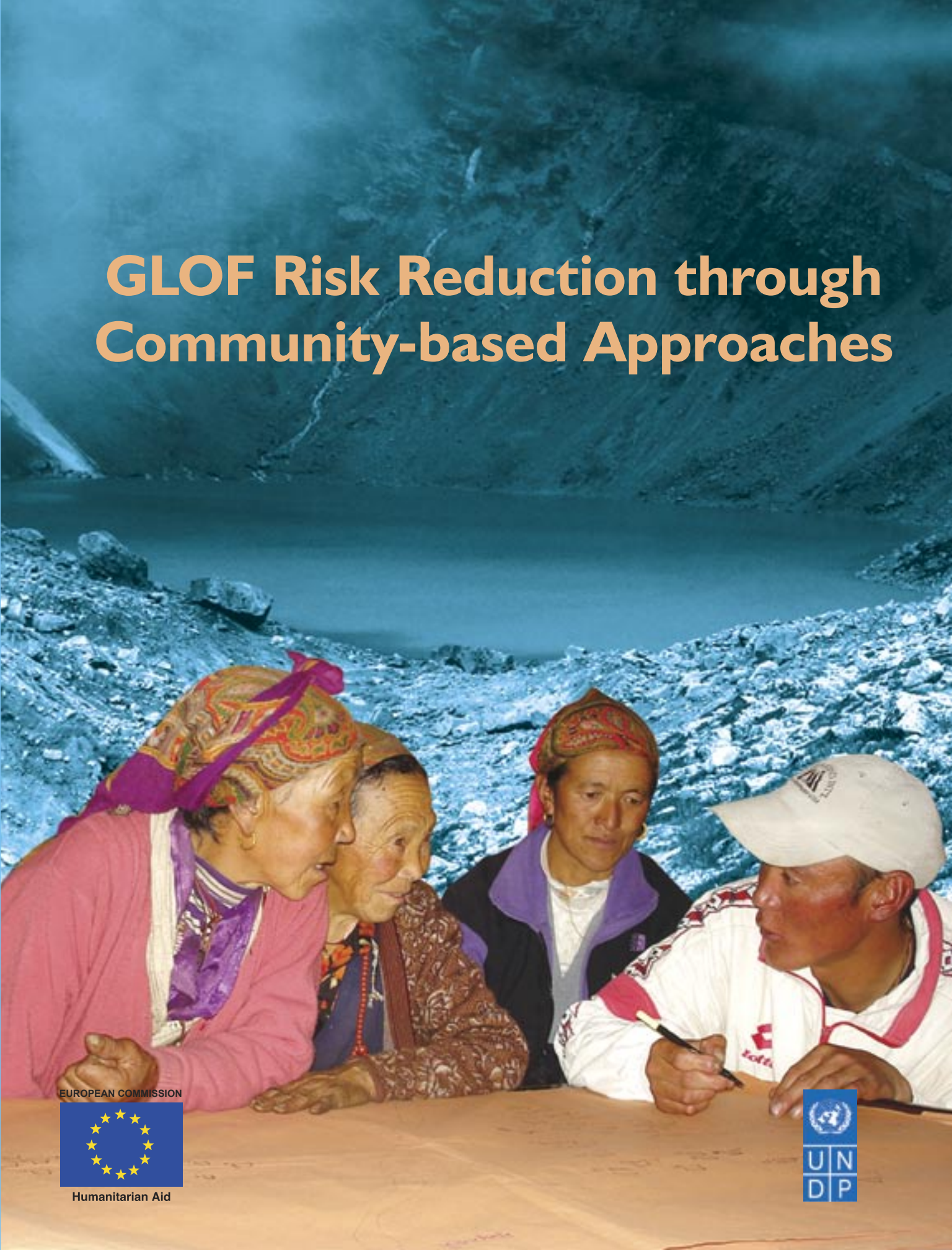
GLOF Risk Reduction through Community-based Approaches



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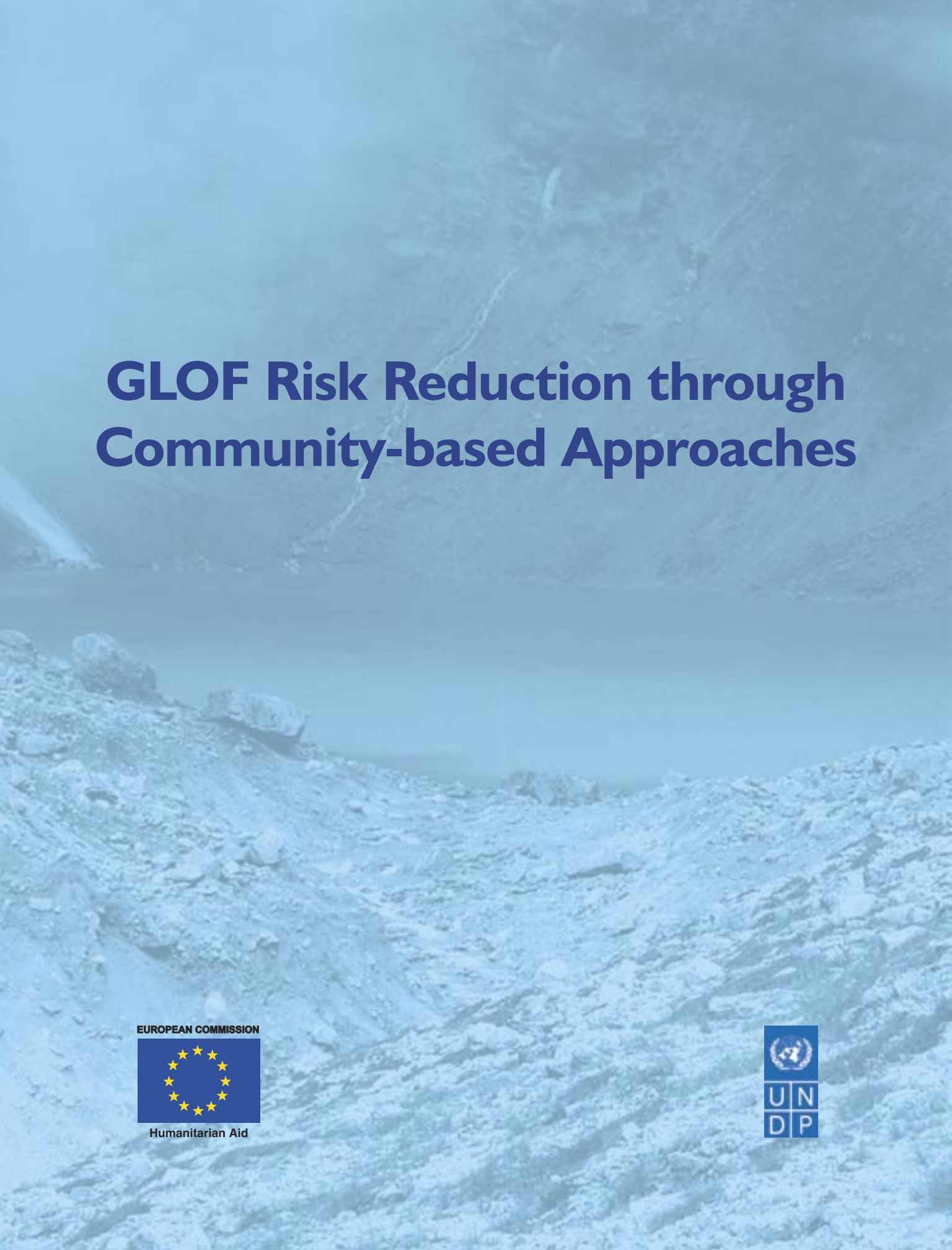

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Regional GLOF Risk Reduction Initiative in the Himalayas

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Introduction

The process of disaster risk reduction poses quite a few challenges by itself. The incidence, number, frequency and severity of natural disasters have been growing over the past decades. Increasing loss of lives and livelihood, destruction of precious socio-economic and development infrastructure and mounting financial losses have made it imperative to evolve appropriate strategies for mitigating their impacts and enhancing preparedness to respond effectively to the formidable challenges.

Community-based risk reduction is recognised as a *sine qua non* for achieving holistic disaster resilience. On the one hand, putting in place requisite institutional, legislative and policy frameworks to address disaster risk management issues are an essential component of risk management approach. On the other, enhancing community capacity and resilience is a pre-requisite for ensuring holistic risk reduction.

Traditionally, mountain and coastal areas have received inadequate attention from risk mitigation and disaster management practitioners. There is very little investment in terms of detailed assessments of the peculiar nature and patterns of mountain hazards and risks posed by them to mountain communities. Concerted efforts to develop comprehensive risk mitigation and preparedness strategies have not crystallised. Due to the scattered nature and low population density of mountain communities and minimal socio-economic and development infrastructure, administrations, technical agencies and risk management practitioners have accorded insufficient attention to addressing the hazards in these regions. More often than not, risk reduction initiatives have remained piece-meal and inadequate. Less focused attention has been given to study, research and analyse the hazard, risk and vulnerability profiles of mountain areas and the underlying fragility and sensitivity of mountain ecosystem.

Over the past decades, this scenario has undergone a radical shift owing primarily to two significant developments. Firstly, countries and communities have invested huge resources in building socio-economic and development assets like hydel projects, dams, bridges, tourism infrastructure etc. in many mountain areas. For many countries in the Himalayan region, these assets constitute the mainstay of their economy and contribute a substantial portion to the national revenues. Secondly, global warming has begun to cast its adverse impact on mountain areas and is threatening the fragile ecosystem and lives, livelihoods and occupational patterns of mountain communities. This has resulted in increased incidence of natural hazards getting converted into disasters which not only undermine the lives, livelihood and natural resources of mountain communities

but also threaten the huge investments made by national governments, the private sector and other actors.

