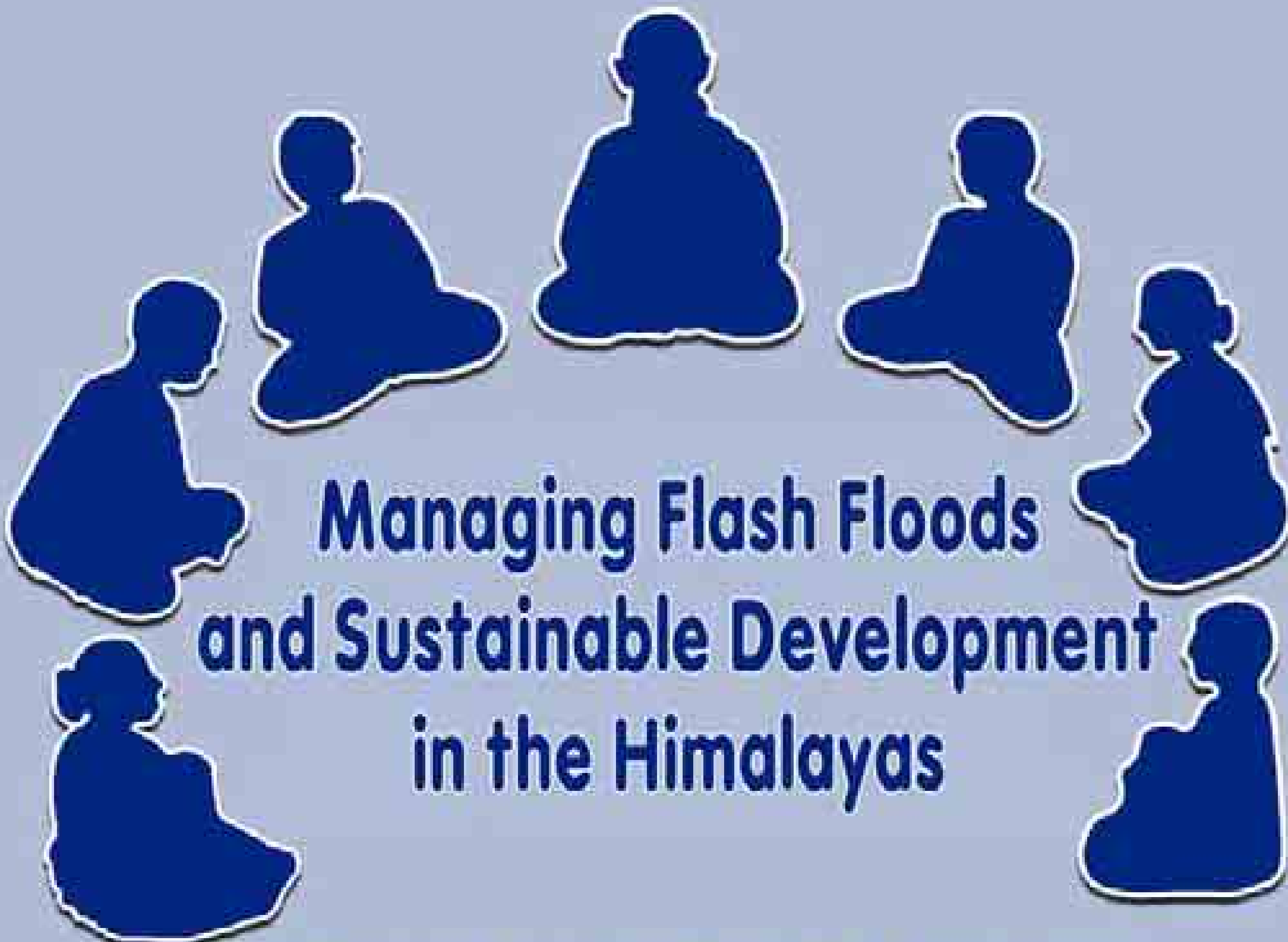

Managing Flash Floods and Sustainable Development in the Himalayas

Report of an International Workshop
held in Lhasa, PRC, October 23–28, 2005

ICIMOD

Partnership Platforms 3/06

About the Organisations

The International Centre for Integrated Mountain Development (ICIMOD) is an independent 'Mountain Learning and Knowledge Centre' serving the eight countries of the Hindu Kush–Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and the global mountain community. Founded in 1983, ICIMOD is based in Kathmandu, Nepal, and brings together a partnership of regional member countries, partner institutions, and donors with a commitment for development action to secure a better future for the people and environment of the extended Himalayan region. ICIMOD's activities are supported by its core programme donors: the Governments of Austria, Denmark, Germany, Netherlands, Norway, Switzerland, and its regional member countries, along with over thirty project co–financing donors. The primary objective of the Centre is to promote the development of an economically and environmentally sound mountain ecosystem and to improve the living standards of mountain populations.

The World Meteorological Organization (WMO) is the specialised agency of the United Nations system responsible for monitoring and forecasting the state of the world's atmosphere, climate and water resources. In the field of freshwater, its stated aim is "to apply hydrology to meet the needs for sustainable development and use of water and related resources; to the mitigation of water-related disasters; and to ensure effective environmental management at national and international levels."

The Organization has its origins in the 1860s and operates on the basis of cooperative action by the National Meteorological and Hydrological Services of its member countries and territories, 190 in 2006. While WMO's principal contacts are with the National Meteorological and Hydrological Services of countries, its collaborative work embraces joint projects with many other intergovernmental and non-governmental organizations and regional bodies. It receives support from a wide range of donor institutions and countries. This also involves participation in many high-level intergovernmental meetings and programmes. Whether at the local level or intergovernmental level, WMO's aim is to help countries develop the knowledge base that they need to manage their water resources and combat the threats of flood and drought.

The China Meteorological Administration (CMA) is a public service agency, which is directly affiliated to the State Council of the People's Republic of China. CMA has been responsible for organizational and operational management of the national meteorological services as a whole. An integrated atmospheric observation system has been set up in China, incorporating sky-, space- and ground-based subsystems, covering relatively complete weather elements, including geographically balanced station sites. CMA's meteorological service system consists of weather forecast, climate prediction, weather modification, drought and flood monitoring and forecasting, thunderstorm and lightning prevention, agro-meteorology and eco-meteorology, climate resource exploitation, and others. CMA is a leading body in China for activities with regard to the Intergovernmental Panel on Climate Change (IPCC), having conducted a series of researches on climate change, its impacts and response strategies. CMA has been in bilateral cooperation and exchanges in the field of meteorology with over 160 countries and regions. China is a member state of the World Meteorological Organization (WMO).

Managing Flash Floods and Sustainable Development in the Himalayas

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Editors
Xu Jianchu, Mats Eriksson, Jacob Ferdinand, and **Juerg Merz**

International Centre for Integrated Mountain Development (ICIMOD)
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Editorial Team
Greta M. Rana (Consultant Editor)
A. Beatrice Murray (Senior Editor)
Dharma R. Maharjan (Technical Support and Layout Design)

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The affiliation and professional positions of the various participants were those current at the time of the meeting.

foreword

Flash floods are severe flood events that occur with little or no warning. They are triggered by extreme cloudbursts, glacial lake outbursts, or the failure of dams – whether man-made or caused by landslides, debris, ice, or snow.

The frequent occurrence of flash floods within the extended Himalayan region poses a severe threat to lives, livelihoods, and costly infrastructure both within the mountains and downstream. The hardest hit are the socially most vulnerable – the poor, women, and children – who often can only find places to live in floodplains or other vulnerable areas. Lack of communication and transportation will often mean that a flash flood event is not known to the outside world; and that injured people do not have access to medical facilities.

Despite their frequent, and likely increasing, occurrence within the Hindu Kush-Himalayan region, there is little recognition of the higher risk that flash floods pose to human life and livelihoods in comparison with the more regular riverine floods that build up over days when there is heavy rainfall upstream. The tendency for flash floods to carry with them much higher debris flows with consequent higher damage to hydropower stations, power lines, roads, bridges, buildings, and other expensive infrastructure is also not widely appreciated. The result of this low awareness has been that little attention is paid to disaster preparedness and response at the policy or operational level in most of the countries in the region.

