

Flood Scenario and its Risk Management, Policy, Practices in Nepal

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ABSTRACT

Nepal is exposed to a variety of natural hazards and human induced disasters. More than 80 percent of the total population of Nepal is at risk from natural hazards, such as floods, landslides, windstorms, hailstorms, fires, earthquakes and Glacial Lake Outburst Floods (GLOFs). The country is among the 20 most disaster-prone countries in the world. In part, this is because Nepal is in a seismically active zone with a high probability for massive earthquake. Globally, Nepal ranks 4th and 11th in terms of its relative vulnerability to climate change and earthquakes, respectively. Nepal as 30th country with respect to relative vulnerability to flood. Every year flood damages many health and wealth. The topography, slope, irregular and high intensity of rainfall cause the flood damage in several part of Nepal. However, such types of research works are very limited in Nepal. Thus, this paper was reviewed and aiming to explore and highlight the Floods scenario : historical trends, cases, incidents, damages, approaches of risk reduction & management practices, policy, legal and institutions in Nepal; Nepal's commitment to global and regional framework.

Thus the total 68 literatures, related to flood, damages, risk reduction and management, policy, legal framework and institutions of both national, regional and global, were collected, reviewed and studied. The desktop review was done highlighting the key aspects of flood disasters, hazard, damages, risk reduction and management, policy, legal framework were noted and analyzed. The analysis shows that there were 3 mega flood disasters especially in 1993, 2008 and 2017 in Nepal. While looking the flood scenario mainly and its socio-economic losses in the period of 1971 to July 2018, it shows that flood is the main reoccurring disaster in Nepal which claimed 4647 deaths, 84 missing, 616 injured, 3726120 family affected. Traditional approaches for flood management were focused on relief and emergency response operations based on Natural Calamity (Relief) act, 1982; where most of the efforts were made after strike of disaster. Whereas new approaches are focused on detail vulnerability, hazard, risk assessment and analysis, early warning system, community based disaster management. Such new approaches are used during disaster preparedness and response planning and project implementations as well as linkage, integration of upstream and downstream. Before enactment of new DRR/M act, 2074, all the efforts, guidelines and disaster risk management were based on old act "Natural Calamity (Relief) act, 1982 which was more focused on response & relief operations after disaster occurrences. The new DRR/M Act, 2074 covers an effective DRM effort which prioritizes DRM (including climate change concern) across government sectors and levels, with a full functional Disaster Management Council.

Nepal has ratified some key global and regional commitments on disaster management: Yokohama, Japan (1994), Hyogo, Japan (2005-2015), and Sendai, Japan (2015-2030). Nepal has made other international framework and commitments on disaster management which are: The Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR), 2016; The Paris Agreement, 1992; The Sustainable Development Goals (2016-2030); The Addis Ababa Action Agenda, 2015; Global Platform for Disaster Risk Reduction, Cancun, Mexico, 2017. Nepal as a UN member state and signatory to the global and regional commitments is committed and entitled to fulfill its obligations related to disaster management. Nepal is trying its best to achieve all the priorities for action by 2030. However, Nepal needs further technical support, financial support and guidance from development partners and friendly nations by 2030. Therefore, this study will be useful for policy makers, researcher, academician and practicer on overall vulnerability analysis, policy & practices of DRM and flood management..

Keywords: Disaster, flood hazard, risk reduction, policy, legislation, institution, vulnerability, upstream & downstream linkage, early warning system

INTRODUCTION

The Hindu Kush-Himalayan (HKH) region is one of the most melodramatic physiographic features on our planet. As the youngest mountain system in the world, it has unstable geological conditions and steep topography, which, combined with frequent extreme weather conditions, makes the region prone to many different natural hazards from earthquakes, landslides, and avalanches, to massive snowfall and flooding. Among these, flash floods are mainly challenging & severe for communities. They can be triggered by intense rainfall, failure of natural or artificial dams, and outbursts of glacial lakes. The frequent occurrence of flash floods within the Hindu Kush-Himalayan region poses a severe threat to lives, livelihoods, and infrastructures, both within the mountains (upstream) and terai/plain (downstream). Vulnerable groups (such as: poor, women, children, older, and people with disabilities) are often the hardest hit. Flash floods pose a greater risk to human life and livelihoods than do the more regular riverine floods, which build up over days when there is heavy rainfall upstream. Flash floods tend to carry with them much higher amounts of debris and, as a result, cause more damage to human settlements, agriculture land, hydropower stations, roads, bridges, buildings, and other infrastructure (Resource Manual on Flash Flood Risk Management/ Non-structural Measures, by A.B. Sheathe, 2008, ICIMOD). South Asia is the most exposed region in the world to flooding and cyclones. Of the world's total population exposed to floods each year, 64% of them are in the South Asia region. (World Bank 2012). Similarly, all the member states of SAARC (South Asian Association for Regional Cooperation) are highly prone to hydro metrological and geological hazards such as: flood, landslide, drought, cyclone, EQ, tsunami. Flood devastates more to Nepal, Bangladesh, India, Pakistan, Srilanka. Flood has been most frequent, highly damaging and widely spread natural disaster in the region. There are three common types of flooding: slow onset floods, rapid onset floods and flash floods (Asian Disaster Reduction Center (ADRC), annual reports 2003, 2006).