One of the manifestations of the impact of climate change has emerged in the form of GLOF hazard – glacial lake outburst floods. A new hazard has been added to the lexicon of natural hazards and the frequency of this hazard has shown an increasing trend over the past decades, especially in the Himalayan region. The strategies to address this mounting risk have not emerged in the region due to inadequate understanding of the processes, nature, physical dimensions and triggers contributing towards it. The primary response has been in the form of a 'structural' mitigation approach. However, the efficacy of such an approach is yet to be established in the light of challenges and constraints associated therewith.

With a view to strengthen GLOF risk mitigation efforts, the Bureau for Crisis Prevention and Recovery (BCPR), UNDP has been focusing on emerging hazards in the Himalayan region. Efforts have been made to understand the nature, patterns and factors contributing to increasing the seriousness of the hazard and the way it is affecting the hazard, risk and vulnerability profiles in the countries in the region. It is expected to promote holistic risk reduction strategies to address this hazard.

In order to complement the processes and the initiatives already underway in some countries, the Regional GLOF Risk Reduction Initiative in the Himalayas project, supported by Directorate General European Commission for Humanitarian Aid (ECHO) and implemented by BCPR through UNDP Country Offices in Bhutan, India, Nepal and Pakistan in close association with national/ local administrations, has sought to develop community-based or sociological measures. The aim has been to develop activities and initiatives which can be implemented in a feasible manner and can be sustained by communities and local administrations easily to mitigate the impact of GLOF events in the long run.

The implementation process adopted – involving wide ranging consultative and interactive approach – has yielded valuable outputs and learning in this respect. Some of the non-structural measures have been field tested to establish their effectiveness and replicability. It is hoped that this will contribute towards strengthening national and regional endeavours on GLOF risk mitigation and help safeguard the precious development infrastructure as well as socio-economic community assets. These will help promote greater involvement of communities and local administrations in GLOF risk reduction efforts and build the resilience of communities by adopting the mitigation and preparedness steps identified.

Glacial Lakes and GLOFs 2

Outside the polar region, the Hindu Kush Himalayan (HKH) region contain the largest area in the world covered by glaciers and permafrost. The Himalayan region is intrinsically linked to global atmospheric circulation, hydrological cycle, biodiversity and water resources. It has about 15,000 glaciers which are nature's renewable storehouse of fresh water. The region is also the cradle of nine major river systems in Asia whose basins are home to over 1.3 billion people. However, in the face of accelerated global warming (warming in the Himalayas being higher than the global average as per ICIMOD, 2007), the glaciers in the Himalayan region are retreating/ melting at as high a rate as 30-60 metres per decade leading to accumulation of increasing amounts of water in mountain top lakes. Remote sensing data indicate formation of new glacial lakes and expansion of existing ones over the last decades and the process is likely to get further intensified as impact of global warming becomes more acute.

As glaciers retreat, the melt water occupies the depression earlier occupied by glacier ice leading to the formation of glacial lakes. These glacial lakes form behind moraine or ice 'dams'. The moraine walls are formed by sediments, stones/pebbles and sand deposits left by melting glaciers. The fragile and unstable material mass formed due to collection of debris and ice is known as the moraine which holds the water body. These moraines are structurally weak and undergo constant changes.

In the eastern and mid-Himalayas, lakes impounded by receding and melting glaciers are the most common and form at the glacier tongue/ terminal. However, in the western Himalayas, ice-dammed lakes are more common which are associated with advancing or surging glaciers.

Due to the inherent instability of such 'dams', the potential of sudden outbursts/breaches is extremely high. The breach or outburst can be triggered by various factors such as an

earthquake, landslide, avalanche, over-topping, rock-fall, slope failure etc. or due to inability of the moraine 'dam' to hold the water as it crosses the retention threshold.

Such outbursts can lead to discharge of millions of cubic metres of water and debris in a few hours and can cause catastrophic devastation and flooding up to hundreds of kilometres downstream. The sudden flooding can lead to serious damage to life, property, agriculture, livestock, forests, ecosystems, the livelihoods of mountain communities heavily dependent on mountain ecosystems for sustenance, as well as precious socio-economic infrastructure/assets like hydro-power, electricity, communications, roads and bridges. They can also bring permanent changes in topography and stream hydrology. All of these can induce forced migration and undermine the already meagre sources of livelihood of mountain people and downstream communities.

This phenomenon, constituting a sudden discharge of a huge volume of water from such glacial lakes is known as Glacial Lake Outburst Floods (GLOFs). The frequency of such events is increasing in the HKH region since the second half of the 20th century (UNEP, 2003) due to the combined effects of climate change and deforestation. Due to the sudden onset nature of GLOF hazard, communities living downstream get very short lead time to respond to such events.

Satellite observation of the mountain top lakes in the region has revealed a steady increase in the size and volume of many of these glacial lakes at high altitudes, enhancing the possibility of a devastating outburst flood affecting sizeable populations and damaging precious socio-economic infrastructure and development assets in the Himalayan belt.

Over the years, countries in the region have built many high value economic and infrastructure assets and the emerging threat from GLOFs has serious implications for their future development pathway. For countries like Nepal and Bhutan, who depend heavily on hydro-power exports generated from glacier fed rivers, these assets are the mainstay of their economy as they generate a substantial portion of their GDP.

The Himalayan region is susceptible to a whole range of hydro-meteorological, tectonic and climate induced disasters. With warming in the Himalayas being higher than the global average (ICIMOD, 2007), climate induced natural hazards are likely to be exacerbated, including severe glacial melting and the formation of glacial lakes.

An inventory of glaciers and glacial lakes has been an important undertaking to get accurate information and knowledge of GLOFs in the region. Countries in the region as well as technical/research institutions like ICIMOD, Wadia Institute of Himalayan Geology, UNEP, G.B. Pant Institute of Himalayan Environment and Development, Department of Geology and Mines (DGM) Bhutan, National Agriculture Research Centre (NARC), Pakistan etc. have been studying and compiling an inventory of glacial lakes in the region. Regular monitoring and tracking of the size of glacial lakes has

revealed that quite a few of these are expanding at an alarming rate due to accelerated glacial retreat and melting caused by climate change and formation of newer glacial lakes has also been observed.

ICIMOD studies have identified 677 glaciers and 2,674 glacial lakes in Bhutan with 24 of them posing an imminent and potentially high risk. Similarly in Nepal, 3,252 glaciers and 2,323 glacial lakes have been identified with 20 of them being potentially dangerous. In India, data is available for three states: Himachal Pradesh, Uttarakhand and Sikkim. In Himachal Pradesh, there are 2,554 glaciers, with 156 glacial lakes, 16 of them deemed potentially dangerous. In the Uttarakhand Himalayas, there are 127 glacial lakes and 266 in Sikkim with 14 of them being labelled potentially dangerous in the Tista basin. In Pakistan, in one of the sub-basins of the Indus river system (Swat, Chitral, Gilgit, Hunza, Shigar, Shyok, Upper Indus, Shingo, Astor and Jhelum, covering the HKH region of Pakistan), there are 5,218 glaciers with 2,420 glacial lakes being identified. Out of the identified glacial lakes, 52 lakes are viewed as potentially dangerous.

These countries have also been witnessing frequent GLOF events with 21 events having adversely affected Nepal in the recent past at an average of one event every 2-5 years. A GLOF in 1991 at Beding destroyed several houses and valuable farmland while a GLOF at Dig Tsho Lake in 1985 occurred due to the collapse of a moraine dam and completely swept away the nearly complete Namche hydro-power plant and damaged roads, bridges, houses and cultivable land. Similarly, Bhutan has a documented history of GLOFs in the 1950s, 1960s and in 1994 at Luggye Tsho.

In India, GLOF events have previously occurred in Ladakh where they had a serious physical impact. However, because they occurred in sparsely populated terrain, their socio-economic impact was minimal. There are quite a few reported events in Himachal Pradesh and Sikkim of GLOFs/flash floods/landslide induced river damming outbursts – the most notable being the Parechu outburst flood in Satluj Valley in 2005 which caused considerable damage to livelihoods, houses, roads, bridges, electricity generation and supply and to hydro-power plants downstream in spite of timely early warnings and monitoring over a period of time. Incidents of flash floods/cloud bursts are quite frequent in Himachal especially in Kullu, Kinnaur and Shimla valley. Satluj valley had witnessed similar event in the year 2000 as well as in the past.

The Hunza River Basin (Passu and Ghulkin glaciers) in Pakistan has faced incidents of GLOFs or flooding of a similar nature in the past. In light of the available data on GLOF/flash flood events, it is evident that occurrence of such events is on the increase in the northern areas of Pakistan. In addition, the Hunza river basin has 1,050 glaciers which cover an area of more than 4,677 sq. km and are about 2,915 km in length. These 1,050 glaciers of this river basin are the highest source of ice reserves in the entire HKH region of Pakistan (NARC, 2004-2005, Inventory of Glaciers and Glacial Lakes and the Identification of Potential GLOFs).

Research findings have revealed that GLOF is emerging as a new hazard due to the impact of climate change in the Himalayan region. Being a relatively new hazard, it has so far received little or inadequate attention of governments and policy and decision-makers. The risks posed by GLOFs have not been factored into the development policies and plans formulated at national, provincial (state) and local level.

Recognising that hazards in the Himalayan region are bound into a delicate relationship of cause and effect and together combine to increase risks, UNDP through its country offices as well as regional initiatives has been making efforts to reduce/mitigate the impact of natural disasters especially at community level, and focus attention of national governments and development actors to factor these risks into national and local development planning.