ICIMOD has been working together with partners from our regional member countries in preparing an inventory of glacial lakes and glacial lake outburst floods, hazard mapping, and disaster management for the past two decades. The frequency of flash floods in particular appears to be increasing. Climate change is causing glacial lakes to grow and burst more rapidly. Many of these flash floods, and others caused by extreme cloudbursts, are transboundary in nature – starting in one country and ending in another.

To identify better the nature of the problems and potential mitigation measures that can be taken to address flash floods, ICIMOD, in collaboration with the China Meteorological Administration (CMA) and the World Meteorological Organization (WMO), organised the 'International Workshop on Flash Floods and Sustainable Development in the Himalayas' in Lhasa, PR China, from October 22 to 29, 2005. There was active participation from ICIMOD's eight regional member countries and from international experts. The workshop presented up to date knowledge about the management of flash floods in each country, explored the possibility for forecasting and early warning, and discussed the importance of community-based disaster reduction management. This publication presents the findings and results of the workshop.

The essence of the discussions and conclusions reached during the workshop was summarised in the 'Lhasa Declaration for Flash Flood Management'. The Declaration, which is contained in this report, provides important guidance for flash flood management, not only for the Himalayan region, but also for the world as a whole. For example, it has already provided important input to an international workshop on flash flood management held in Costa Rica in March 2006.

In addition to the importance of targeting flash floods on a national level, the transboundary nature of the hazard was highlighted during the workshop. Participants called for greater regional cooperation in early warning and data sharing in flash-flood prone areas of the Himalayan region.

We would like to thank the Government of Norway and the USAID Office of US Foreign Disaster Assistance (OFDA) who supported the workshop and thus helped to set the baseline for future activities. As a regionally based organisation, ICIMOD together with our national partners will continue the work on flash flood management and support the building of capacity at the local community as well as national levels. We are committed to help improve the management of flash floods, and reduce the negative effects of floods and other disasters, in the Himalayan region. We hope that this publication will serve to increase awareness and understanding of flash floods management in the Hindu Kush-Himalayan region, especially among those concerned with developing and implementing policies related to disaster management in general, and flash floods in particular.

J. Gabriel Campbell
Director General
ICIMOD

executive summary

The International Workshop on Flash Flood Management and Sustainable Development in the Himalayas that took place in Lhasa in October 2005 was a very important meeting. Internationally it was perceived to create a linkage between an earlier conference on flash floods that had taken place in Hyogo, Japan, earlier that year; the Asian Conference for Disaster Reduction that took place in Beijing in September 2005; and a later meeting in Costa Rica in March 2006 on Flash Flood Forecasting; but it would be mistaken to see it only as a regional link in a series of workshops on flash floods.

The Lhasa workshop provided a voice to the hydrologists and meteorologists of the Himalayas – a contiguous mountain chain of rugged and dangerous terrain, vast expanses of glaciers, and numerous glacial lakes, and origin of the headwaters of all of Asia's mightiest rivers. In terms of flash floods in the Himalayan region, this workshop had many important issues to address, and it did.

Structurally organised around a template for state-of-the art reports from the eight countries of the region – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – the workshop examined the situation in each of these countries, the enormity of flash-flood disasters in the past, and institutional structures and environmental and socioeconomic measures to ensure that such events are not quite as devastating in future.

The workshop taught us many things; among them was the lesson that communities at risk have to be involved from the very onset. Plans and policies from the centre only, no matter how sound they are on paper or how skilled the proponents in central institutions, can fall apart once disaster breaks if local communities are left outside the circle of planning.

The Himalayan region is one of the poorest in the world in monetary terms and in terms of economic development on the ground. Added to this, with the mightiest of wills, even the richest governments in the region are faced with almost overwhelming odds against the unbending terrain. To live in mountains like these is to live at risk, and flash floods are only one of these risks. This Partnership Platforms volume will inform you about the cost of the risks in relation to flash floods in terms of loss of life and livelihood – when mountain people have to see, time after time, the small assets, earned painstakingly over a lifetime, washed away.

This small volume is timely. It gives the salient details of where the hydrology and meteorology departments of the eight countries are today in their flash-flood mitigation efforts. It discusses their future policies and plans and their attempts to bring their forecasting and warning systems abreast of developments at the turn of the 21st century. It casts an eye on the trends in terms of relief and reconstruction, where the many experts gathered in Lhasa saw lacunae in planning, policies, and actions after the events. More and more, too, we see the experts moving towards the opinion that flash floods are not only the responsibility of governments, but rather that such disasters have many stakeholders – the communities at risk, the private sector involved in infrastructural development, and all those involved in one aspect or another of development and in training human resources to meet the challenges of tomorrow.

The workshop was clearly structured into six sessions and a concluding programme. Succinct conclusions and recommendations were derived from the first five to be re-presented in the final (sixth) session. It is in this session that the pertinent points are re-stated, adding weight to the conclusions and recommendations and the Lhasa Declaration, which gives a unified 'voice' to the participants from organisations throughout the Himalayan region.

acronyms and abbreviations

ADPC	Asian Disaster Preparedness Centre
AKRSP	Aga Khan Rural Support Programme
bcm	billion cubic metres
CAS	Chinese Academy of Sciences
CBDP	community-based disaster preparedness
CMA	China Meteorological Administration
FEMA	Federal Emergency Management Agency (US)
GIS	geographic information system
GLOF	glacial lake outburst flood
HKH	Hindu Kush-Himalayas/n
ICIMOD	International Centre for Integrated Mountain Development
NOAA	National Oceanic and Atmospheric Administration
NGO	non-government organisation
OFDA	Office of Foreign Disaster Assistance (US)
TAR	Tibet Autonomous Region
TDRM	total disaster risk management
USAID	United States Agency for International Development
USGS	United States Geological Survey
VSAT	very small aperture terminal
WHEM	Water, Hazards and Environmental Management (ICIMOD)
WMO	World Meteorological Organization
US	United States

Mountain people are vulnerable to flash floods and climate change

contents

introduction to the workshop

Flash Floods in the Himalayan Region

The Himalayas form one of the youngest mountain ranges on earth. They are still tectonically very active with ongoing uplift leading to physical implications such as fragile bedrock, steep slopes, and a high rate of soil erosion. These facts, in combination with the climatic preconditions of intense rainfall, make natural hazards such as floods and landslides omnipresent conditions for mountain people in this region. Intense seasonal precipitation in the central and eastern Himalayas during the monsoon months (June to September), and in the western Himalayas during winter, triggers various types of natural hazards in different elevation zones. Snow avalanches and glacial lake outburst floods predominate at very high elevations (>3500 metres above sea level), while landslides, debris flows, and flash floods are more common in the middle mountains (500-3500m). Riverine floods are the principal hazards in the lower valleys and plains. During extreme weather events, the consequences can be disastrous. Hundreds of lives and billions of dollars worth of property and investment in high-cost infrastructure are lost in the region every year due to landslides, debris flows, and floods, along with the destruction of valuable agricultural land.

Amongst the most devastating events are flash floods. Because of their rapid occurrence, little warning can be given about their imminence and people are caught off guard. In addition, flash floods carry large quantities of water and sediment and produce flood waves of unusual magnitude. The processes that lead to flash floods – cloudbursts, glacial lake outburst floods (GLOFs), failure of man-made and natural dams, and possibly rapid melting of snow and ice – are difficult to predict, making flash floods themselves very unpredictable. In addition, the processes are often combined, increasing the complexity of the problem of prediction. It is argued that flash floods cannot be predicted, but that their impacts need to be reduced through efficient early warning systems.

Many Himalayan rivers originate from glaciers. The glaciers in the Himalayas have been retreating since the climatic period of the Little Ice Age in the late 19th century, and thereby the proglacial lakes located between the glacier tongues and the frontal moraine ridges have increased drastically in size. Glacial retreat and increases in the size of glacial lakes have accelerated during the 20th century, and thereby increased the risk of GLOFs. Bhutan, China, Nepal, and Pakistan have all suffered a number of GLOF events. GLOFs are usually caused by the melting of ice-cored moraine dams and/or by water filling the moraine-dammed lakes to the point at which the moraine ridges can no longer resist the pressure; but they can also be triggered by ice avalanches and rock falls – which in turn can be triggered by earthquakes. The resultant floods of water and debris may be several orders of magnitude greater than normal summer high flow.

