovery Plan to secure Water, Sanitation and Hygiene facilities at Community

(A Part of Retrospective Research to Flood Risk in relation to WASH facilities)

Annex - 3

Field Observations for Flood-Prone and Flood Risk Indicators/criteria

(A part of work on the Retrospective Research on WASH and DRR)

Annex - 1

Flood Vulnerability Ranking analyzed with reference to Indicators/Criteria

*(For Flood Prone with 5 different contexts mentioned as below***)**

7. *Flood Vulnerability Ranking*
8. *Indicators/criteria for Flood-prone specify to Nepal context based on literature reviews and professional consultations*
9. *Indicators/criteria for Flood-prone based on the field and literatures*
10. *List of key literatures reviewed in the study*
11. *Classification of Flood vulnerability by spatial variation (Four Groups)*
12. *Regrouping the Indicators for flood vulnerability in relation with WASH*

Annex 1.1: Flood Vulnerability Ranking

Degree of Flood Vulnerability	Districts
Very High	Mahottari
High	Rautahat, Chitwan, Parsa,Saptari, Siraha, Sunsari, Dhanusha, Bara
Moderate	Sarlahi, Nawalparasi, Kailali, Jhapa, Morang, Kanchanpur, Bardiya
Low	Banke, Kapilbastu, Rupendehi
Very Low	Accham,Arghakhanchi,Baglung,Baitadi,Bajahang,Bajura,Bhaktapur,Bhojpur,Dadeldhura,Dailekh,Dang,Darchula,Dhading,Dhankuta,Dolakha,Dolpa,Doti,Gorkha,Gulmi,Humla,Ilam, Jajarkuthan, Jumla, Kalikot, Kaski, Kathamndu, Kavreplanchok, Khotang, Lalitpur, Lamjung, Makwanpur, Manang, Mugu, Mustang, Myagdi, Nuwakot, Okhaldhunga, Palpa, Pahchthar, Parbat, Pythan, Ramechhap, Rasuwa, Rolpa, Rukum, Salyan, Sankhuwasabha, Sindhuli, Sindhuplanchok, Solukhumbu, Surkehet, Syangja, Tanahu, Taplejung, Terhathum, Udayapur

Source: NAPA, 2010

Annex 1.2: Indicators/criteria for Flood-prone specify to Nepal context based on literature reviews and professional consultations

Indicators/Criteria	Dimensions	Description	Sources
• High concentration of monsoon precipitation • High Relief • Steep mountain topography • Deep and Narrow river valleys	Hydrology Topography Geo morphology		DHM, 2010
• Riverine Flood: • Intense Rainfall • Obstructions in Flood Path (bridge piers, floating debris, weirs, barrages, embankments etc) • Already marked eroded banks • Water volumes in excess of local drainage capacity due to highly localized rainfall of long duration • Prone to Flash Flood: • Little or no warning type • Water flow in the rivers in the Siwalik range • Sharp rise of flood water followed by a rapid recession and high flow velocities • Steep slopes on both sides of the river in narrow valleys	Hydrology Geomorphology Topography	Describe the types of flooding in Nepal: Riverine Flood and Flash Flood Riverine Flood: floods from the major rivers in the southern Terai plains	Pradhan, BK, ICIMOD, 2007
• Floodway: Area adjacent to a River or stream			
• Intense rainfall zone • Very narrow river channels & steep slope • Poor infrastructural design (check dams, embankments, barrage, reservoir etc) along the	Climate, River morphology, Flood plain characteristics	Indication of flooding in national context	Khanal, N.R. et.al, (2007)

river sides • Low land areas (relatively low elevation) • Presence of development infrastructures in the natural flow of surface runoff			
• Construction of roads perpendicular to natural flow without sufficient drainage & construction of barrages, dams on the rivers		Explain about flooding due to construction of infrastructures on the river near the border area	Bhusal, 2004
• Areas which are frequently flooded • Areas which are unstable due to frequent changes in a river channel, its bed, and bank • Lowland areas with a very high water tables even if the areas are far from the river channel but heavy precipitation event in the area • Areas of local depression		Explains about the indication of those areas which are susceptible to flooding and inundation at watershed level (case study of Ratu Watershed)	Khanal, N.R. et.al, (2007)
• Land areas adjacent to River or streams • Plain surface area (quite flat and lies adjacent to a stream/river) • Uncovered land with Natural resources-vegetation around the river and in upstream	Contextual background in natural system-topographic category and vegetation coverage	Explain on the basis of experiences in local context	Practical Action Nepal
• Historical background of the area-flood		Flood prone are defined in terms of	LWF Nepal

reoccurrence, flood level trends, unconsolidated depositional materials- River bed history) • Contextual background- displaced people, food sufficiency, farming practices & livestock management practices etc)		livelihoods.	
• Wide River with low depth-seasonal flood • Vegetation coverage-not exist permanent vegetation • Surface soil characters	Geomorphologic dimension Landform system and vegetation system		Geographer (Department of Geography)
Floodplains: • Quite flat and lies adjacent to a stream • Sediments being transported-primarily of unconsolidated depositional materials • Subject to periodic flooding by a parent stream	Topographic Geomorphologic Hydrological	Defines the flood prone areas in general perspective	Schmudde, 1968[34]
• Annual precipitation • Flat lands nearby river in River valley • Land covers (barren land, water bodies ..) • Low land area and relatively lower elevation	Climate Topography Geomorphology	Explains field practices	Humanitarian Practitioners working in Disaster preparedness in Nepal
• Flood plain • Area with sediment	Topography Geo morphology and	Explains on the basis of academic practices in	Academic Practitioners in the area of geo

[34] http://www.oas.org/dsd/publications/Unit/oea66e/ch08.htm

deposition • Water spill out • Old channel observation • Active fan • Depression area in lower Terai • Uncover permanent vegetation • Not observe permanent settlement but observe human activities in agriculture practices • Silt and sandy deposition	Hydrology	the sector of flood risk reduction	morphology and Water Hazards in the country

Annex 1.3: Indicators/criteria for Flood-prone based on the field and literatures

Field based Indicators	**Literatures & expert consultation based Indicators**	**Threshold values/information (numeric and description)**	**Remarks**
Rainfall Concentration (Intense rainfall) in monsoon	Intense rainfall zone	Continuous rainfall in upstream(if large catchment) standing for 3-4 days (Riverin flood) Continuous rainfall standing for half an hour in upstream-around Bhabar zone Continuous rainfall in upstream in foot hill of Siwalik area standing for 2-3 hours (Flash Flood)	
Deep and Narrow valley (River valley)	Narrow river valley		
Obstructions in Flood Path	Obstructions in Flood Path (development built infrastructures, dams...)		
Poor Infrastructure design near river bank	Poor infrastructures desing along/near river bank		
Area where frequently flooding	Area where frequently flooding	Twice in a year, in general	
Main river channel changes frequently	Frequent changes in River channel	Mountain originated River changes its course (main course) in every 5-10 years in Plain region Siwalik originated River changes its course (main course) in every year in Bhavar and plain region	
Plain land area adjacent to river	Land area adjacent to river		It depends on many other factors
Low land area	Low land area (than river bed)		When flood water level exceeds the natural bank level of river and spills over the banks towards low level area
Warning system time (less lead time)	Little or no warning time (low lead time)		
Water level excess to drainage carrying capacity	Water level excess to drainage carrying capacity		Sedimentation is one of the factors that decelerate drainage

			carrying capacity
Flood level marked in river banks	Flood level marked banks		Flood level marked is hardly seen in plain region but can be known through local elderly individuals/ communities
Wider river when rain occurs but less water depth in dry season		1-2 km wider in Siwalik originated river	Sedimentation deposited area
Sandy soil characteristics	Loose and unconsolidated Land surface/Gravel areas (Bed rock types)		Flood water does not stay for a long-time in sandy soil region but the region is frequently seemed to be a flooding
Formation of sub-channels rapidly	Formation of channels-newly		Plain/Bhavar region where geo-morphologically sensitive
The region where embankment/protection measures and natural vegetation are not present in one site of a river but present in another site of the river			Usually the exposure sites are comparatively more prone to flood
The catchment produces a high discharge but has small /narrow region at outlet of the river			Narrow outlet usually present in Nepal-Indo boarder in Siwalik originated river
	Low land level where high Water Table		
	Area of local depression		
	Relief of the catchment-high		
	High Flow velocities		
	Uncovered land (natural and permanent vegetations) in upstream and around River bank but presence of Temporary green vegetation (buss, …) around river		
	Area from where people displaced		
	Livestock grazing system-Free grazing		

	Not permanent settlement but exist agriculture practices		
	Drainage Density high(more tributary) in upstream of the river		
	Depressed land (Dhasieko Jamin)		
	Deforestation		