Nepal is not only one of the least developed countries in the world, it is also equally prone to several disasters such as flash-floods, landslides, fires, occasional earthquakes and epidemics. Nepal is a hotspot for geophysical and climatic hazards. The country is relatively ranked very

high in terms of vulnerability to natural calamities. The risk is increasing very rapidly mainly due to the growth in population, especially in urban and urbanizing areas. Another major factor for the increasing risk is the lack of a favorable policy and legal environment commensurate with the present-day situation, needs, opportunities and resource availability (Nepal Disaster Reports: 2015, 2017/GoN/MoHA). As per GoN/MoHA, Disaster Report, 2017, Nepal is exposed to a variety of natural hazards and human induced disasters. More than 80 percent of the total population of Nepal is at risk from natural hazards, such as floods, landslides, windstorms, hailstorms, fires, earthquakes and Glacial Lake Outburst Floods (GLOFs). The country is among the 20 most disaster-prone countries in the world. In part, this is because Nepal is in a seismically active zone with a high probability for massive earthquake. Globally, Nepal ranks 4th and 11th in terms of its relative vulnerability to climate change and earthquakes, respectively (Maplecroft 2011, BCPR 2004 cited in MoHA 2015). Consequently, the poor, uneducated and unemployed people are compelled to make a living by settling in flood and land slide prone areas in the hills, Chure, Terai plains and the urban and sub-urban areas. Lack of effective land use and settlement regulations has contributed to increased vulnerability to floods and other hazards caused by both natural and anthropogenic factors (Chhetri 2011). Various studies and reports over the last 33 years have shown that each year, floods, landslides, fires, avalanches and epidemics kill hundreds of people and destroy property worth billions of Rupees. GoN/Disaster report, 2015 said, in the year 2013 and 2014 Nepal saw an overall increase of the disasters – particularly floods in various parts of the country.

Among all the disasters reported in Nepal, floods are the most devastating in terms of the number of deaths that occur and the damages they cause. A study by UNDP ranked Nepal as 30th country with respect to relative vulnerability to flood (UNDP/ BCPR, 2004). Of the total death by any type of natural disaster in 2010, 29.02% were by flood and 24.55% were by landslides; and 71.35% of the total affected families by any type of disasters in 2010 are by flood (DWIDP- Department of Water Induced Disaster Prevention, 2011). In terms of the numbers of people affected by all types of natural disasters, flood is the main disaster affecting 68.3% of the total affected people

between 1971 to 2007 (NSET, 2007). Terai and some hill districts show the highest number of disaster-deaths and injuries although this impact is also spread almost to all VDCs/municipalities of the country. In the last decade between 2001 and 2008, floods and landslides killed 1,673 people, affected 221,372 families, killed 33,365 livestock, destroyed 52,007 houses and washed away or destroyed over 22,000 ha of land. The monetary value of damages due to floods for 2001-2008 was about US\$ 130 million (about 0.1% of GDP), according to government data (MoHA, 2010). Box 1 represents key hazards of the years: 2015-2017 in Nepal. This review was done by studying more than 82 relevant literature and articles.

FLOODS SCENARIO: HISTORICAL TRENDS RISK AND VULNERABILITY

Among the oldest and known disasters, floods have been threatening humanities for ages (Ferreira, 2011). Around the world, acceleration in population growth and changes in land-use patterns have increased human vulnerability to floods. Harmful impacts of floods include direct mortality and morbidity and indirect

displacement and widespread damage of crops, infrastructure and property (Doocy et al., 2013, IPCC, 2007). Every year floods take thousands of lives, leave millions homeless and cause significant loss to properties and infrastructures all over the world. Flooding is the most frequent and common natural hazard in Asia. Floods occur at least once a year in all the Asian countries.

Flood occurs when a large amount of water overflows over dry land. They may result from prolonged or very heavy rainfall, severe thunderstorms, monsoon rains, or tropical cyclone. People, who live near rivers, or in low-lying areas, live with the greatest threat of floods. Glacier Lake Outburst Floods (GLOF), dam burst and avalanches are also common in South Asia (Kafle, 2017: Disaster Risk Reduction). Some major causes of floods are : heavy rainfall, siltation of the river bed, blockade in drains, landslides blocking the flow of the streams, construction of dams and reservoirs, cyclone-storm surge, Tsunami and other disasters, GLOF (Source: ADPC 1991, Kafle , 2013).

Box1. Key Hazards of the Years

The disasters noted are, in alphabetic order: heavy rainfall with hailstones, avalanche, boat capsize, cold wave, drowning, earthquake, epidemic, fire, flood, heavy rainfall, high altitude, landslide, snow storm, lightning , wind storm, excluding the "other" category. This simple fact well illustrates that Nepal is exposed to multiple hazards at a time. According to the MoHA/GoN (Ministry of Home Affairs, Government of Nepal) dataset, during the period of two years under review (2015 and 2016), a total of 16 types of disasters have been noted and 13 types of disasters have been recorded. A total of 2,940 events of disaster have been recorded, of which incidents of fire are highest (N=1,856), followed by incidents of lightning (N=299), landslide (N=290), flood (N=244) and heavy rainfall (N=118). Other disasters also took place but less in frequency (by two digits or even less). Of these killer hazards, earthquake stands out from the rest in all respects – death, disappearance as well as human injuries. Of the total 9,708 human deaths, earthquake (2015) alone claimed the lives of a total 8,970 persons (92.5 percent). After earthquakes, landslide, lightning, fire and floods claimed the lives of most of the people (in a range between 101 and 276 each) in those two years. Note that over the years, lightning is becoming one of the leading killer disasters in Nepal. (Source: Nepal Disaster Report, 2017 'The Road to Sendai', Sep. 2017, GoN/MoHA).