The risks posed by GLOFs have been accorded insufficient attention amongst governments/ communities/development actors in the Himalayan region and the need for a holistic GLOF risk reduction and preparedness strategy for these infrequent, though highly devastating and potentially catastrophic disasters has not crystallised. Primarily, a structural and geo-technical engineered solution oriented approach has been adopted with insufficient acknowledgement of the potential for developing sociological or community-based risk reduction approaches to better prepare vulnerable communities in the region. Construction of channels for gradual and regulated discharge of water from glacial lakes and compiling inventories of glaciers and glacial lakes using GIS and remote sensing has been the traditional response. However, these interventions have their in-built challenges and constraints although these have also been successfully used to lower the water level in some of the hazardous lakes.

GLOF Risk Mitigation – State of Play 3

Recognising the fact that GLOF hazard is a relatively new and an emerging hazard, holistic risk reduction strategies have not been formulated. Only a limited set of activities to mitigate the risks posed by the hazard have been implemented.

In order to address this emerging hazard, countries and organisations have focussed mainly on adopting a 'structural' mitigation approach. Efforts have been concentrated on interventions designed to lower the water levels of hazardous lakes by draining it out in a controlled or systematic manner. These efforts have been supplemented by monitoring the formation/expansion of glacial lakes by using remote sensing and GIS technology. This has helped prepare inventory of glacial lakes and identify the potentially hazardous ones.

However, these 'structural' approaches have only been partially successful in addressing the risks and that too only in some of the identified glacial lakes, especially selected potentially dangerous ones. The 'structural' mitigation efforts are also by themselves beset with formidable challenges arising from inclement weather and forbidding altitudes – where glacial lakes get formed and become inaccessible for significant part of the year. The window of opportunity to undertake structural mitigation is very limited in a year – practically for only about two to three months.

The efforts to drain out water from glacial lakes in order to reduce the water level in the lakes have focused on siphoning the water, pumping it out, spillway construction and/or digging channels to gradually release water.

However, initiating large scale structural mitigation measures becomes difficult as high altitude makes it difficult to transport heavy machinery and other equipment to the

vicinity of the lakes. Only light instruments can be transported using mules or porters. Transportation constraints as well as the risk of triggering an outburst accidentally by deploying heavy machinery make the entire effort dependent on huge man power and manual labour. In some instances, over 200 labourers have had to be deployed for manually draining the water and making appropriate food, accommodation and medical arrangements for such a large workforce at high altitudes, which poses a huge challenge. All these render the efforts to drain the lakes arduous, labour intensive and ultimately interim in nature. The approach also has many limitations in terms of the prohibitive cost involved, its overall efficacy and ability to contribute towards long term risk mitigation. Even otherwise, the probability of efficacy of such measures towards long term risk mitigation from GLOFs remains quite low.

In view of the fact that there are estimated to be about 15,000 glaciers and over 7,000 glacial lakes with nearly 120 being potentially dangerous (as per the inventory of glaciers compiled by ICIMOD) with a high probability of an outburst in near future in the entire Himalayan region, the 'structural' mitigation measures have been confined to only a few select ones especially the ones with a high risk of an outburst or with high value socio-economic or development assets and large populations downstream. With impact of climate change becoming more pronounced by the day, it is likely that the pace of formation of glacial lakes, their numbers and frequency of lake outburst incidents will also increase in coming years.

One of the significant initiatives to promote GLOF risk mitigation has been the efforts to develop an inventory of glacial lakes across the Himalayan region. Studies have been conducted by ICIMOD, United Nations Environment Programme (UNEP), Asia Pacific Network etc. at country and regional level along with identification of potentially dangerous glacial lakes. Inventorisation of glacial lakes has helped the countries, technical institutions and disaster risk management practitioners in the region to develop programmes and initiatives to address the risks posed to communities and development assets in downstream valleys.

The process of inventorisation of glacial lakes has used remote sensing and GIS tools to monitor and track the formation/growth of glacial lakes. Efforts have also been made to develop hydrological models in the event of a glacial lake outburst to predict the likely water flow and height.

In countries like Bhutan, which face a major and imminent threat from GLOFs and where substantial investments have been made in hydel projects, extensive exercise has been undertaken to identify hazard-prone areas in downstream valleys in the event of a GLOF especially in the valleys of Punakha, Wangdue and Chamkhar. These areas have been marked as 'Red', 'Yellow' and 'Green' zones with a 'Red' indicating a high risk prone area in the valley where precious infrastructure and community assets need not be located. These hazard zonation maps have helped in providing useful inputs to disaster risk management practitioners and administrations in earmarking hazard-prone and vulnerable areas. For example, hazard zonation has been done in Bhutan in two of the vulnerable valleys from Punakha to Lhamoizingkha through NCCAP project and Chamkhar valley through UNDP-GEF GLOF Project. However, implementation of and compliance with these hazard zonation maps while planning or undertaking development projects remains a challenge.

Some countries have undertaken geo-technical, geological and foundation investigations and

slope stability assessments to better understand the hazard. Some topographical survey maps of 1:2000 scale have also been developed.

Efforts towards setting up of an early warning system (EWS) have also been made especially in Bhutan. These have focused on installing meteorological observatory at the site of glacial lakes and instrumentation to record discharge measurements. HF sets have also been used in some case to relay warnings especially while undertaking structural mitigation activities at the lakes. However, manning and maintaining early warning equipment have been quite arduous as it is difficult to deploy technical personnel round-the-year and the equipment are required to be abandoned with onset of winter and are generally found to be damaged later on.

Many national, regional and international organisations/institutions have been studying this phenomenon and have generated a body of literature and wealth of information about some of the aspects of this hazard. This knowledge is unfortunately dispersed across institutions and efforts to collate and compile the same have not been undertaken in a substantive manner. Currently, there is no mechanism or platform to facilitate exchange of information, research findings and experiences (about what works and what does not). As a result, the current GLOF risk mitigation initiatives largely remain stand alone and 'one-off' with limited attempts at promoting cross-learning and cross-fertilisation of ideas.

During the latter half of the 20th century, quite a few GLOF incidents have taken place in the countries in the region primarily in Nepal, Bhutan and Pakistan. Yet, systematic efforts to understand and study the disaster cycle associated with these events have not been made. As a result, there is inadequate data/ information about the chain of events beginning

from melting of glaciers, formation of lakes, creation of moraine and/or ice 'dams', stability of moraines, likely triggers and causes leading to an outburst etc. and about the physical dimensions of the hazard.

Although GLOF is of recent emergence as a potentially devastating and imminent hazard in the Himalayan region, however, it has been engaging the attention of administration, risk reduction practitioners, technical/research institutions and communities in Alps and Andes regions for quite some time now. Many risk mitigation measures had been evolved and adopted in these regions and valuable experiences and learning generated there from. However, there has been little effort at adapting and sharing experiences from these regions and applying them to mitigate the impact of GLOF hazard in the Himalayan region. Efforts to collate the experience and knowledge generated in these regions for application in the Himalayan context have also not been made. Promoting cross-learning between experts and practitioners in these regions can help devise suitable interventions and support replication of interventions to address the hazard.

4 Why 'Sociological' or Community-based Approaches for GLOF Risk Mitigation?

Glacial Lake Outburst Flood (GLOF) is a relatively new hazard. Although glaciers and glacial lakes spawn the entire Himalayan region, many of the communities are not even aware of the existence of such a hazard emanating from these lakes and threatening their lives and livelihoods. Since formation of most of the glacial lakes takes place at high altitudes viz. 15,000 feet or 5,000 metres and above and human habitations in the immediate proximity are at the most scanty and rare, the common people downstream appear to be less familiar with the processes leading to formation of glacial lakes and the triggers causing an outburst.

The incidents of GLOFs have been few and infrequent till the recent past. As a result, this hazard has not captured the imagination or conscious space among common people and local administrations alike. In spite of the fact that the number, frequency and incidence of this hazard have already seen an upward trend and there is likely to be an increase in future also, the perception about the devastating potential of this hazard has not been fully established at the community level. Even the local administrations are not fully sensitive and cognizant of the threat posed by this hazard. The local administrations and disaster risk management practitioners had also, till recently, not recognised GLOF as a hazard while recounting the hazards in mountain regions.

A combination of these factors has led to lower levels of awareness among communities about addressing the threat posed by GLOF hazard. As a result, efforts towards devising feasible measures for responding to such events have not emerged at the community and local administrations level. Lack of knowledge and awareness about the nature, impact and physical dimensions of the hazard has also impeded efforts in devising and operationalising an appropriate risk reduction and preparedness strategy.

More often, the affected communities attribute some supra-natural phenomenon to incidents of lake outburst. As such, they do not recognise the need to take suitable measures to respond to such events and have traditionally adopted the prayer route to appease the presiding deities to safeguard themselves. For example, in the Swiss Alps, people resorted to taking vows, undertook pilgrimages into forests etc. as part of their cultural and traditional beliefs and performed other rituals to ward off or mitigate the adverse impact. Some of these practices even found acceptance and sanction by the Church. ('Glacial Lake Outburst Floods in Nepal and Switzerland – New Threats Due to Climate Change, a GERMANWATCH publication)

It is well known that holistic risk reduction makes it essential to incorporate community - based risk management measures along with structural mitigation measures. It entails addressing all aspects of disaster management and encompassing all stakeholders. It also involves integrating risk reduction concerns in every facet of development policy and planning process. In addition to the top-down approach (involving putting in place institutional, policy and legislative mechanisms for risk reduction), the bottom-up or community centric approach is considered essential to complement the same. However, there has been an insufficient acknowledgement of the potential for developing sociological or community-based risk reduction approaches to better prepare vulnerable communities to mitigate the impact of GLOFs/flash floods in the region. Efforts to involve downstream communities and local administrative systems have also not found much acceptance and even much lesser practice.

However, efforts towards mitigating the risks posed by glacial lakes have been primarily 'structural' in nature. The emphasis has been on employing technical or engineered solutions. But these have been confined to upstream areas only. On the other hand, there has been an insufficient acknowledgement of the potential for developing community-based steps for mitigating the risks posed by GLOFs to downstream communities and little or inadequate focus on converting these into feasible and actionable inputs for easy adoption and application by communities. Efforts have not been invested in developing substantial activities to be undertaken with community involvement and with active association of local administrations.