Annex 1.4: List of key literatures reviewed in the study

Sources	Results/Coverage	Dimensions	Indicators/Factors highlighted
Dixit,A et al.(2007)[35]	Provided a broad overview of the impact of flood disasters and adaption to climate change at VDC level - Rohini Basin in Nwalparasi and Lalbakaiya River and Bagmati River in Rautahat distirct of Nepal's Terai	Physical	Frequency of flood Effects of flood Bank cutting/sand casting Damage to structures Effect of inundation – pollution Effect of inundation - on mobility House located along the banks House located next to embankments House located in the direction of flow Flood damaged - land types
		Social	Access to education Head of household Mobility-less or no-mobility
		Economic	Food sufficiency Land holding House types Source of income Food security
		Access to Resources	Access to water, sanitation and health institutions Access to forests Access to service centers
		Communication	Communication
		Gender Perspective	Group formation and funds Women participation in SHG
		Psychological	Psychological

[35] Dixit, A. et al. (2007), Flood Disaster Impact and Response in Nepal Terai's Marginalized Basins, *In: Working with the winds of change: towards Strategies for Responding to the Risks Associated with Climate Change and other Hazards,* eds.Monech, M &, A. Dixit, ISET-International: Boulder and ISET-Nepal : Kathmandu, pp.119-157

NRCS (2008)	Assessed Flood Vulnerability Mapping at ward level of Bhaktapur and Madhyapur Thimi Municipalities of Bhaktapur district	Social	Population distribution Illiteracy rate Energy sources Perception of risk
		Economical	Well being (Ultra poor, Poor, Medium, & Well off)
		Physical	Communication Drinking water sources Toilet accesses Electricity access Sanitation access
		Environmental	Toilet facility Sanitation facility
		Severity	Frequency Impacts (Population density and Types of houses)
Anderson and Woodrow (1989) and Modification ISET (2009)	Covered for risk management and vulnerability for resilient communities at community level in rural areas	Material	Income source Educational Attainment Assets(Fungible assets) Exposure (Distance from the source of hazards)
		Institutional	Social Networks Extra-local kinship ties Infrastructures (road, electricity, clean drinking water, telecommunications, medical facility) Proportion of dependents in a household Warning system Membership of disadvantaged low caste, religious or ethnic minority
		Attitudinal	Sense of Empowerment (access to national leadership structure, knowledge about potential hazard, community leadership etc.)

Shrestha, A.B,(2008)[36]	Covered the flash flood risk in Himalayan region including Nepal context	Nature and Probability of the Hazard	intense rainfall, landslide blocking river flow
		Degree of Exposure of the receptors to the hazard	Loss of life Material damage Environmental degradation
Colombo et al, (2002), Gouldby and Samuals (2005); and Shrestha (2008)	Covered a methodology for Flash flood hazard risk mapping at Community level	Hazard Intensity scenario (the strength of flood)	Danger to Population close to the stream High: 500m from the stream Moderate: 1 km away from the stream Low: more than 1 km away from the stream
		Hazard Probability level	Intense Rainfall Frequency of the Rainfall Return Period or the Frequency of the Flood (at least once in 10 years; once in 10 to 30 years; once in 30 to 100 years; less frequent than once in 100 years)
Cutter 1996; Weichselgartner 2001; Messner and Meyer 2005, RGSL (2003) and Shrestha (2008) and Shrestha (2005)	Defined vulnerability to flood risk in regional including Nepal context	Bio-physical included *Susceptibility* (elements susceptible to flood risk-high value elements –higher vulnerability index)	Natural areas (e.g., natural water courses, unproductive areas, and so on) Agriculture and forestry (e.g., meadows, pastures, forests) Special agriculture (e.g., fields, orchards) Local infrastructure (e.g., trails, secondary roads, tertiary canals) Trade and industry National infrastructure (e.g., main roads, railway lines, main canals) Settlements Special objects (e.g., power stations, cultural heritage sites, strategic facilities)

[36] Shrestha A.B.(2008). Resource Manual on Flash Floods Risk Management: Module 2 Non structural Measures, ICIMOD, Kathmandu.

		Exposures (type, extent, and magnitude of susceptible elements)	River morphology, Geology of the location, Elevation, Return period of the flood, Flow velocity
		Socio-economic Accessibility Health Communications Institutions Economic Loss-sharing measures Economic diversity	Quantitative Indicator Road density (m/km2) Number of health institutions/1000 population Number of telephones/1000 population Number of GOs and NGOs/1000 population Number of financial institutions/1000 population Value of revolving fund (disaster fund) Percentage of families with a number of income sources Qualitative Indicators Emergency facilities Warning system Loss reduction measures Awareness and attitude
ICIMOD (2007)[37]	Covered Vulnerability to Flood at National Level in Nepal Context	Physical and Spatial Vulnerability Extremely dynamic landscape Inaccessibility	 Density of human and livestock population Active tectonic & High sediment production Immense fan formed in the Foothills Excessive rainfall Poor services of water, health, communication, marketing, and transportation

[37] ICIMOD (2007) Flood Hazard, Risk and Vulernability in Nepal: the physical and socioeconomic Environment In: Khanal, N.R., Shrestha, M. and Ghimire, M. (eds) *Preparing for Flood Disaster: Mapping and Assessing Hazard in the Ratu Watershed, Nepal.* Kathmandu:International Center for Integrated Mountain Development.pp 25-21.

		Declining access to physical assets Wide-spread human settlements and migration	Lack of road maintenance & poor drainage along the roads Deteriorate quality and quantity of land resources and increase human encroachment on marginal lands Hill slope cultivation and lowland cultivation in flood-prone areas Emergence and expansion of human settlement in lower river valleys Absence of building codes, and lack of proper technical standards for built-up environments in hazards(flood) prone areas
		Socioeconomic (coping capacity or social resilience) Low human development index Poor economic growth Disparity in productive assets and income Heavy dependence on agriculture and its poor production potential Inadequate service provisions Increased population pressure	Those Indicators of Poverty Low Gross domestic product(GDP)-low agricultural growth, low level of revenue and savings Decrease average size of agricultural land and holding size Largely dependent on variable monsoon Low value added per unit of agricultural land and low agricultural worker Limited access to technology, formal credit sector, roads, markets and agricultural returns Below standards of accessing WASH services Low ratio of health centers to population Low ratio of doctors to population Travel time to service accesses Low electricity use per capita Increase pressures on farmland, marginalized land and forest land

		Ineffective implementation of disaster management strategies, policies, and programmes	Lack of broad perspective disaster management in strengthening institutions Poor coordination in implementing disaster management activities among the existing institutions Ineffective of Joint Inundation Committee (formed under the Ministry of Water Resources)
UNEP (2003)[38]	Formulated a method for Estimating Risk and Vulnerability at Global level	Physical Exposures	Frequency of Flood Population Affected
		Economic	GDP per inhabitant at purchasing power parity Total dept services(% of exports of goods and services) Inflation, food prices (annual in %) Unemployment (% total labor forces)
		Type of Economical activities	Percentage of arable land Percentage of urban population
		Dependency and Quality of the environment.	Forests and woodland (in %age of land area) %age of irrigated land
		Demography	Population growth, Urban growth, Population density, Age dependency ratio,
		Health and sanitation	Average calorie supply per capita, %age of people with access to adequate sanitation, %age of people with access to safe water (total, urban, rural)

[38] Global Risk and Vulnerability Index Trends Per Year (GRAVITY): Phase IV:Annex WVR and Multi Risk Integration: a technical report for United Nation Development Programme, Bureau for Crisis Prevention and Recovery(UNDP/CPR). Geneva:UNEP/DEWA/GRID

			Number of physicians (per 1000 inh.), Number Hospital Beds Life Expectancy at birth for both Sexes
		Politic	Transparency's CPI (index of corruption)
		Early warning capacity	Number of Radios (per 1000 inh.)
		Education	Illiteracy Rate, School enrolment, Secondary (% gross), Labour force with primary, secondary or tertiary education
		Development	Human Development Index (HDI)
DHM (2010)	Determined Flood danger levels at Chatara and Mainachli(forecasting stations) in Koshi and Kankai River Basins	**Features:** Flood Inundation & hazards mapping	Manning's values Flood frequency Discharge Flow depth Flow velocity Inundation area
UNICEF (2008)[39]	Successful practices of UNICEF initiatives in West Bengal, India	**Social**	Women and children active participation Behavioral change & Improved health and personal improvement Addressed Social Problems (HIV/AIDS and Alcoholism)

[39] UNICEF (2008) Conference on Community Based Disaster Risk Reduction, Kolkatta, India