Flood is one of the striking water induced disaster that hits most of the part of the world. Analysis of history of disasters in South Asia tells that Bangladesh and Nepal are the two densely populated least developed countries (LDCs) that experience different types of flood every year with negative impacts on their economies. The plains of the foothills of Nepal and the entire floodplains of Bangladesh are mostly traversed by the rivers and tributaries mainly originated from the same source, the Himalayas. Both countries fall under the "Indian Monsoon" region with heavy precipitation during the wet monsoon that frequently cause severe floods destroying infrastructure, crops, vegetation and displacing millions of people

(Mirza, 2010). The aftermaths of floods are water pollution, waterborne diseases and other epidemics. Loss of human life and livestock, escalation of prices, social insecurity and costs of rebuilding infrastructure are additional layers of constraints that affected regions have to bear after the floods along with resource diversion for immediate response, rescue, relief and early recovery activities (Ghatak et al., 2012). Scientific projections confirm that risks of flooding will increase considerably in the main river basins of India, Bangladesh and Nepal. Nepal lies in very high risk zones, where seismic and hydro-metrological hazards are active. Urbanization, environmental degradation and lack of strong governance are exacerbating

the vulnerabilities in Nepal where political instability, border disputes and ineffective regional networks are triggering the hazard impacts. Floods have significant cross-border impact like Koshi river flooding (2008) in Nepal. Disasters due to natural hazards have

high impact on low and medium HDI countries. All the ten most affected countries from the natural disasters over the past 30 years belong to these two categories in Asia (Source: Kafle 2017, Disaster Risk Reduction).

Box2. Cross-Border Vulnerability

This is very important and highly relevant to DRR. The occurrence and impact of disasters are not confined to a country's political boundary. Some example of key cross-border vulnerabilities are: The Koshi flood of 2008 (Nepal and India), the earthquake of 1223 and 1934 (that killed thousands of people both in Nepal and India), the Kashmir earthquake of 2005 (India and Pakistan), the Indian Ocean Tsunami of 2004 (> than 12 countries affected), GLOF in Nepal (Impact in Nepal, India, Bangladesh and Maldives) and tropical cyclones (India, Bangladesh, Sri Lanka and Maldives). (Source: Kafle, 2017: Disaster Risk Management, Cases studies from Asia).

In Nepal, flood is one of the serious disasters which affect the human lives and huge amount of property. The increase of population and squatter settlements of landless people living at the bank of the river has tremendous pressure in encroachment of flood plain making them vulnerable to the flood damage. Higher flood depth increases and lower flood depth decreases with increase in intensity of flood. Inundation of huge area of urban land indicates that in future human lives are more prone to flood disaster (Shakya, et. al., 2006/ Nepalese Journal on Geoinformatics, Survey Department, Nepal). The floods of 1985, 1993 and 2004 destroyed large tracks of land terraces, farm lands, pastures and orchards in Bhasedwa leaving the country food insecure (Dixit et al., 2007). Nepal witnessed major flood in Tinao basin (1978), Koshi River (1980), Tadi River Basin (1985), Sunkoshi Basin (1987) and devastating cloud outburst in Kulekhani area (1993) which alone claimed 1336 lives (Ghatak et al., 2012). The flood has most devastating effect in the Terai Section of Nepal. Nepal's entire Siwalik zone is highly degraded due to weak rocks, unpredictable extreme precipitation and high rate of deforestation as well as encroachment. As most of the river basins in Terai originate from the Siwaliks region, they carry lots of sediments from degraded Siwaliks and deposit them to the Terai plain. Many areas in the Terai are well below the river bed due to sedimentation and they got inundated in rainy season every year. Since a majority of Nepal's agriculture and forestry resources are dependent on Siwaliks and Terai, climate induced floods are causing significant human and economic devastation and such devastation will further accelerates in the future as the effect of climate change is projected significantly higher in these areas. At the individual and organizational level, there are capacity deficits on the anticipated distribution and effects of potential flood in the

context of climate change. On analyzing the monthly rainfall data for the period of 30 years from 1976-2005 (166 meteorological stations) throughout Nepal, it is found that most part of the country experienced increasing annual trend of pre monsoon, monsoon, post monsoon and winter precipitation (Practical Action, 2009). Frequency analysis of the extreme rainfall event trends for the same duration reveals that the foothill of the Siwaliks, which is the main source of many rivers in the Terai, received the highest intensive rainfalls for 10, 20, 50 and 100 years of return periods. *Box 2 shows the Cross-border vulnerability.*

FLOODS SCENARIO IN NEPAL AND SOCIO ECONOMIC LOSS

Nepal Flood 2017

Heavy monsoon rainfall during 10-13 August 2017 triggered severe flash floods and landslides in 36 out of 77 districts in Nepal. Claimed 1611 lives of which 51 were female, injured 22 persons, displaced 1688,474 people, and left 29 missing. Damage to houses, infrastructure, and productive resources was severe; approximately 41,626 houses were completely destroyed and 158,758 houses were partially damaged (GoN/MoHA, UNRC – Humanitarian situation report, August 2017).