Landslides and debris flows, released by torrential rain or seismic activity, often cause ephemeral dams across river courses which result in the impoundment of immense volumes of water. Subsequent overtopping of, or breaking through, the earth dam will result in landslide and debris outburst floods, events similar to GLOFs. Although these phenomena are well known to local people, they are sudden and unpredictable and may cause serious loss of life and much damage to property.

All these flash floods represent challenges to disaster management, although they cannot be ignored by water resource management systems either. Flash floods in the Himalayan region have devastating consequences and create havoc in river basins. These floods have destroyed bridges, settlements, and agricultural land along river banks and have caused severe soil erosion, resulting in heavy concentrations of sediment in the rivers. For mitigation efforts to be successful, strong cooperation, trust, and confidence are needed locally and nationally, as well as in a transboundary context.

ICIMOD's Role

The International Centre for Integrated Mountain Development (ICIMOD) has been involved in promoting awareness of mountain hazards since its inception in 1983. A glance through its technical publications from 1984 to date supports this statement. Its first occasional paper was on erosion and sedimentation (Carson 1984); in1986 GLOFs and mountain risk engineering were the focus of another occasional paper (Ives 1986). Much work has been carried out by ICIMOD on watershed management and hydrology.

The ICIMOD integrated programme on Water, Hazards and Environmental Management (WHEM) was established to contribute directly to the strategic outcome 'decreased physical vulnerability within watershed and regional river basins' with a vision of 'a safer and just mountain habitat for all'. WHEM's overall goal is to share information and knowledge on water, hazards and ecosystemic health and to promote secure environmental services in the Himalayan region through regional collaboration. The WHEM programme has three Action Initiatives: 1) AI 3.1: Water and Floods; 2) AI 3.2: Climate Change and Local Responses; and 3) AI 3.3: Environmental Services. The greater Himalayan region is the source of eight major rivers – the Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Yangtze, and Yellow River – that downstream serve almost half of the world's population. Environmental services in the Himalayas benefit both upstream and downstream people, directly or indirectly, and are obtained from mountain ecosystems. These services include providing food, fuel, and medicine; regulating water, local climates, and floods; and cultural services that directly affect people as well as support services that are needed to maintain the other services. From an overarching perspective, WHEM, as an integrated programme, attempts to address the continuum of ecosystem, livelihoods, and governance at local level, and policy and markets at national and international level, in the vulnerable mountain context. The cumulative impact of human activities in mountain habitats has already had a major impact on the capacity of mountain ecosystems to continue to provide these services. Current trends in population and consumption growth suggest that competition for these diminishing resources and services will become more intense and will frequently require trade-offs between alternative ecosystem goods and services among different stakeholders on different scales. The WHEM programme strives to develop an ecosystem and river basin approach to integrated water resource management (IWRM) and community-based disaster risk management (CBDRM) as coping strategies for mountain environmental and global climate changes through regional collaboration.

WHEM developed a three-phase concept for the programme on flash floods. In the initial phase, the focus was on documenting past flash flood events and identifying and preparing inventories for areas vulnerable to flash floods through the preparation of structured country reports prepared by focal teams in each country of the HKH region. The idea behind these reports was to present them at a regional workshop and thus set a baseline for planning phases 2 and 3. This is the workshop that is the subject of this publication.

The decision to hold the 'International Workshop on Flash Floods and Sustainable Development' in 2005 can be seen as the result of a logical progression in ICIMOD's journey of enquiry and knowledge on the Himalayas, starting with its first publications and continuing to the present day.

The Lhasa Workshop

The 'International Workshop on Flash Floods and Sustainable Development' was held by ICIMOD together with the China Meteorological Administration (CMA) and the World Meteorological Organization (WMO) in Lhasa from 22nd-29th October 2005. The workshop was sponsored by the Government of Norway and the Office for Foreign Disaster Assistance (OFDA) of the United States Assistance for International Development (USAID). This workshop is the subject of this publication.

Fifty-five participants attended the workshop, representing organisations from the Himalayan region and the international scientific community. For one week, flash floods in the Himalayan region received specific attention. The strong representation from governments, non-government organisations (NGOs), hydrologists, meteorologists, disaster specialists, generalists, donors, media people, and people from the private sector was an optimistic sign that the topic would receive a holistic approach.

One of the purposes of the workshop was to promote a proposal for a project targeting the management of flash floods; a concerted initiative on flash floods with certain goals in mind: namely, empowering individuals, communities, and institutions threatened by flash floods in the Himalayan region to act in a timely and appropriate manner in order to reduce the risk of personal injury, loss of life, and damage to the fragile environment and economy. In addition, the workshop was meant to be a call for attention to the uncertainty mountain people face from flash floods as a result of physical vulnerability and climate change in the Himalayas. It was also a start-up workshop for the three-phase process already discussed above.

The most central inputs to the workshop were the eight country reports, one from each of ICIMOD's member countries: Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. The purpose of the studies was to start-up a flash flood event inventory and an assessment of how each country in the region addresses the problem: community awareness and preparedness, hazard control, forecasting and warning systems, the institutional framework, policies, strategies, and plans.

The structure of the technical workshop followed the structure of the country reports. It consisted of six sessions, one each on the following themes: flash flood risk management assessment in the region; community awareness and preparedness; hazard control; flash flood forecasting and warning; institutions, policies, and strategies; and towards better flash flood risk management in the region.

The workshop complemented and built directly on a number of international conferences and workshops and their outcomes, addressing natural disasters and their mitigation. Among these international conferences and workshops are the Hyogo Framework for Action 2005-2015 and the Asian Conference on Disaster Reduction held in Beijing, China, from 27-29 September 2005 (Beijing Action for Disaster Risk Reduction in Asia). In addition, the workshop specifically built on the outcomes of the International Workshop on Flash Flood Disaster Mitigation in Asia – Understanding of Current Situation and Future Subjects, held 28 February to 4 March 2005. A follow up to the process came at the International Workshop on Flash Flood Forecasting from March 13-17 2006 in Costa Rica.

The Publication

This Partnership Platforms publication is a synthesis report of the workshop summarising the proceedings and discussions. It is divided into three parts. This Introduction is followed by a detailed summary of the technical workshop. Seven of the eight country reports (Bhutan did not participate in the workshop due to logistical problems) were presented by the authors in the first session of the workshop. The overview of the studies is also included here in the summary of the first session. The third section of this publication provides the outcome of the concluding session, the Lhasa Declaration, and conclusions and recommendations. Additional information is provided in the annexes. Annex 1 provides the keynote paper on Approaches to Flash Flood Management in Mountain Regions given by Professor Manfred Spreafico of the Swiss National Hydrology Survey during the inaugural session; Annex 2 contains summaries of the country reports; Annex 3 presents an overview of the group sessions, which provided a planning opportunity for the next phases; and Annexes 4 and 5 the programme and list of participants respectively.

The supplementary CD-ROM contains a wealth of material from the workshop that could not be included in this Partnership Platforms summary: the eight country reports in full; the PowerPoint presentations given at the workshop; an account of the field trip; and 564 photographs from the workshop and field trip.

Together, this Partnership Platforms publication and the CD-ROM provide a comprehensive set of outcomes from the Lhasa conference.

the technical workshop

Inaugural Session

The inaugural session of the workshop took place on Sunday the 23rd of October 2005 and was chaired by **Dr. Xu Jianchu** of the International Centre for Integrated Mountain Development (ICIMOD). Dr. Xu Jianchu welcomed the Vice-Governor of the Tibet Autonomous Region (TAR) of the People's Republic of China, **Mr. Duoji Zeren,** who gave the inaugural address.

Mr. Duoji Zeren welcomed all the participants to Lhasa and said that he was delighted to see so many well-known experts both from home and abroad at the workshop. He gave the participants a brief on TAR. Situated in South West China it covers an area of 1,228,000 sq.km and has a population of approximately 2,700,000. It constitutes the major component of the Qinghai-Tibetan plateau, also known as the 'Roof of the World'. High peaks and deep valleys, complex geological structures, changeable weather, various climates, and frequent natural hazards make it a focus of attention from the international scientific community.

Mr. Duoji Zeren informed the participants that flash floods are among the main natural hazards in TAR, occurring mostly in summer as a result of excessive rainfall. Other factors include collapse of lake dykes and landslides, which usually bring huge losses in terms of life and property as well as serious social and economic losses.