	Identified Flood Hazard Indicators in Bangladesh	**Economical** **Natural** **Manmade**	Improved Quality of life Intensity zone Local Gradient High Flood Level Intensity zone History
UNISDR (nd)[40]	Defined flood risk and Developed a guidelines for reducing flood risk in global perspective	Flood risk based on following indicators	Number of people affected Properties damaged
	Addressed flood risk vulnerability	Key dimension: Poverty Gender inequalities (Human rights; political & economic status; land ownership; housing condition; exposure to violence; education & health)	Low-income Poor-housing and public services Lack of social-security and insurance coverage
Mohammed et al.,(2002)	Discussed a Methodology for the Flood Risk Assessment for Ganges Flood Plain in Bangladesh	Physical Social	Flood depth Frequency Population density Property damage
UNDP (2009)	Assessed flood disaster risk based on the basis of DesInventor data base		The number of events Deaths population; Affected population Properties damaged
GoN (2010)	Assessed Climate change vulnerability in relation to flood risk at national level	Sensitivity ,	Human-Population/Area Ecology-Protected area coverage, Forest area coverage,

[40] Guidelines for Reducing Flood Losses

		Exposure Adaptation	Occurrence Depth Injured Property loss Positive Annual Rainfall Socio-economic-Human Development Index Human Poverty Index, Gender Development Index, Human Empowerment Index; Infrastructures-Road Length, Landline Phone, Population Technology-Irrigation Coverage Area
DHM (2010)	Scoped out the Criteria indicating the flood hazards in Nepal in national context		Highly concentrated monsoon precipitation, High relief, Steep mountain topography, and Deep and narrow river valleys
Tanguay et,al.(2009)	Determined the dimensions and indicators of flooding risk in city in global context	Background Conditions Flood Protection defense Environment Flood Prediction	Flood History and behavior Number of properties at risk Type of defense Design standards Condition of defense Climate change Environmentally sensitive areas Long-and short-term impacts Source of flooding Reliability of forecasting Warning time Flood awareness Resilience of population Nature of housing Social trouble

		Social Economic Natural	Infrastructure at risk Financial trouble Agriculture farming status Potential agriculture system Depth of flooding Flood velocity Rate of flood rise Wave action
Shrestha, M.S.(2008)	Highlighted the indicators of flood impacts in South Asian nations		Loss of lives Total number of people affected Economic damage
Normandin et al,.(nd)	Identified strategic resilience indicators for cities to disasters (floods, earthquake, physical &social risk, coastal hazard, cyclone, drought, epidemic etc.) in global context including India		Income Access to water Having an emergency plan Population growth Oil & gas Insurance coverage Radio & TV access Erosion Land cover House Material Application of building codes Age average Population density Educational level Literacy rate Sex ratio Small business Dams Electric power Hospital beds Water network Subtotal-21)
Twig,J.(2009)[41]	Highlighted community resilience indicators (Developed by ADPC)		Resilience Indicators: A community organization; A DRR and disaster preparedness plan' A community early warning system;

[41] Twig, J. (2009). Characteristics of Disaster Resilient Community: A Guidance note :Version 2 , University College Longon

			Trained manpower: risk assessment, search & rescue, medical first aid, relief distribution, masons for safer house construction, fire fighting; Physical connectivity: roads, electricity, telephone, clinics; Relational connectivity with local authorities, NGOs, etc.; Knowledge of risk and risk reduction actions; A community disaster reduction fund to implement risk reduction activities; Safer houses to withstand local hazards; Safer sources of livelihoods;
Global WASH Cluster, UNICEF (20101)	Covered Integrating DRR in WASH in Emergency and Early Recovery in Global level		Prolonged rains-General flood; Intense rain-Flash flood Snowmelts Breach of dam Topography Deforestation Poor storm water drainage Poor solid waste management Urbanization Poor water management Poor farming practices
UNDP/UNEP(2004)	Identified the Flood Vulnerability Indicators		GDP per inhabitant at purchasing power Total debt services (% of the exports goods & services) Inflation, food prices Unemployment (% of total labor force) Arable land % of arable lands & Permanent crops % Urban population Forest & woodland Human-Induced Soil Degradation Population growth Urban growth Population density Age dependency ratio No. of physician (per 1000 inhabitants)

			No. of hospitals beds Life expiatory for both sexes No. of Radios (per 1000 inhabitants) Literacy rate HDI

Annex 1.5: Classification of Flood vulnerability by spatial variation (Four Groups)

Global	Regional	National	Community
Income	Loss of lives	Manning's values	Danger to Population close to the stream
Access of water	Total number of people affected	Flood frequency	Danger to population in settlement (about 500m from the stream)
Having an emergency plan	Economic damage	Discharge	Danger to population 1 km away from the stream
Population growth	Women and children active participation	Flow depth	Danger to population more than 1 km away from the stream
Insurance coverage	Behavioral change & Improved health and personal improvement	Flow velocity	Intense Rainfall
Radio & TV access	Addressed Social Problems (HIV/AIDS and Alcoholism)	Inundation area	Frequency of the Rainfall
Erosion	Improved Quality of life	Density of human Livestock population	Return Period or the Frequency of the Flood (at least once in 10 years; once in 10 to 30 years; once in 30 to 100 years; less frequent than once in 100 years
Land cover	Intensity zone	Active tectonic &	Income source
House Material	Local Gradient	High sediment production	Educational Attainment
Application of building codes	High Flood Level	Immense fan formed in the Foothills	Assets(Fungible assets)
Age average	Intensity zone	Excessive rainfall	Exposure (Distance from the source of hazards)
Population density	History of flooding	Poor services of water, health, communication, marketing, and transportation	Social Networks
Educational level	Intense rainfall	Lack of road maintenance & poor drainage along the roads	Extra-local kinship ties
Literacy rate	landslide blocking river flow	Deteriorate quality and quantity of land resources and	Infrastructures (road, electricity, clean drinking water, telecommunications, medical facility)
Sex ratio	Loss of life	Increase human encroachment on marginal lands	Proportion of dependents in a household
Small business	Material damage		Warning system
Dams	Environmental degradation		Membership of disadvantaged
Electric power			
Hospital beds			
Water network *(The indicators indicating for disasters risk resilience)*			
Flood History Behavior			
Number of properties at			

risk Type of defense Design standards Condition of defense Climate change Environmentally sensitive areas Long-and short-term impacts Source of flooding Reliability of forecasting Warning time Flood awareness Resilience of population Nature of housing Social trouble Infrastructure at risk Financial trouble Agriculture farming status Potential agriculture system Depth of flooding Flood velocity Rate of flood rise Wave action	Natural areas (e.g., natural water courses, unproductive areas, and so on) Agriculture and forestry (e.g., meadows, pastures, forests) Special agriculture (e.g., fields, orchards) Local infrastructure (e.g., trails, secondary roads, tertiary canals) Trade and industry National infrastructure (e.g., main roads, railway lines, main canals) Settlements Special objects (e.g., power stations, cultural heritage sites, strategic facilities) River morphology, Geology of the location, Elevation, Return period of the flood, Flow velocity **Quantitative Indicator** Road density (m/km2)	Hill slope cultivation Lowland cultivation in flood-prone areas Expansion of human settlement in lower river valleys Absence of building codes, Lack of proper technical standards for built-up environments in hazards(flood) prone areas Poverty Low Gross domestic product(GDP)-low agricultural growth, low level of revenue and savings Decrease average size of agricultural land and holding size Largely dependent on variable monsoon Low value added per unit of agricultural land low agricultural worker Limited access to technology, Formal credit sector, roads, markets and agricultural returns Below standards of	low caste, religious or ethnic minority Sense of Empowerment (access to national leadership structure, knowledge about potential hazard, community leadership etc.) Population distribution by age Illiteracy rate Energy sources Perception of risk Well being (Ultra poor, Poor, Medium, & Well off) Communication Drinking water sources Toilet accesses Electricity access Sanitation access Toilet facility Sanitation facility Flood frequency Impacts (Population density and Types of houses) Frequency of flood Effects of flood Bank cutting/sand casting Damage to structures