Koshi flood 2008

An estimated 70,000 to 75,000 people affected by the Saptakoshi River embankment breach on the 2/05/2005. Flood water swept away 2 entire VDCs (Shreepur and Haripur), affected 7 VDCs partially of Sunsari and damaged a significant section of road.

Nepal flood 1993 (2050)

This flood was battered by heavy rains that caused three major rivers to overflow in the southern and eastern parts of the country.

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Thousands of people died, while up to 400,000 others were injured, displaced or suffered property damage. Such flood worst hit the area of Sarlahi, Rauthat, and Makwanpur districts of Nepal.

Socio-Economic Losses

This includes houses damaged, economic loss and number of families affected, loss of property and assets. All disasters recorded in MoHA database reveal that a total of one million, eighty-five thousand, seven hundred and ninety-seven houses were damaged during

the review period (2015-2016), of which 98.7 percent of the houses damaged was caused by earthquake. This is followed by a host of other disasters attributable to fire and landslide (0.3 percent) and to flood, heavy rainfall and windstorm (0.2 percent). The Socio-economic losses by multi-hazard scenario of Nepal recorded in the period of 1971-2016 shows that the total human loss is 120094 including 40037 deaths and 355 missing. The residential houses as well as animal sheds are destroyed in number of 1322049. The details of socio-economic losses are illustrated here in Table 1.

Table 1. Multi-hazard scenario of Nepal by its socio-economic loss, 1971-2016

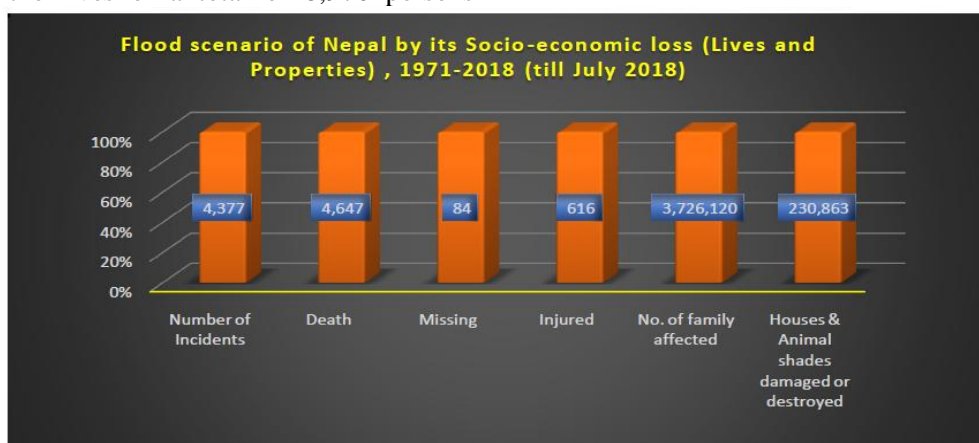
Types of disaster	Number of Incidents	Human loss				Houses, Animal shades damaged/ destroyed
		Death	Missing	Injured	No. of family affected	
Fire	8721	1605	0	1619	259935	86261
Thunderbolt	1711	1620	129	2684	7140	963
Landslide	3246	4980	174	1871	558264	33617
Wind storm	44	2	0	11	191	215
Flood	3950	4445	42	554	3710065	216190
Epidemic	3452	16583	0	43111	512989	0
Avalanche	2	16	3	7	0	0
Snow storm	5	87	7	0	0	0
Hailstones	131	9	0	24	3280	155
Earthquake	175	9771	0	29142	890995	982855
Cold wave	390	515	0	83	2393	0
Structural collapse	389	404	0	596	2016	1793
Total	22216	40037	355	79702	5947268	1322049
(Average)	494	890	8	1771	132162	29379

Source : GoN/MoHA (Ministry of Home Affairs) , 2017

Human Casualties

Of these killer hazards, earthquake stands out from the rest in all respects – death, disappearance as well as human injuries. This is evidently due to the 2015 Earthquake. Of the total 9,708 human deaths, earthquake alone claimed the lives of a total of 8,970 persons

(92.5 percent). After earthquakes, landslide, lightning, fire and flood claimed the lives most (in a range between 101 and 276 each) in those two years. Note that over the years thunderbolt is becoming one of the killer disasters in Nepal. Earthquake appears on top also on matter of number of persons missing.



Of the total number of missing persons (N=281) in those two years, 195 (69.4 percent) were missing due alone to earthquake. Other two

predictable and routine hazards for Nepal, flood and landslide, also resulted into missing, but far less in number. A total of 22,302 persons

sustained injuries in 2015 due alone to earthquake. This is 95.6 percent of the total persons injured (N=23,317). Injuries caused by other hazards are far less. But again, lightning follows it. A total of 369 persons were injured by lightning during the review period. This is followed by fire and landslide claiming injuries more.

While looking the flood scenario mainly and its socio-economic losses in the period of 1971 to July 2018, it shows that flood is the main reoccurring disaster in Nepal which claimed 4647 deaths, 84 missing, 616 injured, 3726120 family affected. Such damages are graphically presented here in bar-diagram.