Mr. Duoji Zeren considered it imperative that improved meteorological services be provided for the prevention and mitigation of increasingly serious natural hazards. He stated that, with support from the central government and great efforts over many years, noticeable achievements had been made and, more recently, measures introduced to control mud and debris flows induced by mountain flash floods; and in addition a plan for flash flood prevention and control in TAR was being formulated in order to implement the national policy for sustainable development and the Grand West Development Strategy.

Mr. Duoji Zeren pointed out that the workshop would provide them with a good opportunity to exchange experiences and to learn from each other. Through such forums, flood formation mechanisms could be improved and awareness about the importance of monitoring, forecasting, and early warning systems, as well as about sustainable economic development in mountainous regions, greatly enhanced. The next welcome address was given by **Dr. Xu Xiaofeng,** Vice Administrator of the China Meteorological Administration (CMA). Dr. Xu Xiaofeng mentioned that Asia is a region prone to frequent natural disasters every year, and China, due to geographical and climatic conditions, is very much prone to flash floods and mountain-related disasters.

Chinese scientists have carried out observational studies on atmospheric circulation over the Himalayas. The observations operated by the weather station at CMA will help improve human understanding of the climate and weather-induced disasters, and consequently improve the accuracy of forecasting.

Dr. Xu Xiaofeng stated that CMA has made great efforts in the field of disaster management and mitigation and has been involved with the activities initiated by relevant international organisations, including ICIMOD. Nowadays, natural disaster warnings had become a focus of attention throughout the world communities. Dr. Xu Xiaofeng hoped that the workshop would enable participants to understand the mechanisms of Himalayan floods and would draw the attention of stakeholders and enhance the capacity to respond effectively to flash floods, human impact, and climate change – and improve natural disaster management and mitigation. Following the address by Dr. Xu Xiaofeng, **Dr. J. Gabriel Campbell,** Director General of ICIMOD, took the floor. Dr. Campbell outlined the reasons for holding the workshop in Lhasa, Tibet: the mountain landscape; cultural heritage; the hospitality and warmth of the people; and the unprecedented investments made to transform its economy and living standards. Other reasons included its handicrafts and products and to seek inspiration and to breathe the clean air.

Dr. Campbell reminded the participants that water is the source of all life and the engine of agricultural and industrial economic growth, and, at the same time, it is also the source of death, destruction, and reversal of economic growth and well-being for the poor and vulnerable in mountain terrains. This vulnerability is created by the geologically active nature of the Himalayas, the variable climatic conditions, and humanity's own constructions. Lack of mechanisms and agreements for early warning, lack of information sharing, and lack of adequate mitigation measures are deterrents.

ICIMOD, as an institution, was established to improve the livelihoods and ecosystems in the region.Its strategy is based on reducing people's physical, economic, and social vulnerability and facilitating information exchange, capacity, and cooperation in the region. To complement technical measures, this approach is based on working with all the different stakeholders, particularly the local communities, to develop community-based disaster management strategies that are built on local knowledge and which are sustainable.

Dr. Campbell called on the government of TAR to take on a leadership role before the next mountain tsunami occurs, as it is the source of headwaters in the region. He stated that the workshop provided an excellent opportunity for bringing together competent and committed representatives from ICIMOD's regional member countries, long-term partners, and experts. Most importantly, CMA, with its distinguished representatives from Beijing, TAR, and the Foreign Affairs' Office could make a real difference in the future security and development of the Himalayan region.

Mountains are not easy places to live; there are many risks and hazards

After a flash flood

The next address was given by **Dr. Wolfgang Grabs,** Chief of the Water Resources Department at the World Meteorological Organization. Dr. Grabs mentioned that the reason for the gathering was a serious one: flash floods are sudden onset disasters with high killing potential. He stated that much had been achieved in the improvement of monitoring and responses to riverine floods, but flash floods remained a challenge to forecasters, disaster managers, and the general public. This called for an integrated basin-wide flood management concept involving the enhanced forecasting performance of national meteorological and hydrological services, improved risk reduction measures, and creating public awareness and adequate preparedness.

Dr. Grabs stated that, at the regional level, exchange of data and information in near real time is essential for improving early warning services. Networking should be a sine qua non between experts and institutions nationally, regionally, and internally, and this is strongly supported by WMO. Thus the workshop provided a unique opportunity and should be fully used for technical cooperation within the region and internationally so that successful national and international flash-flood warning systems could be established.

Following Dr. Grabs' address, a message was delivered on behalf of the United States by Ms. **Katherine Koch,** Director of the Regional Office for South Asia of the U.S. Department of State.

'On behalf of the United States Government, I am pleased to thank the Governments of the People's Republic of China and of the Tibet Autonomous Region, the Chinese Meteorological Administration, the World Meteorological Organization and, of course, our friends at ICIMOD for all of your hospitality and hard work in organising this international workshop on flash flood management and sustainable development in the Himalayan region.

My colleagues from the United States Assistance for International Development's (USAID) Office of Foreign Disaster Assistance (OFDA), the National Oceans and Atmospheric Administration (NOAA), and the Hydrological Research Centre will present techniques, technology, and experience that the United States has acquired to deal with flash floods. We hope these presentations can stimulate fruitful exchange about new efforts in confronting flash floods that will be of value to the people and nations of South Asia as they face the serious challenges and dire consequences of flash floods that so threaten the region.

The inaugural session concluded with a Keynote paper delivered by Dr. Manfred Spreafico of the Swiss National Hydrological Survey on 'Flash Floods in the Context of Disaster Risk Management.' (See Annex 1 for a brief of this paper and the CD-ROM for comprehensive texts and references for this and other sessions.)

The workshop adjourned for the evening. The **technical sessions began on Monday the 24th of October 2005**.

Session 1: Flash Flood Risk Management Assessment in the Region

The Chairperson for the first part of Session 1 was **Professor Cui Peng,** of the Institute of Mountain Hazards and Environment of the Chinese Academy of Sciences (CAS). The second part of Session 1, at which the country reports from India, China, Bangladesh, Pakistan, and Afghanistan, and the regional overview were presented, was chaired by **Mr. Arun Shrestha** of the Department of Hydrology and Meteorology, Nepal. Session 1 opened with a welcome and overview of the programme by **Mr. Jacob Ferdinand** of ICIMOD. Following this, **Dr. Xu Jianchu** of ICIMOD presented an introduction to the flash floods' initiative.

After Dr. Xu Jianchu's introduction, **Ms. Mandira Shrestha** of ICIMOD briefed the workshop on regional floods and early warning systems and introduced the country papers.

Country papers were presented by Nepal, Myanmar, India, China, Bangladesh, Pakistan, and Afghanistan in that order. The authors of the papers were **Nepal, Dr. Arun Bhakta Shrestha** and **Madan Lall Shrestha; Myanmar, Mr. Ye Ni and colleagues; India, Mr.Suresh Chandra; China, Ms. Zhou Li** and **Wan Xiaoming; Bangladesh, Dr.Sazedul Karim Chowdhury; Pakistan, Mr. Shaukat Ali Awan, Mr. Syed Pervaiz Hussain, Mr. Awais Asghar** and **Mr. Akhtar Mahmood** and **Afghanistan, Dr. Pir Mohammad Azizi** and **Mr. Qaseem Naimi**.

Unfortunately, the delegation from **Bhutan** could not attend the workshop due to cancellation of flights from Bhutan and the paper from Bhutan could not be presented by the country author **Mr. Karma Chophel**. (Summaries of all eight country papers are given in Annex 2, and the full texts and figures can be found on the supplementary CD-ROM.) The country reports were followed by a regional overview prepared and presented by **Dr. Juerg Merz** of ICIMOD. A brief of Dr. Merz's presentation is given here as a basis for Session1 so that readers will have an overall picture of the contents of the papers pertinent to the discussions that followed in Sessions 2 to 6.This regional overview can also be found in its entirety on the supplementary CD-ROM.

Introduction to the Regional Overview by Dr. Merz

Dr. Merz explained to the participants that to compile an account of flash-flood events and their management in the Hindu Kush-Himalayan (HKH) region, relevant institutions in all eight member countries of ICIMOD had produced a country report; viz., for Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. The template was provided by ICIMOD, including the description of flash flood events vis a vis riverine floods (Table 1). The overview was a compilation of material from these papers. Dr. Merz commenced his overview by placing flash floods and sustainable development in the Himalayas in context as follows.