Number of people affected Properties damaged Low-income Poor-housing and public services Lack of social-security and insurance coverage Frequency Population Affected GDP per inhabitant at purchasing power similarity Total dept services(% of exports of goods and services) Inflation, food prices (annual in %) Unemployment (% total labour forces) %age of arable land %age of urban population Forests and woodland (in %age of land area) %age of irrigated land Population growth, Urban growth, Population density, Age dependency ratio Average calorie supply per	Number of health institutions/1000 population Number of telephones/1000 population Number of GOs and NGOs/1000 population Number of financial institutions/1000 population Value of revolving fund (disaster fund) Percentage of families with a number of income sources Qualitative Indicators Emergency facilities Warning system Loss reduction measures Awareness and attitude GDP per inhabitant at purchasing power Total debt services (% of the exports goods & services) Inflation, food prices Unemployment (% of total labor force) Arable land	accessing WASH services Low ratio of health centers to population Low ratio of doctors to population Travel time to service accesses Low electricity use per capita Increase pressures on farmland, marginalized land and forest land Lack of broad perspective disaster management in strengthening institutions Poor coordination in implementing disaster management activities among the existing institutions Ineffective of Joint Inundation Committee (formed under the Ministry of Water Resources) Intense rainfall, landslide blocking river flow Loss of life Material damage	Effect of inundation – pollution Effect of inundation - on mobility House located along the banks House located next to embankments House located in the direction of flow Flood damaged - land types Access to education Head of household Mobility-less or no-mobility Food sufficiency Land holding House types Source of income Food security Access to water, sanitation and health institutions Access to forests Access to service centers Communication Group formation and funds collection Women participation in SHG Psychological

capita, %age of people with access to adequate sanitation, %age of people with access to safe water (total, urban, rural) Number of physicians (per 1000 inh.), Number Hospital Beds Life Expectancy at birth for both Sexes Number of Radios (per 1000 inh.) Illiteracy Rate, School enrolment, Secondary (% gross), Labour force Primary, secondary or tertiary education Human Development Index (HDI)	% of arable lands & Permanent crops % Urban population Forest & woodland Human-Induced Soil Degradation Population growth Urban growth Population density Age dependency ratio No. of physician (per 1000 inhabitnats) No. of hospitals beds Life expiatory for both sexes No. of Radios (per 1000 inhabitants) Literacy rate HDI	Environmental degradation Natural areas (e.g., natural water courses, unproductive areas, and so on) Agriculture and forestry (e.g., meadows, pastures, forests) Special agriculture (e.g., fields, orchards) Local infrastructure (e.g., trails, secondary roads, tertiary canals) Trade and industry National infrastructure (e.g., main roads, railway lines, main canals) Settlements Special objects (e.g., power stations, cultural heritage sites, strategic facilities) River morphology, Geology of the location, Elevation, Return period of the flood, Flow velocity	

		Quantitative Indicator Road density (m/km2) Number of health institutions/1000 population Number of telephones/1000 population Number of GOs and NGOs/1000 population Number of financial institutions/1000 population Value of revolving fund (disaster fund) Percentage of families with a number of income sources Qualitative Indicators Emergency facilities Warning system Loss reduction measures Awareness and attitude	

Annex 1.6: Regrouping the Indicators for flood vulnerability in relation with WASH

Sets of Indicators/variables Intersection (GRNC; GRC;RNC; GC; RC;NC)					
GRNC	GRC	RNC	GC	RC	NC
Frequency of Flood	Illiteracy Rate	Excessive Rainfall	Income Source	Intense Rainfall	Distance of a Settlement from Stream
Warning time	Frequency of Flood	Frequency of Flood	Access to Education	Unemployment	Communication (no. of telephone/1000 pop)
Awareness/People's attitude about a flood	Warning time	Warning time	Food Security	Warning System	Frequency of Flood
Poor accessing to Water and Sanitation	Awareness/People's attitude about a flood	Awareness/People's attitude about a flood	Frequency of Flood	Frequency of Flood	Warning time
Population Density	Poor accessing to Water and Sanitation	Poor accessing to Water and Sanitation	Warning time	Warning time	Awareness/People's attitude about a flood
Duration and Depth of flood	Population Density	Duration and Depth of flood	Awareness/People's attitude about a flood	Awareness/People's attitude about a flood	Poor accessing to Water and Sanitation
Losses of lives and properties in the past	Duration and Depth of flood		Poor accessing to Water and Sanitation	Poor accessing to Water and Sanitation	Population Density
			Population Density	Population Density	
			Duration and Depth of flood	Duration and Depth of flood	Duration and Depth of flood

GRNC: Global-Regional-National-Community; GRC: Global-Regional-Community; GC: Global-Community; RC: Regional-Community; NC: National-Community

Annex - 2

Guideline for Preparing Flood Disaster Preparedness and Recovery Plan to secure Water, Sanitation and Hygiene facilities at Community

(A Part of Retrospective Research to Flood Risk in relation to WASH facilities)

Contents

Guideline for Preparing Flood Disaster Preparedness & Recovery Plan to secure Water, Sanitation & Hygiene facilities at Community Level

ARTICLE 1: INTRODUCTION, NAME AND OBJECTIVE OF THE GUIDELINE

Introduction: When weather is abnormal or the climate is under pressure, water and sanitation services systems stand to lose much of their environment and health benefits for mainly two reasons[42]: they lose their ability to deliver the services required because of direct infrastructures damage from floods; and they become a significant source of chemical and biological contamination of ecosystems, water bodies and soil by means of their discharges and polluted overload.

In line with disaster management, District Development Committee (DDC) is the member secretary of District Disaster Relief Committee (DDRC) and Water Supply and Sanitation District Office (WSSDO) is the Cluster lead of Water, Sanitation and Hygiene (WASH) for preparedness and emergency response[43] in Nepal. Despite this, there is a gap between two platforms DDRC and District Water Supply and Sanitation Coordination Committee (WASSCC) to coordinate the agencies within districts and to make WASH services resilient to disasters risk in action both at district and community levels. In order to address such gap, WSSDO in a close collaboration with DDC could play decision making role for the effective coordination to implement key actions relevant to WASH services during pre-flood and post-flood periods. Furthermore, Disaster Preparedness and response Planning 2011 provides guidance to DDRC and WASSDO to work on disaster preparedness including flood. The guidance includes response actions for effective WASH facilities at district level. Besides, National Strategy for Disaster Risk Management, 2009 (NSDRM) highlights strategic activities on Water and Sanitation (WatSan) in line with five priority areas of Hyogo Framework for Action (HFA)[44].

Water Aid in Nepal has categorized natural hazard including floods as one of the risk factors of WASH services.[45]. Water Aid in Nepal intends to address flood risk through a guideline for flood disaster preparedness to ensure WASH services at community level.

Name: 'Guidelines for Preparing Participatory Disaster Preparedness Plan for Reducing Flood Risk to secure Water, Sanitation and Hygiene facilities at Community Level' is the name of this Guideline.

Objectives:

- To adopt minimum criteria/indicators of flood vulnerability in preparedness and recovery plans in line with WASH interventions at community level
- To Prepare participatory flood preparedness and recovery plans to ensure WASH facilities in flood- prone region of the country
- To raise awareness among the partners of WAN in line with flood DRR in WASH domain

ARTICLE 2: SCOPE, PURPOSE AND TARGET OF THE GUIDELINE

Scope: Links between WASH and flood DRR in preparedness of pre-disaster and recovery in post disaster; guides for the preparation of pre-flood plan (Preparedness plan) and post-Flood Plan (Recovery Plan) for the

[42] WHO (2010).Guidance on Water Supply and Sanitation in Extreme Weather Events

[43] Natural Disaster (Relief) Act 2039 and Guidance Note Disaster Preparedness and Response Planning 2011

[44] A Report of Retrospective Research on Flood Risk in relation to WASH facilities

[45] Nepal country Strategy 2010-2015, Water Aid Nepal

partners of Water Aid Nepal in Nepalese context; and helps to address floods in the Terai region in line with Flood Resilient WASH at community level

Purpose: The purpose of the guideline is to prepare preparedness and recovery plan to address pre-flood and post-Flood situation in WASH domain at community level

Target Groups: The guideline targeted for the Partners of WAN at community level to address WASH interventions in Flood vulnerable region of the Terai in Nepal.

ARTICLE 3: IMPLEMENTATION AND LIMITATION OF THE GUIDELINE

This guideline shall be implemented after the approval of the Water Aid in Nepal (WAN). Testing the guideline in WAN's pilot project of DRR and WASH is a basic requirement for the wider application of the guideline under Water Aid in Nepal. The guideline guides only the partners of WAN for preparing pre-flood plan (preparedness) & post-flood plan (Recovery) to secure WASH facilities at community level in the Terai region of Nepal.

ARTICLE 4: GUIDING APPROACHES FOR PREPARING THE GUIDELINE

National Strategy for Disaster Risk Management 2009 (NSDRM, GoN): According to the NSDRM, water and sanitation are some of the key sectors highlighted in the strategy. In order to ensure WASH facilities, DRR should be in high priority at local level. For this, the strategy emphasizes some activities, such as: preparing emergency preparedness plan for the provision of water and sanitation; restoring water and sanitation facilities for post disaster situation including identification of convenient and safe water storage during emergencies; assessing risk of water and sanitation systems to develop contingency plan and implement mitigation measures at VDC level; building culture of safety and resilience by conserving water sources and promoting local level water treatment; adopting water resources mapping in view of disaster scenarios; and integrating water and sanitation issues in district level disaster risk management plan.