TRADITIONAL AND NEW APPROACHES OF RISK REDUCTION

Inadequate & limited, inefficient activities are presently undergoing to prevent the flood in Nepal. Additionally, the interventions are mostly of very small scale and operated by the local government authorities according to their annual budget distribution or by I/NGOs' support as per their priority actions. There is lack of coordination between the authorities and working partners/agencies which are carrying out risk reduction measures whether such interventions come from the government bodies, I/NGOs or combinations. Difficulties faced on monitoring and keeping records of the interventions in the absence of coordinated communication between the stakeholders. The traditional approach of risk reduction do not analyze the cause and effect scenario (such as : root cause, unsafe conditions, dynamic pressure, hazard, risk factors, vulnerability assessment etc.) and mostly apply the structural measures at

the site where there is frequent flooding which include construction of earth and gabion embankment, spurs, making shelter houses and river training, retaining walls . However, it is found that gabion embankment and spurs will be buried under the sediment within short period of time as the sediment deposition is very high in Terai because of intense erosion in the weak and

fragile Siwaliks. As an example, the sedimentation in Koshi River is so high that currently the settlements and paddy fields (outside the embankment) are well below the river beds. Such examples can be found in also other river basins of Terai. In this circumstances, traditional approach of risk reduction becomes ineffective and inefficient. Traditionally, the flood response was focused on relief & emergency repose operations based on Natural Calamity (Relief) act, 1982; where most of the efforts were made after strike of disaster. That's why, detail vulnerability, hazard, risk assessment and analysis was not done properly while preparing for disaster preparedness and response planning and project implementations. But new and comprehensive DRR/M Act, 2074 covers an effective DRM effort which prioritizes DRM (including climate change concern) across government sectors and levels, with a full functional Disaster Management Council. Under this, a National Disaster Management Centre is established as a dedicated institution. Additionally, there is a high level Climate Change Council under the chairmanship of the Prime Minister already in place. This new Act covers all the four phase of disaster like as: before disaster, during disaster, post disaster and recovery phase (Nepal Disaster Report, 2017).

Box3. Early Warning Systems (EWS) in Nepal

Early Warning Systems are recognized in both the HFA (2005-2015) and SFA (2015-2030) as an important element of disaster risk reduction and hence to the achievement of sustainable development and sustainable livelihoods. An effective EWS enables the concerned authorities and at-risk communities to know about the hazards of the locality, community vulnerability and impending risk, warning messages, and building and mobilizing their response capacities to reduce the risks. The Government of Nepal has reported signification achievements in the development and implementation of EWS for floods, landslides and GLOF. However, the studies report shows that this has not been every effective in practice and sustainability as not all the four components of the people-centered EWS have been taken into consideration. The absence of policy and legal frameworks has weakened the efforts for the establishment and strengthening of effective and functional EWS inn Nepal. The Response capacity building of communities is scattered and based on pilot project (Source: Kafle, 2017: Disaster Risk Management, Cases studies from Asia).

Similarly, the upstream and downstream of the river basins are closely related for flood to occur and its concentration to strengthen. The interventions that are meant to prevent floods and mitigate its effect, shall therefore link both

the upstream and downstream through cause and effect analysis approach. Past interventions on flood risk reduction lack the link between the upstream and downstream through cause and effect analysis and proper communications

between upstream and downstream communities. The issues of flood mitigation and community based early warning systems are closely linked to an existing requirement of making the Disaster Management systems and policies in Nepal. Current disaster management policies, risk reduction and preparedness plans in Nepal address recurrent natural hazards in the country through fixed and volatile approach, but are not yet geared to deal with the emerging climate change induced flood threats. In this context, a new approach of flood risk reduction is recently prepared after wide consultations with governmental and non-governmental stakeholders as well as academicians, research scholars, affected communities. This approach integrate all the activities including upstream downstream linkage, watershed management considering extreme precipitation in Siwaliks, information centers and alternate economic activities in replacement of the traditional approach of treating flood risk separately for the upstream and downstream. Proper communications between upstream and downstream communities as a means of early warning systems can support to minimize the loss from the flood to great extent. Without these components in place, the

impact of floods could be very serious in years to come in Nepal especially in southern Terai. This approach has identified different activities for the flood risk reduction in the Terai of Nepal. For the upstream, Siwalik conservation through watershed management, bio-engineering and alternative economic activities to the surrounding communities to stopover deforestation and encroachment has been identified. This will stop the land degradation and sediment production during extreme precipitations. Some key structural part such as: bio-engineering, river training and check dams for erosion control has been identified as suitable method of risk reduction. Embankment construction, safe escape route, shelter houses, early warning systems, water level monitoring systems and formation of information centers have been identified for risk reduction in downstream. Low cost and easy to operate early warning system has been identified to be applied in upstream, middle stream and downstream. Flood risk reduction through this new approach is under the implementation phase in Nepal (Terai region). (Source: Flood Hazard in Nepal and New Approach of Risk Reduction, Dhakal S. 2013).

Box4: Community Based Disaster Risk Management

Community-Based Disaster Risk Management (CBDRM) is a process in which at risk communities are actively engaged in the identification, analysis, treatment, monitoring and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities. It means that people are at the heart of decision-making and implementation of disaster risk management activities. The involvement of most vulnerable social groups is considered as paramount in the process, while the support of the least vulnerable groups to them is necessary for successful implementation (ADPC, 2003, Abarquez and Murshed 2004, Kafle and Murshed, 2006).