The Hindu Kush-Himalayas (HKH) are the youngest mountains on earth and are still tectonically very active, making them vulnerable to hazards that often have disastrous consequences. Intense seasonal precipitation, in the central and eastern Himalayas particularly during the monsoon months (June – September) and in the western Himalayas and the Hindu Kush during winter, triggers a variety of natural hazards in different elevation zones. Snow avalanches and glacial lake outburst floods predominate at very high elevations (>3500 metres), while landslides, debris flows, and flash floods are common in the middle mountains (500-3500 m). Floods are the principal hazards in the lower valleys and plains. During extreme weather events, the consequences can be disastrous. Hundreds of lives and billions of dollars worth of property and investments in high-cost infrastructure are lost in the region every year due to landslides, debris flows, and floods, along with the destruction of scarce agricultural lands. In China, 152,000 people were killed in flash floods during the period from 1950 to 1990, accounting for 67.4% of the total number of deaths from floods during the same period. In Nepal, landslides and flood hazards cause destruction of important infrastructure worth US$ 2.5 million and about 400 deaths annually. In Afghanistan in the year 2005, 362 people were killed or are missing and 192 people were injured as a direct consequence of flash floods. In total about 100,000 people were displaced by these events. Exceptional events can increase these numbers many times over. The Yangtze flood in 1998 for example caused damage costing an estimated US$ 31 billion.

Amongst the most devastating events are flash floods. Due to their rapid occurrence they come at short notice and catch people off guard. In addition, they carry large quantities of water and sediment and produce flood waves of unusual magnitude. The processes that lead to flash floods – cloudbursts, rapid snow and ice melting, glacial lake outburst floods, and failure of man-made and natural dams – are difficult to predict, which makes flash floods themselves very unpredictable. In addition, the processes are often combined to increase the complexity of the problem of prediction. Different authors argue that flash floods cannot be predicted, but their impacts need to be reduced by use of efficient early warning systems.

General characteristics related to flash floods in the HKH

Runoff from the HKH mountain ranges is governed by the seasonal precipitation pattern and the onset of snowmelt. While most of the precipitation in the central and eastern Himalayas occurs during the monsoon season, winter precipitation predominates in the Hindu Kush and the western Himalayas.

On the scale of river basins, floods are largely natural processes and little human impact on the hazard can be expected. On the scale of small sub-catchments to catchments, human activities may have a major impact on flood generation. This is particularly evident in the case of urbanisation, less so in relation to agriculture, and very variable in the case of forests. For flash floods this needs to be considered as they are high intensity-high magnitude events.

Many Himalayan rivers originate from glaciers. These are subject to catastrophic processes that can produce glacial lake outburst floods (GLOFs). Bhutan, China, Nepal, and Pakistan have suffered a number of GLOF events in the past. Causes of such floods include ice avalanches, rock falls, melting of ice-cored moraine dams, and meltwater filling ice-dammed lakes to the point of hydraulic displacement. Earthquakes also trigger such processes. The resultant flow of water and debris may be several orders of magnitude greater than normal summer high flow.

Due to the young geology of the Himalayas and instability of their slopes, the region is prone to recurrent and often devastating landslides. Such landslides and debris flows, released by torrential rain or seismic activity, may cause ephemeral dams across river courses and result in the impoundment of immense volumes of water. Subsequent overtopping of, or breaking through, the earth dam will result in landslide and debris outburst floods, events similar to GLOFs. Although these phenomena are well known to local people, they are sudden and unpredictable and may cause serious loss of life and much damage to property.

The eastern Himalayan region is subject to intense rainstorms or cloudbursts. These are considered to be major factors in the anthropological transformation of the mountains and immediately adjacent plains. Such rainstorms generate flash floods that lead to major cycles of landslides. The resulting transfer of sediment load from the mountains to the plains is much more substantial than in most other regions of the world.

The western Himalayas and the Hindu Kush can receive large amounts of snow during the winter season caused by the westerly disturbances from the Mediterranean. The snow not only affects peoples' livelihoods with avalanches and blocked transport routes, but, in the case of rapid warming in spring, can also lead to flash floods caused by rapid snowmelt.

All these types of flash floods represent challenges to disaster management rather than to water resource management, although they certainly cannot be ignored by water resource management systems. Flash floods in the HKH region have devastating consequences and create havoc in river basins. In many instances, these floods have destroyed bridges, settlements, and agricultural land along river banks and have deposited huge amounts of debris into the rivers with consequent heavy concentrations of sediment. The floods lead further to complex transboundary issues. For mitigation efforts to be successful, strong cooperation, trust, and confidence are needed amongst the countries affected.

Dr. Merz stated that following contextual overviews the reports give descriptions of institutional frameworks, policies, and other relevant information in relation to flash-flood management in the respective countries. He said the structure of the sessions at the workshop followed the structure of the country reports addressing the following topics: flash-flood risk management assessment in the region; community awareness and preparedness; hazard control; flash-flood forecasting and warning; institutions, policies, and strategies; and towards better flash-flood risk management. This first technical session was intended to give an overall assessment of flash-flood management in the HKH region.

Dr. Merz drew the attention of participants to Table 1 which shows that flash floods can occur as a result of cloudbursts or heavy downpours, rapid snowmelt, and artificial or natural dam breaks. Those caused by heavy rainfall occur annually in the HKH; the country reports described 131 events, although these were inconclusive as most countries report only a few. This was thought to be because riverine floods and flash floods are not reported separately. Flash floods occur more frequently than other types, but are the most difficult type to predict in mountainous countries.

Table 1: Features of riverine floods and flash floods		
	Riverine floods	**Flash floods**
Features	• slow water level rise beyond natural channels • reaches peak flow within hours to days • slow recession (within several hours to days) • mostly coinciding with high baseflow levels • medium to long lag times	• rapid water level rise above natural channels • reaches peak flow within minutes up to a few hours • rapid recession (within minutes to a few hours) • often dissipating quickly • not necessarily related to baseflow levels • short lag times
Causes	• prolonged seasonal precipitation of low to high intensity • seasonal snow and glacial melt	• very high intensity rainstorms/ cloudbursts • rapid snow/glacial melt • dam (both artificial and natural) breaks
Associated problems	• inundation	• often carry high sediment and debris loads • very high hydraulic force and herewith erosive power
Frequency	• annually during rainy season	• occasional, any time during the year
Affected areas	• river plains and valleys • local to regional extent • large areas can be affected	• river plains and valleys • alluvial fans • mostly local extent • generally small to medium areas are affected
Issues	• with appropriate technology and measures in place forecasting is easily possible	• very difficult to forecast
Potential mitigation measures	• real-time flood forecasting • community preparedness and awareness • appropriate emergency measures	• early warning systems • community preparedness and awareness • appropriate emergency measures

Flash-flood events

Several events are described in the country reports; they are summarised in Figure 1. Dr. Merz described some of them. In October 2004, flash floods occurred in the Indian state of Assam, around 130 people were feared dead and tens of thousands of people were rendered homeless. The floods were caused by heavy precipitation in the neighbouring state of Meghalaya.On 26 August 2004, a flash flood in the Bagul river, Uttaranchal, India, swept away a tractor with 30 people. The same river marooned Kukroli village. The flood was caused by heavy, incessant rainfall. Another flash flood in Kullu, Himachal Pradesh, India, killed more than 100 labourers in July 2003. Here also heavy and incessant rainfall was to blame. Recent disasters in Nepal included the 1981 flash flood in Lele, the 1993 cloudburst in the Kulekhani