Hyogo Framework for Action (HFA): HFA emphasizes that water is one of the public facilities in relation with social and economic development practices. The facilities need to be protected and strengthened in order to make them adequately resilient to hazards.

Local Disaster Risk Management Planning Guideline 2068, Government of Nepal (LDRMP GoN): LDRMP guideline ensures mainstreaming of disaster risk management into local development planning processes at community, ward, Village Development Committee (VDC) and DDC levels. Here, water and sanitation service at community level is one the key public facilities of local development that need to be addressed in view of disaster resilience. Coordination, vulnerability and capacity analysis, local disaster risk management planning processes, endorsement & implementation of the plan, and monitoring and review of the plan are key steps highlighted in the guideline.

Integrating DRR in WASH in Emergency Response and Early Recovery Guideline[46]**:** The guideline focuses on the links between WASH and DRR in emergency response and early recovery. Planning for disasters in the development phase through mitigation and preparedness is essential to reducing the risk to WASH systems. The guideline emphasizes the WASH components to integrate in DRR (emergency and early recovery phase). Besides integration with DRR, the WASH components, such as water supply, excreta disposal, hygiene

[46] Global WASH Cluster, 2010

practice, vector disease control, solid waste management, and drainage of wastewater and storm water are included in the guideline.

Guidance Note Disaster Preparedness and Response Planning 2011(GoN): T The guidance note is to facilitate the process for preparing Disaster Preparedness and Response Plans (DPRP) at district and VDC/Municipality levels. Identification of humanitarian partners in districts, document reviews, , organization of cluster specific meetings and workshop and documentation and endorsement of plans are the key steps highlighted in the guidance note for the preparation of DPRP. WASH is one of the clusters given a high priority in the guidance. The coordination, roles and responsibility of the cluster lead and its members need to be clearly mentioned in order to prepare effective disaster preparedness and response plan at district level.

Sanitation and Hygiene Master Plan (SHMP): The master plan emphasizes emergency preparedness for water related disasters at community level to control epidemic and diarrhea that may occur during emergency situation. .

The Sphere Project 2011: The Sphere Project guides through the minimum standards for water supply, sanitation and hygiene promotion (WASH). principle of humanity, international laws, right to life and dignity, the right to protection and security and the right to receive humanitarian assistance on the basis of need are the basic foundation of humanitarian response recognized by, the Sphere Project. The Sphere Project consists design, management and maintenance of the WASH facilities where appropriate. Sphere Project emphasizes the guidance note to assessing the needs to identify risky practices that might increase vulnerability of WASH.

Water Aid Approach to DRR: Water Aid intends to provide safe water, improved sanitation and better hygiene. It aims to integrate WASH facilities into development in order to respond Disaster risk through mitigation and preparedness. Water Aid Nepal emphasizes in its country strategy paper that natural hazards like earthquake, floods and landslide remained unpredictable about which staff members and partners need be made aware[47].

The Retrospective Research Study Findings 2012: The Indicators identified in the Retrospective Research Findings determine the flood vulnerability and flood proneness indicators that need to be considered to make WASH facilities resilience to flood risk in Terai region of the country.
Community participation: Community participation in terms of the involvement of women, poor and vulnerable should be ensured in all steps of preparation and implementation of plans.

ARTICLE 5: FORMULATION OF FLOOD DISASTER PREPAREDNESS AND RECOVERY PLAN IN WASH DOMAIN

Flood disaster preparedness is one of the sub-phases of emergency response phase in Flood Disaster Risk Management (FDRM). The purpose of flood disaster preparedness plan in relation to WASH is to respond to potential flood impacts on WASH facilities for reducing adverse impacts. It helps the WASH services to continue after the flood period. The priorities emphasized in the plan are reviewing the situation, identifying and coordinating the relevant stakeholders, limiting damage to WASH facilities and preparing for the better response.

[47] **Water Aid Provisional Guideline and Water Aid Nepal Country Strategy**

The aims of the plan are: to maintain optimum services through the mitigation of potential flood impacts on existing WASH services by adopting appropriate measures; to scale up resilient WASH services to flood risk; to ensure continuous service after flood event when emergency situation is completed; and to raise awareness among the partners specifying their roles and responsibilities to reduce flood impacts on the WASH services.

2.3 I. Formation of Flood-Resilient WASH Unit/Section/Team (FR-WASH Team)

- What?: Identify members of the Team
- Who?: partner's officers, senior management members, and WAN's senior officers (thematic areas), invited participants from WASH cluster and V-WASS-CC in the team (total members to be 5-7 in the team)
- When?: It should be formed at least one month prior to the preparedness planning process till the recovery phase ends

The purpose of the team is to carry out the preparedness and recovery planning, as well as to coordinate the country office mitigation, preparedness and early recovery activities. The following activities need to be carried out by the team.

- Preparation of flood preparedness and recovery plans and implement the plans to ensure flood resilient WASH services
- Coordination at project and programme levels
- Coordination with humanitarian organizations and DDRC in preparedness and emergency response
- Supporting logistics and procurement as per WAN policies
- Information management and sharing
- Protection of the services (especially during flooding in project areas)

2.4 II. Information Collection and Review of Documents

The FR-WASH Team need to review relevant documents including:

- Flood Resilient WASH guideline for preparing flood disaster preparedness and recovery plans in WASH domain,
- District Disaster Preparedness and Response Plans (DDPRP) if they exist,
- Project documents of the respective project area
- WAN's Strategy and policy documents
- National Strategy on Disaster Risk Management (NSDRM)
- WASH related policy documents and project documents (population numbers of project sites, WASH facilities information, project beneficiary, etc.)
- Lessons learned documents including good practices
- Flood vulnerability and flood risk indicators
- Village Development Profile (VDC) specific to concerned community

- Flood hazard and flood risk mappings developed by different agencies like DDRC, DDC, DHM, DWIDP, etc.
- Water resources system and network
- Demographic reports at VDC level
- Historical flood disasters in the river basins (where the WAN's Programs exist) in terms of people killed, number of people affected, total economic damage, flood depth and duration, WASH facilities damage, etc

2.5 III. Meetings within the Team Members and with Concerned Stakeholders

FR-WASH Team members should familiarize themselves with methodologies/process for preparing flood disaster preparedness and recovery plans by reviewing the relevant documents and facilitating the technical work. In general, two to three meetings and one final workshop need to be organized for the preparation of flood preparedness plan. The team should then develop detailed work-plan for the workshop. The participants need to be identified from other WAN staff, relevant government, non-government and donor organizations from community to district levels. The first meeting can decide a technical team including a facilitator (may be from external sources-consultant) to facilitate for the formulation of plan.

The following agenda may be adopted in the meetings:

- Key outcomes of document review
- The internal WASH specific information, which will be used to analyze the current capacity of the partner and WAN's country office to respond to potential food risks in project area
- Resource inventories /mappings including country office key staff, partner's staff with their contact information, offices, alternatives of water sources, sanitation alternatives, vehicles, equipment, etc.
- Contact information for the Government, UN, International and Local organizations active in the district and in the project areas
- Roles and responsibilities of the team members and other agencies involved
- Scenario planning based on historical records
- Needs assessment and gaps identification
- Cross cutting issues and gender issues in both phases
- Finalization of the tentative schedule with agenda of final workshop
- Approaches for flood hazards and risk mapping

2.6 IV Flood Hazard, Vulnerability and Risk Analysis

Frequency of flooding, duration and depth of flood, population density, number of deaths and people affected, and magnitude of impact (property, livelihoods, area etc) are the key criteria to determine the degrees of flood hazard (Table 1). The flood risk for WASH services includes analysis of flood hazard and short analysis on critical facilities of WASH services. Vulnerability, damage potential, is the measure of the capacity to resist or recover from the impact of hazard in the long as well as short term. Flood vulnerability need to be assessed with respect to WASH facilities. For this, assessing potential effects of a flood on critical

facilities is necessary (Table 2). Likewise risk analysis is the function of the probability of a flood hazard occurrence and the potential humanitarian impact of the flood hazard on different segments of the population, property and livelihoods. Capacity and risk analysis specific to WASH services can be carried out by adopting the checklist given in Table 3. The information regarding vulnerability and capacity can be collected by using Vulnerability and Capacity Analysis Tools (VCA-Tools), such as study of secondary data, direct observation, vulnerability/social mapping, transect walk, time line, semi-structured interviews etc.