There is a need of technology to solve flood problem lack accessibility, affordability and management capacity of the communities in need. The role of policy and institutions would be crucial in enabling communities to access appropriate technologies and to achieve adaptation and mitigation objectives. Similarly, policy and institutions might play decisive roles in enhancing knowledge and skills for the successful use of approaches, processes and technologies. Need to analyze and explore the institutional, technological and informational barriers to designing and implementing preventive and remedial measures to floods and tools for DRR. *Flood Vulnerability Index helps describing vulnerability helps to understand the best ways to reduce disaster. The main purpose of assess the vulnerability is to inform decision-makers or specific stakeholders about options for adapting to the impact of flooding hazards (Douben, 2006b).* The need for vulnerability

analysis is noted in scientific literature, and the concept includes natural vulnerability, social vulnerability and economic vulnerability. Vulnerability is considered in the study of Flood Vulnerability Index (FVI) as *the extent of harm, which can be expected under certain conditions of exposure, susceptibility and resilience* (UNESCO-IHE, 2006).

Flood Vulnerability Index (FVI) enables everyone to assess vulnerability to flood disaster at basin level. FVI can be an important policy-making tool for: raising public awareness, assisting governments in priority setting and guiding the international organizations in directions of involvement. A practice in defining vulnerability comes from natural hazards, such as floods the extent to which a system is susceptible to floods due to exposure, a perturbation, in conjunction with its ability (or inability) to cope, recover, or basically adapt.

Flood Vulnerability Factors

There are mainly three vulnerable factors; exposure, susceptibility and resilience. Understanding each concept and considering certain indicators may help to characterize the vulnerability of different systems, by which certain actions can be identified to decrease it.

Key Challenges and Constraints in Disaster Risk Management in the South Asia Region (Nepal) are as Follows

Most of the governments in region have given priority for relief and response operations rather than disaster risk reduction;

- Insignificant and unpredictable amount of resources are available for DRR component in each key sector. Lack of proper coordination has also been a challenge at all levels;
- There are a number of sporadic community level initiatives and good practices. However, there is no proper mechanism to scale up successful initiatives;
- Sustainable local capacity building mechanism has not yet emerged. One of the main challenges for DRR mainstreaming is to strengthen DRR capacity at the local level to ensure implementation of DRR initiatives. DRR mainstreaming into local level development planning to implementation is also required;
- Cross-border vulnerabilities and disaster impacts need to be considered in the regional planning. This has been neglected in the past. Floods, earthquake, accidental fire, tsunamis, volcano have significant cross-border impacts. Recent floods in Nepal, Pakistan, Bangladesh and India devastated the lives and properties in more than a country. (Source: *Disaster Risk Management, Kafle, 2017*).

POLICY, LEGAL AND INSTITUTIONAL FRAMEWORKS

Nepal enacted Natural Calamity (Relief) Act, the first act of this kind, in 1982 and established a network of “disaster relief committees” at various levels (Central, Regional, District and Local Disaster Relief Committee) from central to local levels for effective disaster management focusing primarily on response.

Now, considering the importance of disaster risk reduction, the Constitution of Nepal has clearly spelled out disaster management functions to be

operated in three levels of government structure. Moreover, disaster risk reduction began to receive more attention from Government side since the 10th Five Year development Plan (2002-2007) and the subsequent periodic plans. Furthermore, in alignment with Nepal’s commitment to the HFA, the Government of Nepal approved the National Strategy for Disaster Risk Management in 2009. This Strategy outlines 29 priority activities for risk reduction and mitigation. Recently, Government of Nepal has passed new and comprehensive DRR/M Act, 2074 for an effective DRM effort which prioritizes DRM across government sectors and levels, with a full functional Disaster Management Council chaired by the Prime Minister. Under it, there is a National Disaster Management Centre as a dedicated institution. Additionally, there is a high level Climate Change Council under the chairmanship of the Prime Minister already in place.

The establishment and institutionalization of an authentic and open DRM System, GIS based Disaster Information Management System will be strengthened. Collected information through this system informs decision-making for risk reduction and preparedness in a more effective manner. Finally, in order to strengthen cross-sectoral planning and coordination in the field of DRR, DRR and CRM focal points have been established in key agencies. These focal points work in a harmonized manner to ensure that Disaster and climate change risk reduction mainstreamed within respective ministries. Table 2 presents major DRM policy frameworks in Nepal.

NEPAL'S GLOBAL AND REGIONAL COMMITMENTS

Government of Nepal has been participating in all world conferences on disaster management (Yokohama, 1994; Hyogo 2005; and Sendai 2015), global platforms which occurs in two year intervals from 2007 onwards, and in the Ministerial Conferences on Disaster Risk Reduction in Asia. Moreover, Nepal is one of the signatories to these world conferences and has expressed commitment to fulfill its obligations and priority action within the given time frame.

Yokohama, Japan (1994)

The first world conference on disaster management was held in Yokohama, Japan in 1994 where Nepal participated and presented a national action plan on disaster management.

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Government of Nepal had prepared “National Action Plan on Disaster Management in 1996” incorporating all component of disaster management cycle and the Yokohama Strategy.

Table2. Major policy frameworks on matter of DRM in Nepal.