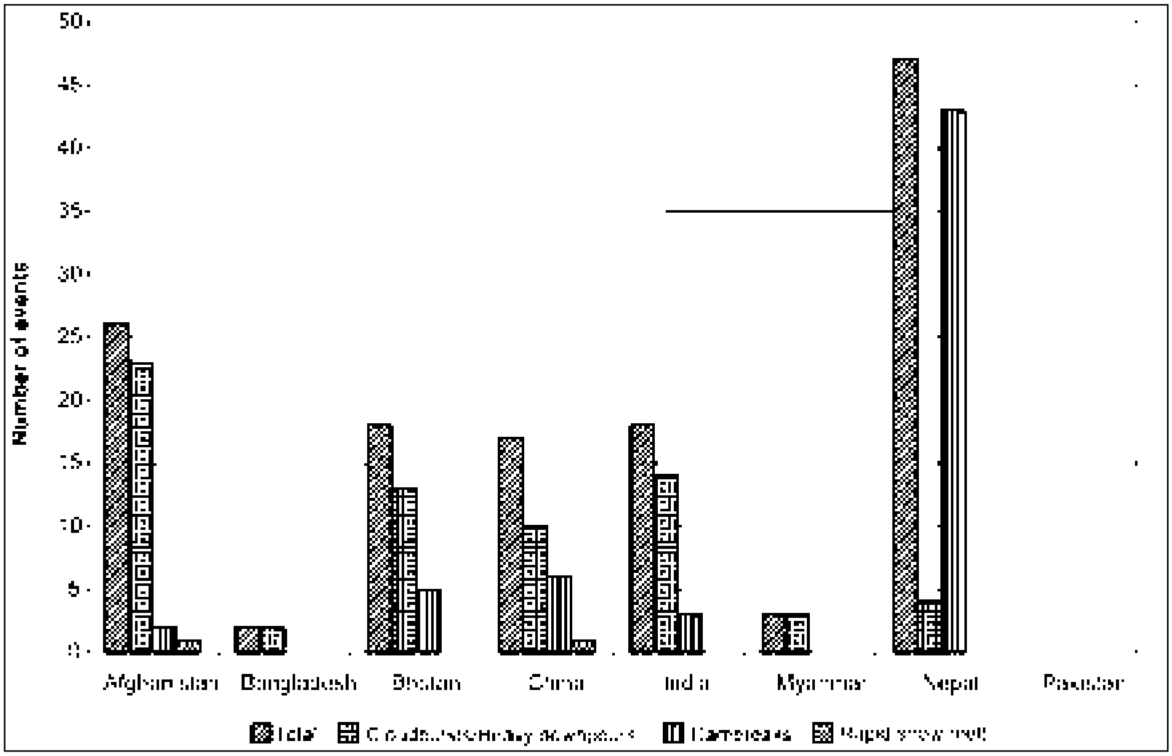


Figure 1: Flash-flood events listed in the country reports sorted according to cause

catchment, and the 1998 Larcha debris flow. In the case of the Lele flood, nearly all the agricultural land was damaged, 27 people died, and more than 48 houses and 7 water turbines were swept away. In Nepal, a cloudburst over the Kulekhani catchment in July 1993 caused several flash floods washing high loads of debris and sediment into the reservoir of Nepal's only storage-type hydropower station, hereby reducing its life by several decades. Fourteen hundred lives were lost and big property losses were incurred. The Larcha debris flow washed away roads, bridges, transmission lines, and 18 houses. In July 2004 severe flash floods affected eastern Bhutan causing the loss of agricultural land, crops, and fruit trees and affecting nearly 1,500 households. During the same event numerous bridges were washed away, irrigation canals were damaged, and a microhydro plant destroyed. Other serious flash floods were observed in Phuentsholing in 2000 when unprecedented precipitation occurred and caused rapid flooding in the Dutekhola and Barsachhu, both tributaries to the Toorsa River. In China, 10 events were reported that were caused by cloudbursts or heavy rainfall. On August 13, 1958, a flash flood occurred in the Kuche River at the south piedmont of the Tianshan Mountain, Xinjiang due to an extraordinary storm. In Kuche City – a famous historic city – more than 5,700 houses collapsed and 507 people died. Myanmar reported three devastating events caused by cloudbursts. The event of April 1987 was particularly destructive. This is because it coincided with the Shwe Settaw Pagoda festival for which market stalls were built along the river banks. These stalls and some temples were washed away in addition to cropland, roads, bridges, and irrigation canals.

Catastrophic events are often caused by dam breaks, affecting both natural and man-made dams. Several events associated with glacial lake outburst floods (resulting from a form of natural dambreak) were reported in the case of both Nepal and Bhutan. These events are believed to be increasing with changing climate. It is feared that increasing temperatures will increase the number of glacial lakes and the size of the existing lakes. This would increase the danger posed by these features. The most recent flash flood due to a break of an artificial dam occurred near Pasni in Balochistan, Pakistan, where a flood caused by a breached man-made dam swept away five villages and killed more than 200 people in February 2005. Though the dam had only been recently built, it breached after days of incessant rainfall. During the event another five dams also breached due to heavy rainfall. At the time of the report preparation, more than 1,000 people were still missing and the exact extent of the disaster was still unknown. In Bhutan, a landslide dammed the Tsatichhu River, a tributary of Kuri Chhu in eastern Bhutan, on 10 September 2003. The lake that subsequently formed behind this dam breached the following year on 10 July 2004 causing some downstream damage. Due to the installation of an early warning system, the Kuri Chhu hydropower project located about 35 km downstream from the lake was saved.

Several flash floods caused by breached landslide dams were documented in southwestern China. In eastern Tibet a huge amount of snow and ice melted as a result of the increasing temperature, which caused a massive, complex landslide that occurred on 9th April 2000 in the upper part of the Zhamulongba watershed. This landslide created a natural dam in the Yigongzangbu River in only eight minutes. No deaths occurred directly as a result of the huge landslide, but it created a condition for upstream inundation as the impoundment filled and this caused downstream flooding when the dam failed. Though the Chinese government spent US $ 7.2 million to construct a spillway through the dam, it did not prevent dam failure because the soil was so loose that the ditches kept widening until the dam broke on 10 June 2000. The landslide dam overtopped and caused extensive flash flooding downstream. According to the Chinese newspapers, several bridges were destroyed by the flood but no injuries or deaths occurred. According to an Indian newspaper, the flash flood was on a scale seldom seen before and resulted in the death of 30 people with more than 100 people missing. More than 50,000 people in five districts of Arunachal Pradesh, India, were rendered homeless. More than 20 big bridges, lifelines for the people, were washed away. The total economic loss was estimated at more than one billion rupees (22.9 million dollars). Also in India, several flash floods occurred after damming of the main river. This includes the July 1970 flash flood on the upper Alaknanda Valley in Garhwal, which wiped out the village of Belakuchi situated on the bank of the Alaknanda River. It also washed away a 7km stretch of road and 15 vehicles and killed about 100 people. The Sutlej Valley in Himachal Pradesh has had four flash floods as a result of cloudburst and landslide debris flow dam failure in the last 12 years. On 29 September 1988, a cloudburst in Soldan stream generated a flash flood that brought a huge amount of sediment to its confluence with the Sutlej River, partially blocking the river and creating a reservoir. The cloudburst washed away 15 houses and an apple orchard: 32 people were killed. The flash flood downstream washed away a 2km stretch of road and a bridge over the national highway. On July 31st 1991 a flash flood occurred in the Maling nallah (stream), a tributary to the Spiti River, in upper Sutlej Valley. The flash flood was caused by a glacial lake outburst in the headwater region on Maling nallah. Vast amounts of sediment generated by the flash flood were deposited at the confluence of the Maling and Spiti rivers. The failure of the temporary dam across the Spiti River was responsible for damage to a road section, a bridge, and farmland downstream.

Events caused by rapid snowmelt were mainly reported in Afghanistan where most flash flood events are caused by a combination of rapid snowmelt and heavy rainfall events. During an event in 2005 in Badakhshan in the Kokcha Amu, 130 people were killed, and 120 km road, about 800 ha of agricultural land, 9 bridges, 5 wells and more than 2,000 houses were destroyed. Another event was reportedly caused by rapid snowmelt and occurred in the Songhuajiang River in China in 1994; this event caused direct economic losses of 17,000,000 RMB (about 2 million US$).

All the country reports expected an increasing trend for flash flood events: some, for example the paper from Nepal, on the basis of the cumulative occurrence of GLOF events. Rising temperatures and subsequent increased melting of glaciers and alpine permafrost are thought to be responsible for this trend. Causes cannot be attributed to many types of flash flood because of lack of records. In 2001 in Nepal, some indication was found of increasing occurrence of extreme precipitation events, although the impact of global climate change on the precipitation pattern is still a subject of heated discussion. In Afghanistan, for example, trends can not be shown as there are no long-term data. In India it appears that flash floods due to cloudbursts and excessive rainfall are increasing in the Himalayan states of Himachal Pradesh and Arunachal Pradesh. In China an overall decrease in the number of deaths in floods is observed, but the proportion of deaths from flash floods has been increasing. This calls for immediate and strong action in improved flash-flood hazard mitigation.