Table1: Flood Hazard Analysis Matrix (based on the information of last 5 years of flood events)[48]

cations	equency	ration & depth flood	pulation nsity	deaths	of people ected	gnitude	al Ratings

Table 2: Flood Vulnerability Ranking specific to WASH services

tential Effects on WASH Services	lnerability Ranking in Consensus w/Medium/High)	k Factors[49]
rastructure		
man resources		
terials		
ganization		
uts		
ers		
ernal infrastructure and service providers		

Note 1: Need to refer to the followings concerning potential effects of a Flood on WASH services[50]

Infrastructure: Damage to infrastructure (e.g. damage to overflowing dams, damage to infrastructure by erosion, settlement of soil, floating debris, settling of soil); the course of changes in river channels; and systems affected by deposited sediments)

Human resources: Reduced productivity workforce (e.g. workers attending to livelihoods and family, poor access to service structures); need in additional capacity (both in number and potential skills) to deal with damage assessment, damage repair, monitoring, changes in organization, communication and transport

Materials: Damage or loss of materials (e.g. materials affected by water, damaged by floating debris, washed away); Increased need in materials (e.g. for repair of infrastructure, spares, tools, consumables)

Organization: Increased needs in resources for maintenance of service level and recovery; Ddsruption of normal procedures and systems; possibly new or modified procedures/ systems needed

Inputs: Difficulty in raising funds needed for operation and recovery; contamination of water source (e.g. overflowing sanitary structures, silt); contamination of water in distribution system; reduced water availability (for users, for operation processes), sedimentation, water; demand high for clean-up system; difficulty in obtaining consumables, spares, equipment

Users: Change in ability and demands of users; Change in attitude of users

[48] Adopted from Retrospective Study, WAN, 2012

[49] Adopted from Retrospective Study, WAN (2012) and UNICEF (2010) Note down the prevalence risk factors based on the community perception: Prolonged rains/intense rainfall, Breach of dam, Topography, Deforestation, Poor storm water drainage, Poor solid waste management, Urbanization, Poor water management, Poor farming practices, Poor access to WASH facilities, Level of People's Perception on Flooding, Income level and sources

[50] Adopted from: UNICEF (2010) WASH and DRR Guideline; and from 131, 135, 136 and http://en.wikipedia.org

External infrastructure and service providers: Suppliers may be affected; possible liability issues on materials/ structures in use and damaged; transport and communication systems will be affected; emergency response may claim part; reduced supply in external services (e.g. electricity, waste management; may be damaged); Difficulty in obtaining specialist support (on same terms); specialists may be affected, claim for emergency response.

Note 2: Vulnerability ranking is based on the total scoring of flood hazard ranking and the consensus of the community and the team

Table 3: Checklist for Capacity Assessment and Risk Analysis

Capacity assessment
• Identify agencies (CBOs, government authorities, private sector, WASH services, public health system, emergency response services, NGOs) that may collaborate with WAN's Partner for preparedness and recovery phases. Define the roles, responsibilities and real capacity (resources of the relevant stakeholders) • Assess what the capacities and strengths of WASH services are with regard to possible hazard events • Identify the level of capacity and strength of the components of WASH systems towards flood hazard events (e.g. low, medium, high). The level of capacity should approximately correspond to the level of vulnerability identified; i.e. high vulnerability should be roughly leveled out by high capacity
Risk analysis
• Predict the impact of flood hazard event would have on the components of WASH systems, and project how this will affect the functioning of the WASH service • Estimate the impact on service levels for users. • Identify possible ways to reduce the flood hazard threat (e.g. relocation of WASH structures services from flood plain to zone safe from flooding) • Identify capacities and strengths that can be built upon to reduce flood impacts and vulnerability

Preparedness plan will usually be carried out on regular basis (normally on annual basis). It is necessary to develop scenarios and defines planning assumptions based on the flood hazard and risk analysis. The assumptions include the implication of flood hazard and its impact on the population, and WASH facilities. Scenario based planning in WASH sector includes specific projections of humanitarian needs of WASH services including WASH kits, characteristics of the population and capacities of affected communities (in the project area of WAN) and WAN itself to respond to the situation to ensure continuous services of WASH facilities after a flood event in the project areas.

Scenario assumption can be developed by addressing the following questions related to the core services of WAN at community level.

Water

- What safe water systems exist in project site/VDC?
- What measures exist to reduce water use during flood?
- What equipment/means would be necessary to supply safe water (cleaning, wells, boreholes, bladders, etc?)

- What patterns of water collection, maintenance and management, different uses and responsibilities of water by men, women and children are practiced by the community before the flooding?
- What are the security aspects around water sources?
- What types of impacts may occur due to a flood on WASH facilities adopted by a community in the project site of WAN?

Sanitation

- What are traditional sanitation practices in the community?
- What are traditional sanitary habits of women and girls in the community?
- What are the cultural assumptions with regard to water and sanitation activities, for example during pregnancy? Do these traditions poise possible problems in crowded or temporary locations?
- What special sanitation facilities are necessary for women and girls?
- Will traditional sanitary practices exasperate the situation (particularly for disease outbreak)
- What types of measures need to be adopted when a flood with particular magnitude (worse scenario) hits the project area (as per the risk analysis) in the community?

2.8 VI Needs Assessment and Gaps Identification

According to the WA provision, WAN does not respond emergency response during a disaster. However, the services provided by the organization through its partners need to be continued regularly aftermath a flood disaster with an additional emergency support in the community. In considering this, needs assessment and gaps identification should be carried out and it needs to be reflected in preparedness plan (Table 4). The assessment format can also use for recovery plan.

Table 4: Needs and Gaps Identification

	Emergency actions to protect WASH facilities during a flood disaster	Preparedness actions to address emergency actions	Gaps identified to address preparedness actions	Key responsible agencies (partners, WAN country office and others)	Cost estimation in NRs.

2.9 VII Identification and Prioritization of the WASH facilities

On the basis of flood hazard assessment, vulnerability assessment and capacity and risk analysis, preparedness and recovery activities need to be prioritized. The prioritization of the activities should be done by adopting inclusive and participation of local community approaches. Give a ranking values 1, 2 and 3 for high, medium and low Priority respectively by using Table 5.

Table 5: Prioritization of the WASH services

Locations	WASH facilities	Preparedness activities	Post-flood activities	Prioritized activities	Rationale

2.10 VIII Drafting Flood Disaster Recovery Plan in WASH domain

After finishing all the exercise/steps including the Post Disaster Damage and Need Assessment for Recovery Plan (PDNA), a draft on disaster preparedness and recovery plan at community level need to be prepared by adopting the formats as given in Table 6. The draft plans will then be discussed widely among the WAN's Programme and finance sections, partners, concerned stakeholders, and community. A workshop is proposed for the discussion.

Table 6: Content of Flood Disaster Preparedness and Recovery Plan in WASH Domain

……Programme Location/VDC/District
…….Partner's Name
Target Flood Event……
Plan Formulation Date: D/M/Y…..

Message: Include message from WAN Country Representative

Acknowledgement from VDC

Executive Summary

Part-1: Introduction

1.1 Background
(Brief summary of introduction of community/district regarding demography; water resources situation, sanitation and hygiene condition; previous experience in flood disaster management; brief summary of the planning exercise; reference document; links of the plans with WAN's programmes-DRR programme at community; a general picture of water and sanitation damages based on detailed need assessment aftermath a flood disaster)

1.2 Objective of Plan
1.3 Rationale and Limitation of Plan
1.4 Methodology Adopted for the Preparation of Plan
1.5 Plan Implementation, Monitoring, Evaluation and Review strategy
1.6 Expected Outcome of Plan

Part 2: Flood Disaster Preparedness and Recovery Planning

2.1 Brief introduction about formulation of Flood-Resilient WASH Team; List-out the potential partners at community and district levels to collaborate with them for preparedness and recovery works
2.2 Outcome of the documents review
2.3 Minutes of Various Meetings
2.4 Flood Hazard, Vulnerability, Capacity and Risk Analysis (Specific to WASH facilities)

2.5 Scenario and Assumption Planning (Specific to WASH facilities,only for preparedness planning)

2.6 Need Assessment and Gaps Identification
(For preparedness plan: Scenario and assumption basis
For recovery plan: the gaps identification should be carried out on the basis of detailed need assessment of water and sanitation facilities)

2.7 Prioritization of WASH facilities

2.8 Roles and Responsibilities to fill the Gaps on the basis of Prioritization

2.9 Formulation of Action Plan

Part 3: Adoption, Implementation and Review

3.1 Activation of Plan

3.2 Implementation Timeline of Plan

3.3 Regular Review and Follow-up

Annexes

Annex - **3**

Field Observations for Flood-Prone and Flood Risk Indicators/criteria

(A part of work on the Retrospective Research on WASH and DRR)

Table of Contents

1. BACKGROUND

Field work was carried out as a part of the study on 'Retrospective Research on WASH and DRR to verify and amend the developed indicators/criteria of occurrence of flooding and flood risk in the country. This work has been done in reference to the agreement between WAN and Nature's Conservation Pvt. Ltd. The study has identified indicators of flooding and flood risk at national and community levels. The identified indicators were verified and updated to ensure the criteria of assessing flooding in Nepal. The verification was done on the basis of community experiences and field observations in the selected districts prone to flood risk. The field work was done from 26th December, 2011 to 6th January, 2012.