The impact of natural disasters is felt more at community level and it is the people who are recognised as the 'first responders' as well as the 'last responders' – as they continue to grapple with the long term impact well after

everyone else, including the administrative support, has been withdrawn. Communities have been coping with various hazards over centuries and have developed systems and mechanisms for addressing the same. These community-based approaches will help collate and document the traditional risk mitigation knowledge of communities and cultural or religious practices, and build upon the existing capacities and knowledge.

Communities are the most important stakeholders in GLOF risk mitigation initiatives. Communities living downstream of a glacial lake are the first ones to face the impact on their lives, livelihood, infrastructure and disruption of day-to-day life. On the other hand, the vulnerability data and research conducted by scientific and research institutions are seldom shared with the communities who live downstream of a glacial lake and these are not used to inform communities of the risks to which they are exposed.

In view of the fact that there are over 7,000 glacial lakes with nearly 120 potentially hazardous ones, the feasibility of undertaking structural mitigation activities in all glacial lakes, or even the dangerous ones, to prevent water from reaching a critical threshold

remains quite suspect and an onerous one. It will require a vast workforce, intensive resources and can virtually be implemented over a long time period whereas the threat is imminent and is actually increasing rapidly. At the same time, the success rate of such measures in reducing GLOF risks is still in the realm of uncertainty.

This will make implementing structural mitigation measures addressing all the glacial lakes across the entire Himalayan region well nigh impossible, if not unviable. Hence, it will be appropriate that concerted efforts to undertake community level risk mitigation and preparedness actions are made to prepare the communities and local administrations in addressing the risks posed by glacial lake outburst incidents. Feasible risk reduction initiatives with communities offer an equally, if not more, practicable and sustainable option.

Moreover, undertaking large scale structural mitigation requires a vast technical resource base. Many of the countries in the region do not possess adequate technical capacity and expertise to undertake these measures on a massive scale across all glacial lakes.

From the perspective of a cost benefit analysis too, it is far more cost effective to invest resources in risk mitigation and preparedness at local administration and community level. Natural hazards will continue to exist and cannot be avoided or wished away. However, efforts can be made to minimise risks and reduce vulnerabilities while building capacities to mitigate their impact.

It is widely acknowledged that the very *raison-d-etre* of disaster risk reduction initiatives is that the end beneficiaries should be the communities. The initiatives should contribute towards reducing risks and vulnerabilities of common people and lead to building their capacity to reduce, mitigate, prepare for and respond to natural hazards. The research and knowledge generated by technical and

academic institutions should be harnessed to devise relevant approaches for implementation at community level. People should be able to integrate them into their day-to-day activities and sustain them on a long term basis to address their hazard and risk scenario.

The mountain communities are inherently beset with a high vulnerability profile. In spite of a high hazard, risk and vulnerability scenario, the hazard-prone mountain regions have seen lesser interventions aimed at risk reduction. As a result risks and vulnerabilities have multiplied manifold due to prolonged neglect of risk reduction issues in mountain communities. Factors like poverty, challenges posed by tough terrain, low levels of awareness, inadequate capacity and lack of appropriate skills and aptitude for risk reduction have further exacerbated the already high vulnerabilities of mountain communities.

Emergence of newer hazards like GLOFs is compounding the scenario and the impact of climate change with a likely higher incidence of climate induced hazards in the coming decades will overwhelm the already meagre coping capacity of communities as well as that of the local administrations. Over the centuries, communities have been responding to hazards in their respective areas including GLOFs or flash floods and have built a strong reservoir of traditional practices, cultural symbolisms and religious beliefs. For example, the Bhutanese people construct a Chorten (Stupa) on the outskirts of villages or community settlements or near the river bends and believe that the Chortens help to ward off any evil or damaging force from entering their house/fields/settlements. Similarly, other communities have also developed similar traditional or social practices to protect themselves from harm.

Moreover, it has been observed that most of the households in mountain areas are women-led. With most of the men folk migrating out to urban centres in search of employment or taking up jobs in the army or police traditionally, the women are left to manage the families, fields as well as children and elderly family members. In view of this peculiar situation, community-based risk reduction efforts would help build the capacity of women to enable them to act as disaster managers.

The hazards in the mountain regions are inter-related with a higher cause and effect ratio as compared to other geographical settings. The interplay of primary and secondary hazards and the multiplicity of hazards makes it imperative to adopt and implement risk mitigation and preparedness activities involving communities and local administrations. The inaccessible terrain and lack of alternative transportation routes also entail building capacities at local level to take advantage of the golden hours immediately after a catastrophic event and to tide over the likely time-lag in mobilisation and availability of external assistance and its optimum efficacy.

Interactions with communities affected by a GLOF event in the past have revealed that the generation which had witnessed the event and had directly been affected thereby were found to be more responsive and receptive towards adopting appropriate measures for safeguarding their homes, lives, livelihoods and socio-economic assets and infrastructure. On the other hand, the younger generation did not appear to be equally sensitive and alive to the threat posed. The need to familiarise the communities with the risks they are exposed to and the threats they face from such hazards would help build a culture of safety and resilience.

The implementation of community-based approaches for GLOF risk mitigation will endeavour to make risk reduction measures more ‘tangible’ and effective. Early warning

systems, land use planning and management, low cost risk reduction measures, training and capacity building endeavours, building knowledge and skills in risk mitigation etc. will ensure that risk reduction gets integrated at local level with communities and local administrations and results in effective and sustainable reduction of risks posed by GLOFs and other natural hazards.

Although the glaciers and their retreat/melting, formation of glacial lakes and consequent outburst events have been studied by various scientific and research institutions and extensive resource materials have been generated on the subject, yet the knowledge generated has not been factored into while developing strategies to reduce the risks posed by GLOFs and for better preparing the administrators and communities. The focus has primarily been on undertaking structural mitigation initiatives and insufficient effort has been devoted to explore the possibility of utilising the potential offered by appropriate EWS, land use planning, contingency and preparedness planning and their incorporation into development process to complement the 'structural' mitigation initiatives.

It will be pertinent to highlight that the overall objective of risk reduction initiatives, as reiterated in Hyogo Framework of Action (HFA) and other international covenants, is to build the resilience of national and local governments, key stakeholders and communities to disasters. Hence, the end objective of all risk reduction interventions has to be to minimise the risks and vulnerabilities of communities. One of the Priorities for Action in HFA mandates strengthening disaster preparedness for effective response at all levels and use of knowledge, innovation and education to build a culture of safety and resilience. This makes it imperative to adopt community centric approaches for risk reduction.

Regional GLOF Risk Reduction Initiative in the Himalayas

5

The Regional GLOF Risk Reduction Initiative in the Himalayas project, supported by Directorate General European Commission for Humanitarian Aid (ECHO) and implemented by UNDP's Bureau for Crisis Prevention and Recovery (BCPR) through UNDP Country Offices in Bhutan, India, Nepal and Pakistan, aims to strengthen existing GLOF risk reduction efforts in the Himalayan region through sociological or 'non-structural' risk mitigation and preparedness measures.

In order to understand the entire disaster cycle associated with GLOF hazard and to formulate measures for community-based risk mitigation and preparedness, the project has studied one/two GLOF/flash flood events each in Bhutan, Nepal, India and Pakistan to assess their socio-economic impact, risk mitigation and preparedness measures adopted, and to identify gaps and needs vis-à-vis capacity for responding to, mitigating and preparing for such events at community and local administration level.

This has been supplemented by a desk review of existing secondary information published by respective governments or technical/ research institutions in the region on past GLOF incidents or on GLOF related issues. The information base on the subject has been built by collating and compiling findings from different research initiatives undertaken by various academic, scientific and technical institutions across the region. The experience and knowledge developed in other regions facing a similar hazard context, Alps and Andes, has also been analysed with a view to inform the implementation process.

The Regional GLOF project has factored community-based GLOF risk mitigation as an essential component in its work plan. Preparatory Assessment Reports documenting the experiences of communities, local administrations, elected and traditional community leaders, women and elderly have been compiled on the basis of interactions on a one-on-one basis. Detailed demographic, occupational and socio-economic information about the communities in select GLOF-shadow valleys has been compiled through a questionnaire.

Information has been collected on the issue through interactions with affected communities and local administration. A detailed questionnaire was developed to understand the demographic profile of the affected areas, socio-economic parameters, occupational patterns, behavioural profile and the perspective/experience of communities and their representatives (elected as well as

traditional leaders) and social/community institutions. Interactions with communities helped collate experiences, perceptions of affected communities and understand the risk mitigation and preparedness needs at community and local administration level. Inputs to better understand communities' perception of GLOF hazard, the impact from an incident in the past, the steps taken by people either individually or as a community before or after an incident and the needs vis-à-vis capacity to mitigate, prepare for and respond to such events in future have been collected.

Efforts have also been made to build upon the knowledge and experience generated through studies conducted by various technical, research and academic institutions in the region, at national and regional level. Consultations were held with key institutions like ICIMOD, Wadia Institute of Himalayan Geology, G.B. Pant Institute of Himalayan Environment and Development, College for Natural Resources (Bhutan), National Agricultural Research Centre (NARC), Global Change Impacts Study Center and WWF (Pakistan), Tribhuvan University (Nepal), TERI, Snow and Avalanche Study Establishment, Department of Science and Technology (Shimla) etc. The studies/research conducted was utilised to understand GLOF hazard and the data generated was harnessed for being factored into the project activities and knowledge networking endeavours.