In summary, it can be said that flash floods caused by cloudbursts and heavy downpours are the most frequent type. With increasing temperatures, the number of glacial lake outburst floods is expected to increase. Landslide dam breaks might also increase with an increase in precipitation and increased saturated conditions of steep slopes in the upper parts of rivers. Many artificial dams have reached an age at which they are no longer safe. This mainly includes small-scale dams that are not under more or less constant supervision. Most of the countries in the region, however, do not have the means to ensure that these dams are either decommissioned or rehabilitated.

Flash-flood management and mitigation

Dr. Merz stated that in the eight member countries flash-flood management went hand in hand with riverine flood management, as the impact of a flash flood is often very similar if not the same as that of a riverine flood. The major differences rest in their triggering mechanisms and their speed of occurrence and rapid recession and dissipation (see Table 1). In general it can be said that in the region flood management in general, and flash-flood management in particular, are still in their infancy. None of the countries places particular emphasis on flash floods, with the exception of the People's Republic of China. Wide differences are found between the different countries in the region in different aspects of flash-flood management.

Institutional framework

Institutional frameworks vary. Afghanistan is only just building up the necessary institutions in a number of fields, disaster and flood management among them. In Afghanistan, a Department of Disaster Preparedness has been established and is in the process of formulating a National Disaster Preparedness Strategy. The approach to flood management needs to be intersectoral and interdepartmental. A number of ministries support these efforts, but there is no mention of local government organisations or the involvement of any non-government organisations.

On the basis of the Standing Order for Disaster of the Government of Bangladesh, the overall supervision for disaster management rests with the Bureau of Disaster Management for rescue, evacuation, and rehabilitation. The National Disaster Management Council and the Inter-Ministerial Disaster Management Coordination Committee ensure coordination of disaster-related activities at the national level. The respective district and local disaster management committees coordinate the district and local-level activities. The different ministries, divisions, departments, and agencies prepare their own action plans in respect of their responsibilities under the standing orders for efficient implementation.

The paper from Bhutan indicates that there is no comprehensive disaster management plan. However, various agencies of the Royal Government of Bhutan have responded well on an ad hoc basis in cases of disaster. The main agencies that are involved in disaster mitigation are the National Environment Commission, the Department of Geology and Mines, and the Department of Energy. The Department of Local Governance has been entrusted with setting up a national-level disaster management committee. A disaster relief fund entitled 'His Majesty's Relief Fund' has also been proposed with seed money from the Royal Government and contributions from other sources.

In China, a National Flash Flood Hazard Prevention Team has been established led by the State Flood Control and Drought Relief Headquarters with a membership of representatives from the Ministry of Water Resources, the Ministry of Land Resources, the China Weather Bureau, the Ministry of Construction, and the State Environmental Protection Administration of China. This team focuses on discussing and solving important issues, coordinating departments, and implementing relevant policies. Each province has established a flash-flood hazard prevention command institution which is led by the leaders of the provincial government and is constituted of representatives from relevant agencies. Further institutions involved in flash-flood management are to be established at local level in future.

In India, flood management is organised at central, state, and local level. The central level provides guidance to the states, and the states implement flood management at the field level. In addition to relevant ministries, commissions, and technical support agencies, the government has created river boards for major rivers such as the Ganga and Brahmaputra. A National Committee on Disaster Management has been established under the Prime Minister to review disaster situations in the country. At the state level, a Relief Commissioner organises flood management in collaboration with government and non-government organisations.

Myanmar's flood management is mainly at central level with the involvement of various departments. The Department of Meteorology and Hydrology is responsible for flood forecasting and warning. The Irrigation Department takes care of structural mitigation measures such as dams, reservoirs, and embankments. The Relief and Resettlement Department holds disaster management training courses, and the Myanmar Red Cross Society is in the process of establishing disaster prevention and reduction policies.

Nepal has a Central Natural Disaster Relief Committee chaired by the Minister for Home Affairs; its membership includes two more ministers, the secretaries of most ministries, different director generals, and representatives from the armed forces, police, scouts, and the Nepal Red Cross Society. There are also provisions for regional, district, and local natural disaster relief committees. In addition, there is a Department of Water Induced Disaster Prevention which currently implements the Disaster Mitigation Support Programme with the objective of strengthening the capabilities of His Majesty's Government of Nepal and communities in coping with water-induced disasters. Other departments and non-government organisations are involved in soil conservation and watershed management, hydrometeorological monitoring, monitoring of glacial lakes and outburst flood mitigation, study of disasters, information dissemination, and relief, rescue, rehabilitation, and reconstruction activities.

Flood management in Pakistan involves several federal and provincial organisations, including the agencies involved in forecasting (Provincial Irrigation and Drainage Authority, Water and Power Development Authority, Flood Forecasting Division of the Pakistan Meteorological Department), flood mitigation (Federal Flood Commission), and flood relief measures (provincial relief organisations, Pakistan Army, Emergency Relief Cell). An important position in the process of forecasting is that of the Commissioner for Indus Waters who is the link between the Indian authorities upstream on the tributaries of the Indus River and the flood forecasters in the Pakistan Meteorological Department.

Policies

Dr. Merz briefed the workshop on current policies relevant for flash flood management; selections from this section are given below. In most countries of the region flood management policies are in the process of development. Flash floods are considered to be part of flood-management policies with the exception of China, where a number of policies are indirectly related to flash-flood management and a plan is in process to come up with policies focusing on flash floods. Laws related to construction stipulate flash-flood assessment. Land-use changes from agricultural land to more forested land are encouraged in different land-use policies at national and provincial level.

In Bangladesh, floods and flood management became an issue of national importance quite early on. The Bangladesh country paper discusses the different studies and policies that led over the years to the National Water Plans in 1987 and 1991, respectively. The Flood Action Plan, triggered by severe floods in 1987 and 1988, introduces innovative ideas like the concept of controlled flooding instead of full flood control for rural flood plains. In 2003 a National Water Management Plan was approved by the government.

Severe floods in 1954 led to the first policy statement on floods in India. In 1957 a high-level committee pointed out that absolute immunity from flood damage is not attainable, and it recommended an integrated approach with flood-plain zoning, flood forecasting and warning, and so on. The most comprehensive flood policy was completed in 1980 by the National Floods' Commission.

No direct flood-management policy is mentioned in the country paper from Myanmar.

In Nepal, water-induced disasters receive high priority. According to Nepal's country paper, the promulgation of the Natural Calamity (Relief) Act in 1982 was a landmark in systematic disaster management in Nepal. It has been amended twice since then and has provided a framework for disaster mitigation in the country, although it only describes the duties and responsibilities of the Ministry of Home Affairs, and it is accepted that there should be involvement from other disaster management agencies. The Tenth Plan (2002 to 2007) underlines improved prevention, mitigation, and reduction of natural disasters. By 2027 Nepal hopes to reduce social and economic losses from water-induced disasters to the level of those in developed countries.

The national water policy of Pakistan is in the process of formulation. The first priority is to use the water available in an equitable and judicious manner. Land-use planning on the Indus plains is also included to ensure that settlements are not endangered by flood events.

Strategies and Action Plans

The Afghan government and its Department of Disaster Preparedness, in particular, are formulating a National Disaster Management Strategy.

The strategy for flash-flood and riverine flood management in Bangladesh explicitly includes collaboration with upstream countries in the exchange of data and for joint assessments.

According to the country paper, Bhutan is working on a national disaster management strategy under the guidance of the Department for Local Governance. In addition, the dzongkhags (districts) are to be mandated to draw up plans for emergency prevention and mitigation by 2006.

In China, flash flood management follows the principles of harmonious co-existence of man and nature, reliance on prevention, a combination of prevention and control, a combination of non-structural measures and structural measures, and finally the full use of existing resources to avoid repeated construction. The country plans to reduce the flash-flood hazard by 2020.

In India, four major strategies have been adopted over the years: a) modification of floods, b) modification of the susceptibility to floods, c) modification of the impacts of floods, and d) relief in the event of flood disasters. Non-structural methods such as flood-plain management, flood proofing, flood forecasting and warning, disaster preparedness and response planning, flood fighting, flood relief and rehabilitation, and flood insurance are used.

In Myanmar the flood management strategy is targeted at reducing the risks of death and injury among the population; secondary aims include reducing damage and economic loss inflicted on the public sector.