Year	DRM Policy, Guideline, Legal, Regulatory Framework
1982	Natural Calamity (Relief) Act, 1982
1996	National Action Plan on Disaster Management in Nepal (1996) and the Guidelines
1999	Local Self Governance Act, 1999
2002	The Tenth Five year Plan (2002 - 2007)
2007	The Three Year Plans (2007-2010)
2008/9	Toolkits for preparing DPR Plan (2008) shared: Monsoon based DPR/Contingency plan preparation....
2009	National Strategy for DRM 2009
2009	The Nepal Risk Reduction Consortium (NRRC)
2009	Hyogo Framework for Action (HFA) and its implementation in line with NSDRM, 2009.
2010	Nepal's Disaster mgt. actions between 2010-2015, guided by five priority actions of HFA
2011	Disaster Preparedness and Response Planning Guidance Note 2011 endorsed by GoN/MoHA and circulated to all concerned districts and regions; Concept of DLSA utilized
2011	Disaster Risk Reduction in Nepal: Flagship Programmes, February 2011
2012	Guidance Note 2011 applied during DPR planning process. Multi Hazard Scenarios. Disaster Preparedness and Response Plan (EQ Hazard is mandatory) in all most all 75 Districts
2011/12	LDRMP (Local Disaster Risk Management Planning) Guideline : 2013; DDMP (District Disaster Management Planning) Guideline 2013 (By MoLD)
2012/13	EMERGENCY OPERATION CENTER (EOC) establishment & SOP (Standard Operating Procedures) preparation
2013	National Disaster Response Framework, 2013
2013	The Three Year Plans (2011-2013)
2013	Sector specific policies and plans (NPC); Nepal Multi-Sectoral Nutrition Plan (MSNP) 2013-2017
2015	The Constitution of Nepal, 2015 ; stipulated that DRM is a shared responsibility of all levels of governments
Dec, 2015	NRA (National Reconstruction Authority) establishment
May-16	The Post Disaster Recovery Framework (NRA 2016)
2016	DRM Priorities under Current 14th five-year Development Plan (2016-2020)
2017	Flood Reconstruction and Rehabilitation Project established under NRA
2017	Carving the Road to SFDRR : GoN developed National Disaster Risk Reduction Policy and Strategic Action Plan aligned with SFDRR, one that will replace the NSDRM, 2009
2017	The National DRR Policy and Strategic Action Plan for Nepal (2017-2030)-step towards fulfilling Nepal's Commitments to SFDRR (The Sendai Framework of DRR)
2009-2017	Nepal Disaster Report (NDR) : NDR 2009, NDR 2011, NDR 2013, NDR 2015 and NDR 2017
2017	The new Disaster Risk Reduction and Management act, 2017.
2017	Local government Operation act, 2017
2017	National DRR Policy and action Plan, 2017-2030
2017	Reconstruction related policy and legal frameworks :
	• Reconstruction and Rehabilitation Guidelines, 2072 • Private Housing Grant Distribution Procedure, 2072 • Environmental Impact Assessment Related Procedure, 2072 • Land Acquisition Related Procedures, 2072 • Land Registration Related Procedures, 2072 • Public Procurement Related Procedures, 2072 • Mobilization of NGO Sectors Related Procedures, 2072 • Post Disaster Recovery Framework, 2073 • Grievances Hearing Procedure, 2073 • Reconstruction Fund Mobilization Related Procedure, 2073 • Community Rebuilding Committee Related Procedure, 2073 • Private Housing Reconstruction Technical Inspection, 2073 • Training Procedure, 2073 • Training Strategies, 2073 • Reconstruction of Schools Procedure, 2073
	Existing DRM Institutions and Mandates :
	Office of the Prime Minister and Council of Ministers; Ministry of Home affairs (MoHA); Ministry of Federal affairs and Local Development (Modal); National Planning Commission (NPC); Water and Energy Commission (WECS); Central Natural Disaster Relief Committee (CNDRC); Ministry of Irrigation through Department of water Induced Disaster Management; Ministry of Education (MoE); Ministry of Urban Development.
	Other ministries working on DRM include: • Ministry of Forests and Soil Conservation (MoFSC) • Ministry of Environment (MoEn) • Ministry of Science and Technology and Environment (MoSTE) • Ministry of Health and Population (MoHP) • Ministry of Industries (Mol) • Ministry

	of Agriculture Development (MoAD) • Ministry of Water Resources (MoWRs)
1982	Institutional Framework (in line with 1982 Act) : Cabinet (Policy, Budget, Emergency Declaration); Central Natural Disaster Relief Committee (chaired by Home Minister-Coordination, Response, Rescue, Relief); Regional Natural Disaster Relief Committee (Chaired by Regional Administrator); District Disaster Relief Committee (Chaired by Chief District Officer- Execution, Rescue & Relief, Data collection)
	Source : Nepal Disaster Report 2017; GoN/NRA 2017b, p.7, December 2017

Hyogo, Japan (2005 - 2015)

The second world conference on disaster reduction was held in Kobe, Hyogo, Japan in 2005 and Nepal participated and endorsed the goals and priorities for action between 2005 and 2015. Integration of DRR into sustainable development, develop and strengthen institutions to build resilience to hazards and

emergency preparedness, response and recovery programs were the major goals of HFA.

Sendai, Japan (2015 - 2030)

The Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 was adopted in Sendai, Japan, on March 18, 2015. The SFDRR has four priorities as given in the table 3.