2. OBJECTIVES OF THE FIELD VISIT

The objectives of the field visits were:

- To verify/amend identified indicators of flood proneness and flood risk at community level;
- To identify the criteria/issues of flood risk on WASH schemes that needed to be incorporated in the guidelines of preparedness and recovery for WASH facility in flood scenario;
- To compile existing practices of WASH schemes that were adopted/being adopted by the community/stakeholders in reducing flood impacts.

3. SITES

The field visits were performed in the following communities in three districts: Sunsari, Rautahat, and Bardiya. The districts were selected during the desk work on the basis of some key criteria mentioned below.

The selected Districts, corresponding community, basins and criteria for the selection of the sites

I) District: Sunsari; Communities: Inarwa-6 & Haripur-4; Basins: Koshi and Sunsari Watershed

Features of the district in line with flood risk

- Snow-fed and Rain fed river
- Extensive precipitation in river basin
- Possible flood due to the failure of infrastructures built on the river, due to frequent changes of river course and due to the heavy rain-falls in the basin.
- Ranked within first-tenth position (ranked 8th) in terms of risk in the period of (1971-20 10)
- Water and sanitation interventions in 2008 Koshi flood.
- Significant interest of humanitarian and development agencies.
- High degree of flood vulnerability with respect to climate change on the basis of exposure, sensitivity and adaptive capacity.

II). District: Rautahat; Communities: Banjahara VDC-3, Chandranigahapur-4 & Bhrampuri VDCs and Watersheds: Lal Bakaiya-Bagmati

Features of the district in line with flood risk

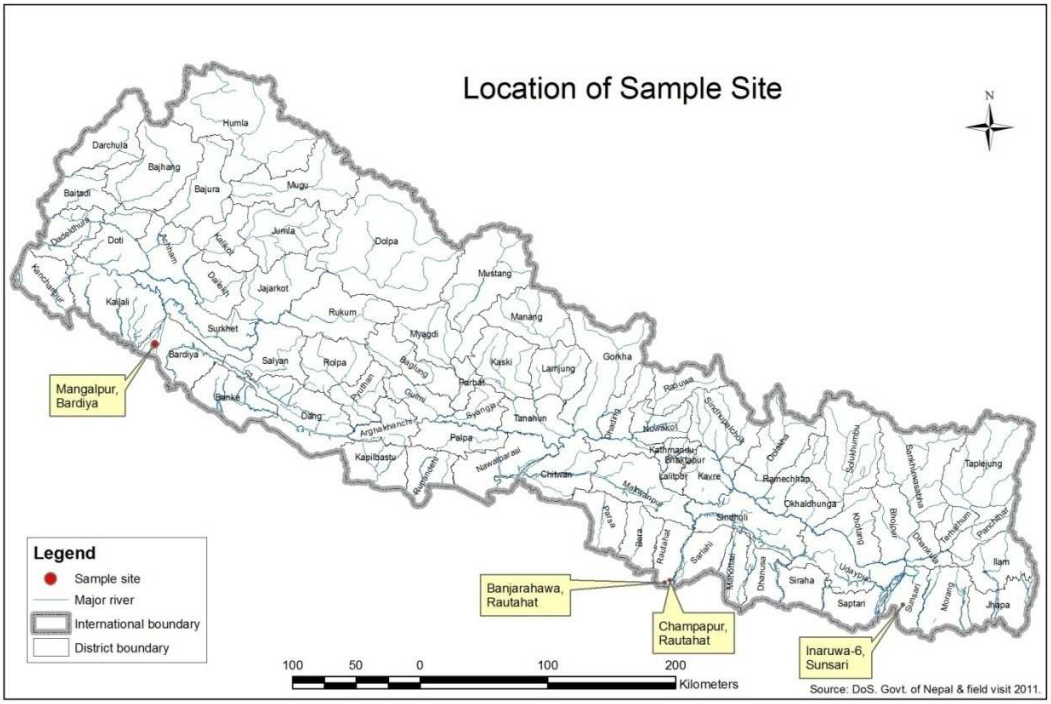
- High ranked (4th position) to flood risk in the period of (1971-2010);

- High degree of flood vulnerability with respect to climate change on the basis of exposure, sensitivity, adaptive capacity;
- Flooding due to frequent changes of river course and active flood plain
- Inundation due to infrastructures on the river

III). District: Bardiya; Communities: Manau-3 and Watersheds: Karnali-Bheri

Features of the district in line with flood risk

- Island of Karnali River
- Moderate degree of flood vulnerability with respect to climate change on the basis of exposure, sensitivity, adaptive capacity;
- Significant in ranking (13th position) to flood risk i in the period of (1971-2010);
- Siltation and water logging problem due to cross-border infrastructures



3 4.TOOLS ADOPTED IN THE FIELD WORK

The following tools were adopted in the field

- Transect Walk
- Social map
- FGD
- WASH intervention
- Flood history
- Social map (hazard and vulnerability map)
- Visits to flood prone arias
- Information collection from key informant

- CBO/NGOs courtesy visit and interactions

The above tools are briefly summarized below:

Transect Walk: The flood hazards area were observed in the transect walk in close coordination with the local community. The key features like flood prone areas and causes of the flooding were observed and discussed with the community during the transect walk. The visits were made in the flood prone regions, the t flood affected communities and the sites where floods were responded and preparedness programmss adopted. From the transect walk, it was observed that physical-natural, technical, socio-economic and governance sectors are the key dimensions that govern flood prone and risks to flooding.

Focus Group Discussion (FGDs): The focus group discussions with the concerned local communities were carried out during the field visits. Community based organizations (CBOs), social mobilizers (SM), women group organizations, youth groups, elderly people, and village development committee (VDCs) representatives participated in the FGDs. The discussion was based on the prepared checklists for FGDs. The defined indicators of flooding and flood risk were brought into discussion to check whether the indicators needed modifications based on the feedbacks from communities. The lessons learned from the WASH services in the community were also discussed. The participants were asked about the causes/criteria of flooding and its impacts. The ways forward to enhance the community resilience to flood risk were also discussed during the FGDs.

Stakeholder's consultation meeting: The consultations with local stakeholders at project level were carried out during the field visits. The consultations focused on sharing the scope of the visits and learning from stakeholder's experiences on flood vulnerability, risks, flood impacts, and WASH services. The field team met with different agencies, such as, Plan International, Lumanti, Oxfam and NRCS working at project level. The major topics of discussions included causes of flooding, and its impacts on WASH services for making it resilient to flood risks at community levels.

Key Informants Interview: Social leaders, project coordinator of different agencies, social mobilizers, community leaders, experienced individuals were asked about the causes of flooding and also requested them about the indicators of flooding and flood risk. The informants included individuals who could explain the history of flooding and its impacts on the communities

4 5. OUTCOMES OF THE FIELD WORK

Ensuring the consultations at community level, we were able to rectify the selected indicators, which were based on literature reviews. Outputs include the field report on the verification of indicators and the compilation of community experiences on WASH and DRR.

The indicators of the occurrence of floods, flood prone area and its risks were verified during te visits. The field work was also useful to identify factors to be incorporated in integration of DRR in WASH and in the guideline/handbook. Gaps between WASH services and WASH resilience to flood risk are the additional outcomes of the field work.

5 FINDINGS AND DISCUSSIONS

5.1 Identification of Criteria/Indicators

The indicators/criteria indicating flood prone area/flood occurrence and flood risks are identified by reviewing literature related to flood and by interacting with the professionals and experts. The identified indicators were discussed with the communities in the field. The verification and further improvements of the indicators were accomplished during the field-level discussions. The verified and amended indicators for different river basins are listed in the table below.