The data/information generated through community interactions, desk review of existing literature/studies and consultations with various technical/research institutions, focal departments/agencies of respective national governments and local administrations were compiled and validated through triangulation workshops and Focus Group Discussions (FGDs) in each of the project countries. The findings/observations have been shared with a whole range of national stakeholders including government departments/agencies; technical and research institutions at national and regional level; NGOs/CBOs; and local administrations and other key actors, and their inputs factored into the Preparatory Assessment Reports for each country.

In order to broad-base the information base, a 'Query' was floated on knowledge networks in the project countries at the initiation stage (viz. Solution Exchange in India and Bhutan, DP Net in Nepal, Pamirtimes and Knowledge Network for Climate Change (KNCC) in Pakistan) as well as on regional/international networks like Disaster Risk Management Asia and Crisis Prevention and Recovery Net to invite experiences and research studies on GLOF risk mitigation. The technical knowledge of national/regional institutions working on GLOF related issues was harnessed to inform the process and to develop a better understanding of GLOF hazard and associated risks.

A month long e-discussion was conducted in November-December, 2008 with specific focus on the following:

- Key issues, challenges and approaches for GLOF risk mitigation.
- GLOF risk reduction: Community approaches for mitigation and preparedness, EWS and land use planning.

The e-discussion was hosted on Disaster Risk Management Asia (DRM-Asia) network covering practitioners from the fields of disaster management, climate change, environmental management, development planning, experts from technical, research and academic institutions working on GLOF related issues, independent experts, administrators, civil society organisations and other stakeholders in the Asia-Pacific region. It was simultaneously co-hosted on national networks in the project countries mentioned above and queries/ responses were cross-posted across all

networks for synergies of deliberations and to stimulate a vibrant exchange of ideas and experiences. Substantial information and inputs on technical aspects related to GLOF hazard and the approaches adopted in other regions, especially Alps and the Andes, have been gathered with a large technical resource base on the subject. This has been documented and uploaded for wider dissemination through www.managingclimaterisk.org/glofs.htm. At the same time, regular updates/summaries were also posted on international networks like CPR Net, Energy & Environment Net, DIPECHO-ICIMOD network etc.

The information compiled was also discussed with the Core Working Groups constituted in each of the project countries with representation from counterpart national nodal department/ agencies, key national technical/research institution, NGOs/CBOs working on risk reduction issues with the communities, focal points from UNDP Environment/DRM Units and the project staff to guide the implementation process.

On the basis of this interactive process, the Preparatory Assessment Reports have been formulated. The Reports seek to understand the disaster cycle through study of past events, their impact, coping mechanisms and capacity of affected communities and local administrations, steps adopted either before or after the event to mitigate, prepare for and respond to such events in future. These have been shared with a range of stakeholders at national and local level. A set of initiatives for implementation at community level have also been derived/formulated.

Specific initiatives to validate the community - based measures for minimising the risks posed by GLOF hazard and for building community capacity identified through the consultative process have been implemented as pilot community activities in identified GLOF shadow valleys in each project country. IEC materials, training and capacity building initiatives, sensitisation meetings, pilot mitigation initiatives, school level debate and painting competitions, first-aid and search and rescue trainings on a pilot basis have been conducted. The activities have been conducted in close collaboration with local administrations and with involvement of communities in GLOF affected areas.

In order to provide greater visibility to issues and approaches related to GLOF risk mitigation, concerted attempts have been made to associate media and utilise their reach to disseminate information about GLOF risks and the project activities and outputs. Articles/ inserts have appeared in newspapers (viz. Punjab Kesri, Ajit, Dainik Bhaskar and Divya Himachal) in Himachal Pradesh, India and a few in Bhutan. All India Radio, Shimla (India) featured the project in its news bulletin on 30th and 31st August, 2008. The National Stakeholder Consultation Meeting in Bhutan was telecast over Bhutan Broadcasting Service along with interviews with key government participants and project personnel on 30th August, 2008. The Stakeholder's Consultation Workshop in India featured on Doordarshan Shimla and New Delhi on 10th September, 2008 as well as in a newspaper.

In addition, a large body of IEC materials have been produced to complement the activities and to generate awareness not only among communities but also among policy and decision-makers, administrators, key institutions, NGOs/ CBOs and other stakeholders. This has helped place GLOF hazard on the conscious horizon of disaster risk management practitioners and placed it within the thinking of administrative functionaries. It is now being acknowledged as a new and emerging hazard which requires focused attention with a view to better understand the processes and triggers and the physical dimensions.

This process involving extensive interaction with various stakeholders has helped devise practical risk mitigation and preparedness activities including capacity building initiatives to promote holistic GLOF risk reduction. The effort being to complement the existing structural measures with sociological or community-based GLOF risk mitigation measures and to enable communities and local administration to minimise the risks posed by GLOFs/flash floods.

The initiative, poised at the interface of climate change and disaster risk management, acknowledges the inherent limitations of engineered or structural interventions to promote a holistic solution to GLOF risks in the HKH. The ongoing interventions need to be complemented through sociological or community-based measures. Therefore, it is imperative to adopt a multi-stakeholder approach, integrating cross-cutting issues like gender and disability. The following actionable findings/observations emerged from the process adopted under the project:

- Making risk mitigation feasible for communities.
- Preparing communities through contingency planning.
- Building an aware and secure community.
- Making early warnings really 'early'.
- Building capacities to mitigate, prepare for and respond to GLOF events.
- Land use planning – making risks 'visible'.
- Networking knowledge and making it 'actionable'.
- Mainstreaming DRR into development planning.

- Regional coordination.
- Harmonising risk reduction and natural resource management.

The sociological or community-based interventions help build community resilience while complementing the ongoing structural risk mitigation initiatives. These 'sociological' or non-structural risk mitigation and preparedness measures are being further developed and translated into actionable programmes in hazard-prone areas. An effort to field test these approaches with identified communities in selected GLOF-shadow valleys has been made with a view to validate the findings/observations from the assessments conducted in the project countries.

Through this process, the benefit of knowing what works and what does not has also emerged and the interventions are being informed with the knowledge and experience generated. This has also given a better assessment of the ability of communities and local administrations to sustain identified risk mitigation and preparedness measures to address GLOF risks and to identify their peculiar needs and requirements to minimise the impact of GLOF/ flash flood events.

The Regional GLOF project is aimed at identifying and developing 'non-structural' or community oriented risk mitigation and preparedness approaches to facilitate GLOF risk reduction. These would help complement and harmonise structural and non-structural approaches for holistic GLOF risk reduction and preparedness.

Knowledge networking

One of the key activities under the project has been the facilitation of a knowledge networking process on GLOF issues among various stakeholders. The project has adopted a regional to national and local approach by collating the knowledge generated at regional and international level for GLOF risk mitigation and bringing it to bear upon national strategies and local implementation targeted at communities and local administrations.

Networking disaster risk management, climate change, environmental management, administrators, civil society actors and other stakeholders with knowledge institutions is aimed to help better understand the physical dimensions of GLOF hazard. This will facilitate cross-learning among institutions and agencies in both the government as well as academic or community domain. The measures to mitigate the risks posed by GLOFs and to prepare the people to respond to them have been implemented at local level. The initiatives promoting knowledge networking and information sharing endeavour to harness global practices and knowledge and factor the same into regional, national and local approaches for GLOF risk mitigation. This will help develop coordinated strategies to reduce/mitigate the impact of such events.

Moreover, the knowledge and experience generated through studies/research is largely

dispersed across various technical, academic or research institutions. To date, insufficient efforts have been made towards creating a common platform for transferring this knowledge in a synthesised manner for experts and practitioners from the fields of climate change, disaster risk reduction, land use and development planning as well as civil society to share information/knowledge on GLOF risks. The Regional GLOF project is trying to virtually bring together and network practitioners from these diverse practice areas to generate/share knowledge and experiences. The learning derived from project activities would support the national governments, partner institutions and UNDP Country Offices in developing strategies/projects addressing the risks emanating from GLOFs.

Recognising that GLOF is a hazard which is poised at the intersection of climate change and disaster risk management, knowledge networking will enable practitioners to benefit from the knowledge, research and experience of practitioners from related streams. This will help formulate informed steps to address the issues by factoring in relevant inputs from related practice areas. Efforts have been made to bring the practitioners together and to bring the knowledge generated in the public domain.

Project updates and information about findings/observations are being regularly shared with over 3,000 disaster management/climate change practitioners, administrative functionaries, technical/research institutions, civil society actors and other stakeholders for cross-fertilisation of ideas/approaches for GLOF risk mitigation. Monthly updates on project implementation have been shared with identified national stakeholders as well as other actors through e-mail groups also. A dedicated webpage www.managingclimaterisk.org/glofs.htm has been created to upload information on project activities and findings.

The e-discussion on GLOF Risk Mitigation, hosted on Disaster Risk Management Asia network and cross-posted simultaneously on partner national, regional and international networks received active participation from practitioners from different streams. The contribution from over 35 practitioners brought forth varied as well as valuable perspectives and experiences to risk mitigation issues connected with GLOFs. The inputs ranged from community approaches to EWS, land use planning, harmonising strategies, greater synergies of action through enhanced regional coordination etc.

The project has been able to secure a strong ownership of initiatives by key nodal administrative departments/agencies in the project countries. The activities have been anchored with the nodal disaster management departments/agencies at national level and implemented in close coordination with local administrations, thereby ensuring greater sustainability. The implementation process has immensely benefited from the expertise and intimate understanding of the local context by UNDP Country Offices of Bhutan, India, Nepal and Pakistan.

Recognising that hazards in the Himalayan region are bound into a delicate relationship of cause and effect and together combine to increase risks, UNDP through its country offices as well as regional initiatives has been making efforts to reduce/mitigate the impact of natural disasters especially at community level, and focus the attention of national governments and development actors to factor these risks into national and local development planning.