Table3. Four priority areas of SFDRR

<p>Priority 1: Understanding disaster risk; Priority 2: Strengthening disaster risk governance to manage disaster risk; Priority 3: Investing in disaster risk reduction for resilience; and Priority4: Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction.</p>
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Nepal being an UN member state and signatory to the global and regional commitments is entitled to fulfill its obligations related to disaster management. Nepal is trying its best with its limited trained human resources and financial resources to achieve all the priorities for action by 2030. However, Nepal needs further technical support and guidance from development partners and friendly nations by 2030.

coordinated effort to tackle climate change (Climate Focus, 2015). The Paris Agreement’s central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise for this century below 2 degrees Celsius and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

OTHER INTERNATIONAL FRAMEWORKS AND COMMITMENTS

The Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR)

This first Asian Ministerial Conference for Disaster Risk Reduction (AMSDRR) after the advent of the Sendai Framework was hosted by the Government of India in November 2016. As a follow-up from the 6th Asian Ministerial Conference outcome (2014) and as a requirement of the Sendai Framework, the AMSDRR conference concluded with the adoption of the New Delhi Declaration; the Asia Regional Plan for Implementation of the Sendai Framework together with a ten Voluntary Commitment Action Statements.

The Sustainable Development Goals

The 17 Sustainable Development Goals (SDGs) adopted by world leaders in September 2015 at the UN Global Summit officially came into force on 1 January 2016. Over the next fifteen years countries will mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change (UN Sustainable Development Homepage, UN, 2017). The SDGs build on the success and challenges of the Millennium Development Goals (MDGs) and aim to go further to end all forms of poverty (NPC, 2017a). The SDGs are not legally binding. Governments are expected to take ownership and establish national frameworks for the achievement of the 17 Goals. Six (Goal :1,2,9,11,12,13) of the 17 Goals are directly related to disaster, climate change risk and resilience. A reflection paper prepared by the UN Office for Disaster Risk Reduction identifies 25 SDG targets related to DRR (captured in 10 of the 17 SDGs), firmly establishing the role of DRR as a core development priority of the SDGs (UNISDR, 2015).

The Paris Agreement

The 1992 Parties to the UN Framework Convention on Climate Change (UNFCCC) adopted on 12 December 2015, the Paris Agreement, and a new legally-binding framework for an internationally

THE ADDIS ABABA ACTION AGENDA

The Addis Ababa Action Agenda (AAAA) (UNDESA, 2015a), adopted at the Third International Conference on Financing for Development (Addis Ababa, Ethiopia, July 2015) and endorsed by the General Assembly in its resolution 69/313 of 27 July 2015, is all about financing sustainable development and developing sustainable finance. It seeks to look into a new financing framework to ensure a complete realization of new global development agendas including SDGs. The Action Agenda (AAAA), according to Department of Economic and Social Affairs briefing notes (UNDESA, 2015b), provides a comprehensive set of policy actions by Member States, with a package of over 100 concrete measures to finance sustainable development, transform the global economy and achieve the Sustainable Development Goals.

GLOBAL PLATFORM FOR DISASTER RISK REDUCTION, CANCUN, MEXICO

The Global Platform for Disaster Risk Reduction (Global Platform), as recognized by the UN General Assembly, is the main forum at the global level for strategic advice, coordination, partnership development and the review of progress in the implementation of international instruments on disaster risk reduction. The 2017 Global Platform for Disaster Risk Reduction was held in Cancun, Mexico on 22-26 May, 2017.

CONCLUSIONS

Among all the disasters reported in Nepal, floods are the most devastating in terms of the number of deaths that occur and the damages they cause. Traditional approach of flood risk reduction does not consider cause and effect analysis, root cause analysis, understanding unsafe conditions, without vulnerability context analysis (hazard, risk, vulnerability) and intervene only in affected area after. This traditional approach has been identified as not so ineffective and inefficient, and therefore new approach of risk reduction/management has been proposed, that integrates interventions for understanding the ground reality, analyzing flood risk and vulnerability context by using scientific tools and methodology, vulnerability context, shocks and trend of floods, relationship between components and factors. The new approaches also assimilates interventions for minimizing river bed cutting, flood control, erosion control in upstream, inundation control

in the downstream, reducing land degradation, focusing on CBDRM (Community based Disaster Risk Management) approach and early warning systems through the communication between upstream and downstream communities through upstream downstream linkage. Conducive environment is a prerequisite for mainstreaming of CBDRM into government policy and programming. Influence in both the policy-making and grassroots level interventions are necessary to come up with long-lasting results in CBDRM. Similarly, disaster Early Warning System (EWS) is at infancy in Nepal. There is a strong need of the promulgation of legal and policy framework, institutional set up, SOPs (Standard Operating Procedures), and interventions in all the aspects of an early warning system. The new Disaster Risk Reduction and Management Act, 2017 of Nepal is considered far progressive than the hitherto existing Natural Calamity Relief Act, 1982 in many respects. It approaches to disaster is much comprehensive and recognizes both risk reduction and management as integral part of the task. It covers all three phase (Before disaster; during disaster, after disaster) of disaster management.

Governmental support in reducing the disaster risk is vital as government of a country should play a lead role in making conducive environment to work for local communities, NGOs, private sector and civil societies.

Required for the formulation of appropriate and relevant policies, strategies and frameworks and their effective & implementation in the prerequisite of an efficient and effective disaster management system in a country.

A sound disaster management system together with the strong coordination among the disaster risk management actors in the countries should prevail to augment the capacity guiding of the community and build their resilience capabilities.

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