Table: Indicators of flood-prone based on Desk work and field verification

Indicator	Bardiya (Karnali-Bheri River Basin)	Rautahat (Lalbakaiay-Bagmati River basin)	Sunsari (Koshi-Sunsari River Basin)	Threshold value (highest) Community Experience	Remarks
Rainfall Concentration (intense rainfall) in monsoon				3-4 days continuous rainfall in upstream catchment (riverine flood), flash flood in Foot hills of Siwaliks: about half an hour of continuous rainfall in upstream areas and flash flood in Bhabar zone: Continuous rainfall 2-3 hours in upstream areas	
High Relief					
Steep mountain topography					
Deep and narrow river valley)					
Obstructions in flood path					
Poor infrastructure design near river bank					
Dam or other infrastructure built against river flows					
Area prone to frequent flooding				2-times in a year, in general	
Low land level with high water table				Flood observation in the area where water table ranges 6-8 m in general	The indicator is not applicable in all region
Frequent				Mountain originated	

changes in river channels				river changes its main course in every 5-10 years while plain region and Siwaliks originated river changes its main course every year in plain region	
Area of local depression					
Land area adjacent to river					It depends on many other factors
Low land area					
High flow velocities					
Warning system time (less lead time)					
Streamflos in excess to drainage carrying capacity					
Already marked eluded banks					
Uncovered land with vegetation free lands in upper catchments					
Temporary green vegetation (bushes, …) along river banks					
Areas left by displaced people					
Livestock grazing system					
Agriculture system					

Bed rock types					
Wide rivers with low depth					
Sandy soil					
changes in main/old river channel					
Active fan					
Agriculture lands					
High drainage density					Additional Indicators in the field
Subsided land					Additional Indicators in the field
Absence of embankment and natural vegetation along single bank of river					Additional Indicators in the field
Deforestation					Additional Indicators in the field
Loose and unconsolidated land with gravel surface					Additional Indicators in the field
Small/narrow outlet with high discharge in a river					Additional Indicators in the field
Island or delta area					Additional Indicators in the field

Table: Indicators of flood risk based on the desk work and the field verification

Indicator	**Bardiya (Karnali-Bheri River Basin)**	**Rautahat Lalbakaiay-Bagmati River basin)**	**Sunsari (Koshi-Sunsari River Basin)**	**Threshold value Community Experience**	**Remarks**
Frequency of Flood	✓	✓	✓	2-3 years in average for Major flood	

				3 times in a year if catchment is relatively small	
Lack of Early Warning system (lead time)	✓	✓	✓	Flash flood: within 20 minutes after extreme rain in 2-km upstream of from community	
(Attitude) People's perception on flood	✓	✓	✓		
Poor access to WASH	✓	✓	✓		Technical gaps in design of toilets that are susceptible to flood risk. Flood levels in settlement areas are not considered. water pump toilet, and building construction increase vulnerability if weak WASH resilience services during and after flood.
Degree of population density	✓	✓			
Duration and	✓	✓		3-7 days	

Depth of Flood				depending on many other factors	
Type of income source	✓	✓	✓		
Education status	✓	✓	✓		
Characteristic of Settlement	✓		✓		
Distance from River	✓	✓	✓		
Excessive rainfall	✓	✓	✓		
Poverty (economically deprived castes)	✓	✓	✓		
Link between River's production and livelihoods	✓				
Weak sanitation	✓				
Distance from river	✓	✓	✓		
Isolation from government priority	✓	✓	✓		

5.2 Disaster Risk Reduction and Response (Flood Specific) in WASH Domain: Field Observations

Lack of consideration of flood scenario in providing water and sanitation facilities (hand pump, tap water) both in riverine flood zone and water logging area: In some cases, the foundation of hand pump are raised to some height by considering flood water levels in the area. Flood water levels in flood zone (settlement regions) need to be assessed by considering some key features of flooding, such as flood history, duration, flood impacts, and approaches or tools for water harvesting from the sources during the flooding period.

Gaps in WASH structural intervention in relation to flood risk: Weak attention given in the sanitation with inappropriate practices (Flush toilet connected to public sewerage, flush to open drains. Non-flush contains dry raised latrine, dry pit latrine useful during floods. Likewise, the indicators of flooding, such as, soil types, flood defense, poor preventive measures, distance from the flooding source, etc are not considered while providing water and sanitation facilities.

Assurance of water (in terms of quality and quantity) availability at the sources (tap or at hand pump) during and after flooding: Drinking water accessibility in water logging region during and after the flooding is not ensured. This indicates ineffective preparedness measures. The assessment of the availability of resources and way out for providing the resources need to be planned before floorings. Likewise, if water is not available at the tap/pump, drinking water should be stored in large container equipped with tap, drainage, and water purification tools.

Inadequate awareness about how to use drinking water in flood response period: Communities are not aware about water contamination sources and the availability of treatment measures. Simulation exercise on the use of water treatment measures needs to be performed in pre-flood period at community level and household level in water logging area. Soap, hand washing and waste water drainage facilities need to be provided at exit of latrines. Distance of pit latrines and house/ community building need to be maintained at minimum standard (5m < buildings < 30m)

Critical gaps in the provision of water, sanitation and individual house in water logging and flash flood region: Water and latrine facilities are constructed by raising their foundation to save it from flood inundation. Community household and individual houses need to be raised (ground space to flow water) to some height in inundation condition. Communities do not get water both for drinking and washing during and post flooding as the water sources-tap may get damaged Therefore, flood hazard mapping and vulnerability assessments need to be carried out before providing the WASH service facilities. Such assessments need to be given priority in a place where recovery programmes with housing facility and WASH intervention are provided.

Lack of integration programme : Integrated interventions in recovery programme st need to be promoted for the sustainability of WASH service facilities. Furthermore, formal and informal education system and sustainable income generating activities should receive priority in the recovery programme. Likewise, a sanitation system has to be not only economically viable, socially acceptable, and technically and institutionally appropriate, it should also protect the environment. For sustainability of the services, the services are constructed in such a way that community could use those services after a flood hits the area.

6 CONCLUSIONS

Flooding is a result of heavy or continuous rainfall exceeding the absorptive capacity of soil and the flow confining capacity of rivers and streams. Floodplains are, subject to recurring floods. Floodplains are therefore "flood-prone" and are hazardous to development activities if the vulnerability of those activities exceeds an acceptable level. Floodplains are land areas adjacent to rivers and streams that are subject to recurring inundation. Floodplains and other flood prone areas need to be examined in the light of development interventions. The indicators of Flood-prone and flood risk are important dimensions to enhance resilience of WASH services in flood-plain. Consequently, the indicators of flood-prone areas and flood risk need to be identified to adopt WASH services (one of key sectors in development intervention) for their sustainability.

About 21 indicators indicating flood–prone were identified during the desk work. . Of these, about 15 indicators (including 2 new indicators added by the community) were satisfied in the field in all three districts. Likewise, about 15 indicators representing flood risk were tested in the field. Of these about 11 indicators were satisfied by the community in all three districts. It is difficult to get the threshold values of the indicators in the field by considering limited communities and sites (limitation of the field work in the study).

Pilot programmes, in terms of action research, need to be piloted to verify the indicators of flood prone areas with their threshold values. WASH services need to be made resilient to flood risk when the services are considered in line with disaster risk reduction. For this, the identified key issues are **:** lack of consideration of flood scenario in providing water and sanitation facilities-hand pump, tap water both in riverine flood zone and water logging area; gaps in WASH structural intervention in relation to flood risk; Ensuring water (in terms of quality and quantity) available or not at the sources (tap or at hand pump) during and after flooding;. Inadequate awareness about the use of drinking water in flood response period; critical gaps in the provision of water, and sanitation in individual house in water logging and flash flood region; and Lack of integration programme.

7 SOME PHOTOGRAPHS OF THE FIELD WORK

Photo: The local elderly person in Karnali-Bheri Basin in Bardiya pointing out maximum flood water level (about 1 m from the ground) observed in 2064 flood event.

Photo: Informal and locally made pit toilet constructed in Flood-prone area (Karnali-Bheri Basin) where flood water level exceeded 1 m. There is no route to escape to safe place and access to the toilet facility during the flooding period is difficult.

Flood-prone region where heavy siltation and bushes are observed in the region (Karnali-Bheri Basin)

Temporary agriculture practices observed in flood-prone region in Lalbakaiya Basin

FGDs in Rautahat District (left) and in Sunsari District (Right)

Photo: Inundation areas in Rautahat District (Banjaraha VDC)-Junge Pillar seen in subsided land. The embankment made by India causes inundation in Nepal region. The embankment has been constructed across E-W direction , that is, against flood water flowing in Lalbakaiya River (N-S direction) in monsoon season. The region is flood-prone due to the floods in Lalbakaiya River.

Photo (left):Prone to Flash Flooddue to heavily deforestation-uncovered lands in hill side and huge deposition of bed rocks in lower side(Bhabar zone) in Lalbakaiya Basin.

Photo (right): Flood-prone area in Sunsari watershed due to overflowing of flood water in Monsoon season

Photo: Gaps (left and right pictures)in Water, housing, and Sanitation services in Koshi Flood Recovery.