Pilot risk mitigation and preparedness activities at community level

Going beyond the specific mandate and activities outlined under the project, pilot

initiatives to field test the steps identified for mitigating the risks of GLOFs and for preparing the communities for responding to such events have been implemented with one community in downstream GLOF-shadow valley. Basic risk mitigation measures in the form of informal embankments, plantations, erecting natural barriers etc. have been promoted. Activities aimed at raising awareness among common people about likely impact of GLOF incidents and sensitisation of administrative officials have been undertaken. Schools have been actively involved with the process with organisation of painting and debate competitions for school children in vulnerable valleys. Preparedness planning through hazard and risk identification, resource mapping and identification of evacuation routes, safe shelters etc. have been initiated. Trainings on search and rescue and first medical response have been organised to build the immediate response capacity of identified communities.

The activities, undertaken on a pilot basis, have helped provide valuable inputs about efficacy of community-based risk mitigation and preparedness measures advocated under the project. This has helped validate the findings/ observations emanating from interactions with communities and local administrations as well as from the national level consultations with various stakeholders.

The GLOF project has been adopting a regional approach with a view to promote greater regional cooperation amongst countries in the region for developing coordinated strategies to reduce/mitigate the impact of such events and to facilitate cross-learning among institutions and agencies in both the government as well as academic and community domain. It would endeavour to harness global practices and knowledge and factor the same into regional, national and local approaches for GLOF risk mitigation.

6 Reducing GLOF Risks – Elements of A Community-centric Approach

The principal objective of the Regional GLOF Risk Reduction Initiative has been to strengthen GLOF risk reduction efforts in the Himalayan region through non-structural and community-based interventions. The methodology adopted – involving preparing Assessment Reports (to understand the socio-economic impact, risk mitigation and preparedness measures and capacity gaps and needs), promoting a regional network of practitioners, e-discussion and information sharing, supporting project countries with better understanding of the hazard and promoting feasible steps to enable communities to undertake risk mitigation and preparedness activities – has yielded actionable inputs to complement the on going structural mitigation efforts for minimising GLOF risks.

The initiative, poised at the interface of climate change and disaster risk management, acknowledges the inherent limitations of structural interventions to promote a holistic solution to GLOF risks in the HKH. The on going interventions need to be complemented through sociological or community-based measures. It is imperative to adopt a multi-stakeholder approach with active involvement of various sectors and integrating cross-cutting issues like gender and disability. The following actionable observations and recommendations with regard to 'non-structural' or community centric approaches have been developed as essential components to address GLOF risks. These have emerged from the processes adopted under the project:

i. Making risk mitigation feasible for communities

More often than not, the risk mitigation measures formulated for reducing the risks posed by a natural hazard are too technical, cost intensive, time consuming or so complex that these cannot be implemented at local level, either by communities or by local administrations, without external financial and technical assistance. The challenge is to devise easy-to-implement, low cost and feasible risk mitigation activities which can be understood and adopted by common people. These will contribute towards creating a greater acceptability of concepts and practices related to risk reduction among the communities. The communities need to feel the necessity, understand the functionality and should be able to manage the costs associated with any risk mitigation activity targeted. This will promote sustainability of risk mitigation for disaster resilience among communities.

However, the risk mitigation measures need to be properly evaluated and assessed from the point of view of their efficacy to contribute towards risk mitigation in the identified areas/communities. Detailed assessment of the valley terrain, community settlements, width and topographical ingredient of the river/water channel should be made. This will help obviate the possibility of any adverse impact, albeit inadvertant, on the communities. These simple mitigation measures can be in the form of informal embankments or creation of natural barriers like plantations, boulders, spurs etc. for protection of precious assets. However, care must be taken to ensure that plantations do not begin to act as barriers obstructing the smooth flow of water and debris during a GLOF or flash flood event. But they should be planned to break the force, thrust and devastation potential of water body towards human habitations or other precious socio-economic and development infrastructure as well as religious and cultural monuments of national heritage.

It might also be a good idea to link plantation initiatives to socio-economic needs as it will ensure greater ownership among people. It is also important to ensure that these community-based mitigation measures are factored into the local developmental programmes. This will lead to a formal engagement with the community and will strengthen acceptability of the measures.

ii. Contingency planning to prepare communities – a stitch in time

Contingency planning is one of the most essential components of disaster preparedness. The communities need to be sensitised, oriented and trained to develop disaster management plans in a participatory manner to identify what needs to be done before, during and after a disaster. With

specific reference to mountain communities, the planning process must ensure active association of women, children and elderly as due to peculiar socio-economic conditions, the men folk mainly migrate to cities in search of employment. The plans must address their special needs and these must be factored into the contingency planning process.

Contingency planning is also essential in mountain areas as in the event of a natural catastrophe, mobilisation and transportation of external assistance is likely to take more time than usual to reach the affected populations/areas due to tough hilly terrain and transportation challenges.

The contingency planning process must also include constitution of task forces for addressing specific needs. The identification of tasks for particular members along with their capacity building to perform that task must be factored into the plan. The skills needed to complete these tasks need to be honed on a regular basis through trainings, refresher trainings and mock drills. The seasonality of disasters should be recorded and a record of identifying vulnerable people,

buildings and infrastructure should be made and revised at a regular basis. Emergency evacuation routes and shelters need to be identified and should be ingrained into the minds of the people. These could be done by simple tasks like painting the village map along the emergency evacuation routes and shelters onto the walls of community building where everyone can see it on a regular basis. These planning activities need to be further replicated.

At the same time, the contingency planning process must be anchored with local administrative units or elected local bodies viz. Panchayats in villages etc. This will ensure greater synergies with administrative response mechanisms and contribute to sustainability of planning process.

Recognising the strong cultural affinity of mountain communities with their traditional practices, it will be good to incorporate and build upon the traditional knowledge on risk mitigation, preparedness and response developed by communities over the centuries. The involvement of social or cultural or religious institutions will further strengthen the preparedness planning process at community level.

iii. Advocacy and awareness to build an aware and secure community

Communities can only be secure when they are aware of the hazards they are facing and know how to best mitigate and prepare for them. It is a known fact that people having experienced a GLOF or a flash flood in the past are more aware, sensitive and receptive to the need to adopt risk reduction steps. The level of awareness and receptivity among the younger generation or among communities who have not experienced a GLOF disaster is comparatively low. Therefore, it is pertinent that concerted and pointed awareness generation campaigns and activities at community level should be undertaken on a regular basis to overcome the human mindset of not recognising an adverse threat and 'I-am-not-likely-to-come-in-contact' syndrome. Simple tools like awareness songs and movies on disaster risk reduction in the local language, painting and debate competitions on flash floods in local schools, use of traditional and folk mediums etc. on hazards, simple steps to reduce risks and enhance preparedness disasters at local fairs and festivals contribute substantially towards building a culture of risk reduction and resilience.

The community awareness programmes should be complemented by a sustained policy and advocacy effort aimed at policy and decision-makers not only at national and regional level but also at the local administrative functionaries. Sensitising policy and decision-makers helps establish the risks posed within the administrative thinking and promotes formulation of suitable risk mitigation measures. It facilitates securing a stronger buy-in from relevant stakeholders and institutionalising the process of risk reduction. The stakeholder network can be broad-based to create a resource pool and promote synergies of action.

iv. Making early warnings really 'early'

The hydro-meteorological hazards especially in hilly regions occur quite suddenly and generally provide a very short respite time. This is especially true in case of GLOFs and flash flood incidents. An assessment of some of the past GLOF incidents from existing records shows that the lead time available has been in the range of five to six hours. In view thereof, it is pertinent to have a very quick EWS for events like GLOFs where the response time is not much.

Currently, monitoring and observation of some of the potentially hazardous glacial lakes is being undertaken. Some sophisticated tools like remote sensing and GIS have been used to monitor formation/expansion of glacial lakes. However, an EWS designed to generate and relay real time warning round the clock has not been deployed. HF sets have been used during structural mitigation process in countries like Bhutan to relay information to ground stations.

On the other hand, there are quite a few inherent limitations in existing EWS. In some places, different agencies/departments operate disparate systems to cater to their specific requirements/priorities. These systems remain stand alone for catering to peculiar requirements of that sector/agency. These are inadequately aligned or integrated with the administration and the data generated is not shared with other stakeholders. Moreover, the systems are not imparted adequate community orientation and there is a lag time in analysing and disseminating information to communities with the result that appropriate response time is generally not available to people to act upon the warnings generated.

With a view to address the challenges posed by hydro-meteorological hazards in mountain areas, it is essential to devise and implement an easy-to-maintain and operate EWS. The effectiveness of EWS can be gauged from the speed of community response. It must be imparted greater community orientation and community-based systems need to be seamlessly integrated into the administrative information dissemination mechanisms. Guidelines to promote better understanding of and response to warnings generated at community level should be developed. The warning dissemination protocols should ensure last mile connectivity or community ownership as more often than not it is the people living in remote and hazard-prone areas that have to bear the brunt of these disasters.

Protocols to facilitate greater coordination between technical/monitoring agencies and civil administration can help overcome the challenges posed by scattered communities and valleys as well as mountain shadow areas in devising effective warning dissemination mechanisms. Experience from operational EWS indicates that covering scattered mountain communities and overcoming the constraints posed by mountain geology/topography need to be factored into the design and operational details vis-à-vis the variation in lead time for each type of mountain hazard. Efforts should be made to develop holistic EWS with a regulatory framework for warning dissemination, identification of stakeholders and their roles, user information, information flow mapping etc. Efforts must also be invested in documenting and building upon the traditional practices for warning dissemination among communities and integrating them into any proposed EWS. The EWS must address the key concerns and needs of local communities.

The high vulnerability of mountain communities, tough and inaccessible terrain, pressure of poverty and meagre livelihood options, and peculiar socio-economic conditions necessitate designing and operationalising an EWS which can cater to their specific requirements i.e. from where they can get timely and actionable warnings. This will facilitate greater ownership and acceptability among the communities.

v. Building capacities to enhance preparedness

A well known adage in military circles goes that 'the more you sweat in peace time, the less you bleed in war'! It is equally applicable to the field of disaster risk management. More preparedness activities conducted during pre-disaster phases lead to lesser impact during

a disaster. Hence, the focus on training and capacity building activities needs to be ensured to enable communities, local administrations and other key stakeholders to mitigate, prepare for and respond to natural disasters.

Programmes to build capacity in contingency planning and disaster preparedness including first responder trainings especially search and rescue and first-aid etc. need to be undertaken on a regular basis. Tough mountain terrain and lack of multiple access routes make it imperative for creating capacities at local level for immediate response to optimise external assistance.

Capacity building programmes must have a strong focus on training women as disaster managers due to peculiar social fabric among mountain communities as majority of the men folk find employment away from their villages/ families and women virtually act as head of the family with responsibility to look after the children and the elderly. The knowledge to protect people from climate induced hazards must be disseminated in an easy-to-relate manner. The technical inputs and hazard specific knowledge must be used for developing capacity building initiatives. Involvement of national and/or regional training institutions must be promoted and their expertise harnessed for fine-tuning the training programmes. Civil society organisations (NGOs/CBOs) also have a very important role to play in community capacity building endeavours as they have strong grassroots presence and intimate community interaction.

vi. Land use planning – making risks 'visible'

The land in mountain valleys, especially flat land, is quite scarce and more often it is located on either side of a river or stream. This is the land used by communities for supporting habitations and livelihood and for building socio-economic infrastructure. However, the same is also prone to hydro-meteorological hazards. Schools, hospitals, community buildings like religious places, the local administrative/government offices etc. play an important role in organising and supporting community lives and livelihood. They also become crucial in a post-disaster situation either as administrative hubs for mobilising resources and activating social/ administrative response and some are also invariably used as community shelters during an emergency. Hence, it is essential to ensure that these critical infrastructures are not lost during a disaster.

From this perspective, it is essential to introduce concepts and practices related to land use planning and management at community and local administration level. This will help identify hazard-prone and vulnerable areas and prevent location of high value individual, community and development assets in these areas. However, recognising the fact that scarcity of available land makes it imperative to set up some assets in risk prone areas, it will be advisable to ensure that only low value assets are located in danger zone to minimise casualties and losses.

However, a major challenge is to make it tangible for common people. They should be able to recognise the hazard zones easily and develop an understanding of the importance of land use planning concepts and practices in their day-to-day lives. Therefore, it is important that the local administration and communities realise the importance of 'where to locate what'. These can be established at community level through easily identifiable and visible activities. The risks posed by GLOFs, for example, to what level the water could reach, what are the vulnerable structures in the path of a potential flash flood etc. need to be factored into the development planning process in vulnerable valleys.

Promoting land use management is also critical in safeguarding socio-economic assets and development projects which constitute the mainstays of economies of many of the mountain countries like Nepal and Bhutan. For example, Bhutan depends upon hydro-power projects to generate nearly 45 percent of its national revenues. A GLOF incident can severely undermine this potential. Protecting socio-economic development assets and livelihood will make recovery from a catastrophic event faster.

vii. Networking knowledge and making it 'actionable'

Impacts of climate change and climate variability present newer challenges. From an ecosystem perspective, it is very important that we share the knowledge available and the research being conducted by governments and institutions in the region. The need is to ensure '*melting of knowledge domains*' by facilitating greater information sharing through platforms/ mechanisms for the same. The shifting hazard, risk and vulnerability profiles need to be studied and assessed to generate suitable risk reduction, mitigation and preparedness strategies.

The networking of knowledge is a two-way process – sharing and disseminating knowledge generated to feed into programmes and strategies for GLOF risk mitigation, and using the experience derived from implementation of the same to inform the research findings. It is important to utilise the technical and scientific research output/knowledge and convert it into actionable projects so that it is practically used to benefit risk reduction activities and helps in reducing the inherent vulnerabilities in communities.

Many national, regional and international institutions and technical agencies have conducted wide ranging studies on issues related to glacial lakes and their outburst, the characteristics and processes leading to their formation and occurrence of hazards etc. Unfortunately, most of it has not been transformed into workable strategies to address the risks related thereto. Moreover, the knowledge generated has remained dispersed across institutions and organisations. It is imperative to collate and synthesise the knowledge and make it available to disaster risk management practitioners, administrators, civil society actors and other stakeholders. Demystifying the technical aspects of risk mitigation and converting it into easy-to-implement actionable inputs will help promote and broad-base risk reduction measures.

Consultations, seminars, documentation of local knowledge and traditional practices, assessment studies, use of media to generate awareness, use of education and awareness raising materials, discussions, debates and lectures have been the traditional ways of sharing knowledge. Relatively modern, knowledge networking systems like online discussions, knowledge and resource centres and village information centres can be adopted to facilitate this process. At the regional level, there needs to be greater sharing of knowledge on emerging hazards like GLOFs,

among the governments of different countries, international bodies and organisations.

The process of knowledge networking will help identify needs at local/community level on which research can be undertaken in technical institutions. Similarly, the knowledge generated by scientific and academic institutions can be used to promote risk reduction and community resilience.

viii. Mainstreaming DRR into development planning

Disaster risk reduction is not a set of stand alone and 'one time' activities. It is a part and parcel of the developmental plans that we have for our area, region and country.

Countries in the Himalayan region have been investing vast resources for developing socio-economic and infrastructural assets like dams, hydel projects, bridges etc. With increasing hydro-meteorological hazards due to the impact of climate change, incorporating risk reduction elements into the development planning process will ensure their safety and sustainability. The development plans, national and/or local, formulated for mountain areas, must seek to mainstream risk reduction concerns to insulate the development process from recurrent hazards. For example, it is important to use the principles of land use planning while making plans on where exactly to lay the highways and bridges in the GLOF shadow areas and ensure incorporation of risk reduction elements to make them hazard resistant. Incorporating DRR into developmental planning forms an essential component of sustainable development and must also be communicated and established at community level.

ix. Regional coordination

The delicate cause and effect relationship between hazards and risks in the Himalayan region and cross-border impacts necessitate concerted and convergent strategies and closer coordination among various stakeholders including national governments. Experience has shown that hazards in one country have the potential to create a disaster in a downstream one. For example, a GLOF event in Bhutan or Nepal could have an impact in India and Bangladesh downstream. This is especially true in the context of the fact that disasters do not recognise boundaries as evidenced during the Kashmir earthquake in 2005 and Kosi floods in 2008 in the region.

Experiences of previous GLOF incidents and events of similar nature underscore the fact that these incidents require greater cooperation between countries in the region in terms of monitoring, sharing data and disseminating timely warnings to countries/communities likely to be impacted. Satellite observations indicate that GLOF in one country have the potential to cause considerable devastation in neighbouring Himalayan countries, including the countries in riverine plains. Hence, it necessitates greater coordination between countries in the region in terms of joint monitoring, sharing of data, developing risk mitigation and preparedness strategies.

The platform provided by institutions like SAARC disaster management centre should be used to formulate a regional coordination strategy for addressing such hazards and to implement a multi-stakeholder and multi-sectoral approach. Similarly, other regional mechanisms like UNESCAP and informal platforms like ISDR Asia Partnership, a network with representation from national governments, civil society, academia, development and humanitarian organisations can also help promote closer coordination between various actors.

Risk reduction is recognised as an area requiring synergies of action between administration,

technical agencies, civil society organisations, humanitarian and development agencies and other actors. However, systematic efforts to devise a work plan involving various stakeholders and addressing concerns of different sectors have not been made. The current strategies largely remain confined to a few sectors. Active engagement of all stakeholders has not materialised. As a result, the activities have remained stand alone or one-off interventions.

Coordinated strategies can be devised by harnessing knowledge generated by technical/ research agencies to formulate an actionable agenda for implementing organisations like NGOs/INGOs etc. Greater information sharing needs to be facilitated between countries sharing the Himalayan ecosystem to learn from and feed into each others' work.

x. Harmonising risk reduction and natural resource management

Afforestation and natural resource management including water/watershed management must be incorporated into risk mitigation strategies to protect the Himalayan ecosystem. It is well known that mountain communities are overwhelmingly dependent upon natural resources. Their lives and livelihoods are closely related to and intimately dependent upon the natural resources available in their vicinity. Connecting risk mitigation measures with natural resource management efforts will also help secure stronger buy-in and interest from the communities and make them more sustainable.

The approaches identified have been developed and implemented in close coordination with nodal administrative departments/ agencies in each of the project countries and in consultation with key technical/scientific institutions in the region. Experiences emerging from implementation of GLOF risk mitigation measures in other parts of the world, especially in Andes and Alps, have been collated. These have helped identify the activities which offer ease of implementation at community level and provide greater sustainability in the long run. The over-arching objective being to ensure that the feasible risk mitigation and preparedness activities taken up with communities contribute towards holistic GLOF risk mitigation and complement the ongoing 'structural' mitigation efforts.

7 Conclusion

Under the Regional GLOF Risk Reduction Initiative, some of the actionable elements of the community-based strategy have been field tested and implemented on a pilot basis with a few communities living in GLOF-shadow valleys in each of the project countries viz. Bhutan, India, Nepal and Pakistan. The process has helped demonstrate the practicality and feasibility of the activities identified. The idea has been to assess the level of acceptability and value addition brought by the identified set of activities to communities and local administration with regard to mitigating the impact of disasters and building their capacity to respond better to natural calamities.

A Regional Workshop on GLOF Risk Mitigation through Community-based Approaches was organised on 20-21 January, 2009 in Paro, Bhutan to deliberate upon the viability and feasibility of the above mentioned elements of a community centric approach for mitigating the impact of GLOF hazard. The Workshop saw participation of key stakeholders from each of the project countries as well as experts, individual researchers and technical institutions from the region and from other regions/streams of expertise. The components of GLOF mitigation measures envisaging active participation of communities and local administration were discussed, validated and fine-tuned with inputs from various stakeholders.

The ability of approaches identified to contribute to reducing the risks posed to common people, their individual or socio-economic assets and make them better prepared to mitigate and respond to such events in future has been the key criteria for adopting the same. It has also demonstrated as to what works and what does not at community level and due to which, valuable experience has been gathered.

At the same time, there are some elements which will require further refinement and fine-tuning in order to transform them into more action oriented activities. This will be essential to impart a more tangible shape to them and to make them community centric. For example, the challenge to convert hazard and risk assessments into easily understandable and actionable format for communities would require to be addressed in due course. Similarly, establishing suitable EWS for addressing varying response requirements of vulnerable communities and ensuring last mile connectivity so as to enable quick response and action by communities would require more concerted effort.

The countries and communities in the Himalayas share a common ecosystem, a similar hazard and risk profile and socio-economic context. In view of the cause and effect relationship of hazards in the Himalayan region and their trans-boundary impact, a coordinated approach to develop joint risk reduction strategies and response mechanisms is required to be developed. Each country has set up its own scientific and technical agencies/institutions to study the hazards, compile data and formulate requisite risk reduction measures. The research conducted over the years, data generated and experiences derived, however, remain limited within the confines of respective institutions and have not been shared across for feeding into each others' initiatives. It will be imperative to effectively harness the potential offered by platforms like SAARC Disaster Management Centre, ISDR Asia Partnership and other regional forums to fill the vacuum in this regard and promote greater and effective convergence of approaches.

During the course of project implementation, the activities have been shared with counterpart government departments/agencies at national, provincial (state) and local level, key technical/ academic institutions, NGOs/CBOs working with mountain communities and with other stakeholders. The inputs and suggestions from all of them have been incorporated while designing the project interventions to fine-tune the community-based activities for GLOF risk mitigation.

The project has been able to place GLOF hazard and the risks posed thereby in the conscious space among administrators, technical institutions, civil society organisations, national and international humanitarian and development organisations and among other stakeholders. Being a new and emerging hazard, the recognition of its devastating potential was quite low among communities and administrations alike. However, the risks posed and serious impact of the hazard on lives, livelihood and socio-economic infrastructure are being acknowledged and factored into development and risk management strategies/frameworks. For instance, the district administration of Kinnaur district in Himachal Pradesh (India) has initiated the process of revision of its disaster management plan to integrate GLOF risks within the ambit of the plan. Similarly, the disaster management plan of Northern Areas of Pakistan is being revised to integrate risk mitigation and preparedness strategies for GLOFs into it.

Hitherto, GLOF hazard and the risks posed were not being addressed as part of national disaster risk management strategies or by UNDP and other national/international organisations. The Regional GLOF project has been able to highlight the criticality of the hazard and the need to address risks associated therewith. UNDP Country Offices in India, Bhutan and Nepal are in the process of integrating GLOF hazard in their disaster risk management programmes. In India, GLOF hazard has been incorporated into the United Nations Development Assistance Framework (UNDAF) Vulnerability Reduction Cluster activities and has also been added as one of the components under the new Disaster Risk Management Programme (2008-2012).

It is hoped that the community-based risk mitigation and preparedness activities for addressing GLOF risks will complement the on going 'structural' mitigation measures and lead to the formulation and implementation of sociological or 'non-structural' measures as outlined above. This will pave the way for holistic risk reduction approaches and help address one of the manifestations of adverse impact of climate change by using proactive DRR as an instrument/tool for mitigating its impact.

Viewed from the community's perspective, activities aimed at promoting GLOF risk mitigation and preparedness should not remain stand alone initiatives. It would be more feasible and practical to adopt an integrated approach addressing all climate-induced hazards through a holistic climate risk management approach.

The impact of climate change is becoming more pronounced by the day and the hazard and risk profiles in the mountain regions, especially the Himalayan region, are undergoing a major transformation. Newer risks are manifesting themselves and the nature, occurrence, pattern, seasonality and intensity of the existing ones is indicating a changing trend. It requires greater understanding of the processes involved and the impact especially at community level.

Studies to assess the impact of climate change on high, middle and low Himalayan mountain ranges should be undertaken to analyse the impact on different climate sensitive sectors. At the same time, documentation or inventorisation of hydro-meteorological hazards at regional, national and local scales should also be done. The inventory will indicate a clearer picture of trends and patterns related to occurrence of climatic hazards. It is felt that it will also help to formulate appropriate adaptation and risk mitigation strategies addressing the climatic hazards and risks posed by them in a more comprehensive manner. The need to integrate community-based risk mitigation interventions will build community resilience and contribute towards the strategic goals of the Hyogo Framework for Action.

Key Institutions/Organisations Associated with the Regional GLOF Risk Reduction Initiative

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Regional

- Asian Disaster Preparedness Centre (ADPC)
  http://www.adpc.net
- Fluvio, Institute of Geography and Earth Sciences, University of Wales
  http://www.fluvio.com
- International Centre for Integrated Mountain Development (ICIMOD)
  http://www.icimod.org
- IRI Earth Institute, University of Columbia
  http://portal.iri.columbia.edu/portal/server.pt
- SAARC Disaster Management Centre
  http://saarc-sdmc.nic.in/index.asp
- The Mountain Institute
  http://www.mountain.org
- DIPECHO Partners: IFRC & Handicap International

India

- Wadia Institute of Himalayan Geology (WIHG)
  http://www.wihg.res.in
- Government of Himachal Pradesh-Department of Revenue
- Government of Himachal Pradesh-Science and Technology Department
- Government of India, Ministry of Home Affairs
  http://www.mha.nic.in/
- Himachal Pradesh Institute of Public Administration (HIPA)
  http://himachal.gov.in/hipa/
- Mountain Forum Himalayas (MFH)
  http://www.mfhimalayas.org
- National Institute of Disaster Management (NIDM)
  http://www.nidm.net/
- Snow and Avalanche Study Establishment (SASE)
  http://www.drdo.org/labs/sase/index.html
- TARU
  http://www.taru.org/
- The Energy and Resources Institute (TERI)
  http://www.teriin.org/
- GB Pant Institute of Himalayan Environment and Development
  http://gbpihed.gov.in/

Pakistan

- National Disaster Management Authority (NDMA)
  http://ndma.gov.pk/
- Northern Areas Disaster Management Authority (NADMA)
- National Agricultural Research Council (NARC)
  http://www.parc.gov.pk/NARC/narc.html
- Global Change Impact Study Center (GCISC)
  http://www.gcisc.org.pk/
- Earthquake Relief and Recovery Authority
- Federal Flood Commission
- Geological Survey of Pakistan
  http://www.gsp.gov.pk/
- Aga Khan Foundation, Pakistan
  http://www.akdn.org/akf
- Government of Pakistan, Ministry of Environment
  http://www.moenv.gov.pk/

- IUCN Pakistan
  http://iucn.pk/
- Karakoram International University
  http://www.kiu.edu.pk/
- Lead Pakistan
  http://www.lead.org.pk/
- Pakistan Meteorological Department (MoD)
  http://www.pakmet.com.pk/
- Pakistan Mountain Areas Conservancy Programme
- Pakistan Wetlands Programme
- Planning Commission
  http://www.planningcommission.gov.pk/
- Quaid-e-Azam University, Islamabad
  http://www.qau.edu.pk/
- WAPDA Pakistan
  www.wapda.gov.pk/
- Water Resources Research Institute (WRRI)
  http://www.parc.gov.pk/wrri.html
- World Wide Fund for Nature, Pakistan (WWF)
  http://www.wwfpak.org/

Nepal

- Ministry of Home Affairs
  www.moha.gov.np/
- Department of Hydrology and Meteorology
  http://www.dhm.gov.np/
- Department of National Parks and Wildlife Conservation
  http://www.dnpwc.gov.np/
- DP Net-Nepal
  http://www.dpnet.org.np/
- Himalayan Climate Center
- Kathmandu University
  www.ku.edu.np/
- Ministry of Environment, Science and Technology
  http://www.natlib.gov.np/
- Ministry of Physical Planning and Works
  http://www.moppw.gov.np/
- Ministry of Water Resources
- Department of Water Induced Disaster Preparedness
  http://www.dwidp.gov.np/
- National Planning Commission
  http://www.npc.gov.np/en/
- Nepal Center for Disaster Management
- Nepal Red Cross Society
  http://www.nrcs.org/
- Tribhuvan University
  http://www.tribhuvan-university.edu.np/
- Water and Energy Commission
  http://www.wec.gov.np/
- Institute for Social and Environment Transition
- Bhote Koshi Power Co. Pvt. Ltd.
  http://www.bhotekoshi.com/

Bhutan

- Disaster Management Department
  Ministry of Home and Cultural Affairs
  Royal Government of Bhutan
- Department of Geology and Mines
  http://www.mti.gov.bt/dgm/dgm.htm
- Department of Energy, Hydro-met Services Division
- Department of Agriculture, Ministry of Agriculture
  http://www.moa.gov.bt
- Gross National Happiness Commission
  http://www.pc.gov.bt/
- National Environment Commission
  http://www.nec.gov.bt/
- Austrian Coordination Office
- College of Natural Resources, Lobeysa, Royal University of Bhutan
  http://www.rub.edu.bt/
- Dzongkhag Administration, Punakha and Wangdue districts
- JICA, Bhutan
- Bhutan Water Partnership
- Jigme Dorji National Park
- Royal Society for the Protection of Nature
  http://www.rspnbhutan.org/
- Tarayana Foundation
  http://www.tarayanafoundation.org/

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