Nepal prepared a National Action Plan for Disaster Management in 1994. This plan has been revised recently and was presented to the World Conference on Disaster Reduction in Kobe, Japan, in January 2005. The action plan includes a disaster response action plan matrix, a disaster preparedness action plan matrix, a disaster reconstruction and rehabilitation action plan matrix, and a disaster mitigation action plan matrix.

Hazard control

After the Tsatichhu landslide dam was formed in Bhutan, the hazard of a potential break has been continuously controlled by lowering the water level of the lake behind the dam. More generally, Bhutan is trying to keep its extensive forest cover at the current level with the firm belief that this is the best way of protecting the downstream areas inside and outside the Bhutanese boundaries from flooding and destruction.

China is embarking on a major structural, hazard-control campaign by improving flash-flood, debris flow, and landslide control through diversions and dams. In addition reservoirs are closely inspected for potential hazards. There are plans to reinforce or decommission 17,000 small, defective and dangerous reservoirs. Water and soil conservation measures applying hard engineering as well as bio-engineering approaches are planned on a larger scale.

In Nepal, great efforts have been made to carry out studies related to glaciers and glacial lakes. The Department of Hydrology and Meteorology is responsible for carrying out these studies in collaboration with the Water and Energy Commission Secretariat and the Department of Water Induced Disaster Prevention. ICIMOD is also involved in glacial lake outburst flood studies across the region. So far there is only one example of GLOF hazard mitigation in Nepal, the Tsho Rolpa GLOF Risk Reduction Project. In terms of catchment management, the Department of Forests and the Department of Soil and Water Conservation carry out reforestation and afforestation activities in the denuded hills, scientific management of the forest resources in the Terai as well as in the hills, and soil and water conservation work, with the aim of mitigating natural disasters such as soil erosion, landslides, and floods caused by deforestation throughout the country. Hazards are being mapped, e.g., The Department of Mines and Geology is preparing a landslide inventory and the Department of Hydrology and Meteorology and ICIMOD are preparing a map of flood-prone areas.

Forecasting

Dr. Merz stated that flash-flood forecasting needs to be approached differently from riverine flood forecasting. While there is generally ample time to forecast the flood wave of a riverine flood by means of overall meteorological patterns, for flash floods a good understanding of the local precipitation pattern is essential. Often flash floods are associated with rainfall density during thunderstorms in spatially limited areas, and this is difficult to forecast.

Afghanistan has no forecasting system. However, a programme funded by the World Bank is reconstructing 167 hydrological and 30 meteorological stations. The Civil Aviation Department is in charge of weather forecasting based on long-term records of meteorological parameters.

Since 2000, Bangladesh has been developing flash-flood forecasting. Improved forecasting for the flash-flood prone rivers of the Manu-Dhalai-Kushiyara-Khowai river system has been proposed as an initiative for the Regional Water Management Plan. Feasibility studies have been carried out for improved flood warning on the Juri River. At present, more detailed evaluation of a pilot flood-forecasting model for the Khowai River is being carried out. A one-dimensional MIKE 11 Flood Forecasting Module has been applied to forecast water levels and discharge at ungauged locations along the Khowai River.

In China, the flash-flood hazard forecasting system includes weather, stream and river flooding, and debris flow and landslide hazard forecasts. The weather forecasts in China cover global, limited-area, and medium-scale numerical forecasts. The accuracy of medium- and short-term forecasts of disastrous weather events has improved significantly, but flash-flood hazard events in small drainage areas in mountainous regions and medium- and small-scale, sudden weather events are still rather difficult to forecast. Flood-forecast models are operational at central level and in most provinces of China for large basins. However, only in a few small drainage areas in mountain regions have forecast models been established. In order to establish a functioning flash-flood forecasting system in future, it is planned to build on existing monitoring and forecasting systems, focusing first on pilot areas where flash floods pose a particularly grave hazard. Capacities in weather and river forecasting will be upgraded.

The Central Water Commission of India has set up an extensive flood forecasting network of 173 stations on 62 major rivers in the country. Gauge to gauge, rainfall-runoff correlations and the MIKE 11 model are being used for forecasting and, recently, cooperation with the United States Agency for International Development (USAID) has begun in climate forecasting with the aim of developing improved flash-flood forecasting capabilities. Cooperation between India and China in data collection and exchange is seen to be particularly important and beneficial in flash-flood prone areas along the Sino-Indian border.

The Department of Meteorology and Hydrology in Myanmar has a number of stations of which 54 meteorological and 25 hydrological stations report the real-time data for weather forecasting and river forecasting on a daily basis. In addition, the Department uses different satellite products and regional collaboration for its daily weather and river-level forecasts. River forecasting is carried out through simple and advanced techniques. Sophisticated conceptual models include the Sacramento model, SAAR, HBV, and Tank models.

According to the Nepal country paper, there is no flood-forecasting system operational in Nepal. The Department of Hydrology and Meteorology runs a flood-forecasting section which operates a network of hydrological and precipitation stations. The data obtained are transferred to India by wireless communication on a daily basis. Several studies have been carried out on appropriate computer models for flood forecasting, but none of them has been implemented on an operational basis.

In Pakistan, a network of weather radars is used to get detailed pictures of the precipitation potential of cloud masses.

Warning systems

In Afghanistan, there is no official warning system in place for floods or flash floods. Traditionally upstream communities and government offices pass flood information along to friends, relatives, or government offices downstream.

In Bhutan no formal warning systems are in place. However, an ad hoc warning system was implemented in 2004 at the Tsatichhu landslide dam, and two high frequency radio sets were installed to provide early warning in case of a dam breach.

In China, flash-flood hazard warnings are classified into three levels: the first is for flash-flood warning during the non-flood season. The second stage is a warning during a state of alert in the flood season, and the third indicates that disastrous weather events have occurred or are about to occur. The highest level means that flash floods are about to occur.

According to the country paper from India, flood warnings in India are issued by the Central Water Commission and disseminated to the offices of district administrations, irrigation, state flood control rooms, police, and other authorities for further action. Warnings to the public are issued by the state authorities and flood bulletins are aired by the All India Radio and published in newspapers.

In Myanmar flood warnings are issued by specialised sections of the Department of Hydrology and Meteorology. These central sections contact local authorities and other related departments to take action. The general public is alerted through radio, television, and newspaper bulletins.

In Nepal, a GLOF Early Warning System was established on the Tsho Rolpa in 1998 with a loan from the World Bank. Other early warning systems are operated by hydropower projects (e.g., Bhote Kosi Power Company). The Intermediate Technology Development Group, Nepal, has introduced a community-based disaster management system which includes a community-managed, flood early warning system along the Rapti River in Chitwan District. This system is in the test phase and can be extended if it proves to be an effective and timely means of flood warning.

Community awareness and preparedness

In Afghanistan, radio and television programmes are aired nationally and locally to inform people about the possible risk of flash floods caused by heavy downpours and/or rapid snowmelt.

Existing systems are not discussed in the paper on China in terms of community awareness and preparedness related to flash floods, but insight is provided into government plans to address the issue. Plans include adult education; erection of permanent flash-flood hazard sign boards, banners, and blackboards; distribution of publications; and broadcasts on radio and television.

Non-government organisations play a big role in awareness creation and improving flood disaster preparedness in India, although the responsibility rests with the government. According to the country paper, it is hoped to increase the efficiency of local administrations.

In Myanmar the education curriculum includes information about necessary action in case of flash floods.

Different government and non-government organisations are involved in holding workshops, seminars, and training programmes on disaster management in Nepal. Since 1996, the United Nations Development Programme (UNDP) in coordination with the Ministry of Home Affairs has been implementing community-based disaster management programmes to address the challenge of recurrent disasters. These programmes are focused on people and rely on social mobilisation and promotion of disaster preparedness. Nepal Red Cross is also involved in community-based disaster preparedness with the objective of getting communities involved. The Department of Water Induced Disaster Prevention has produced extension materials which include videos, a comic book, brochures, calendars, and posters. The Department regularly organises drawing and writing competitions for pupils on topics related to water-induced disasters.

Indigenous knowledge

Only a few of the country reports discussed indigenous knowledge in flash-flood management.

In Afghanistan people living in the vicinity of big rivers usually keep watch at night time to see if a flood is approaching.

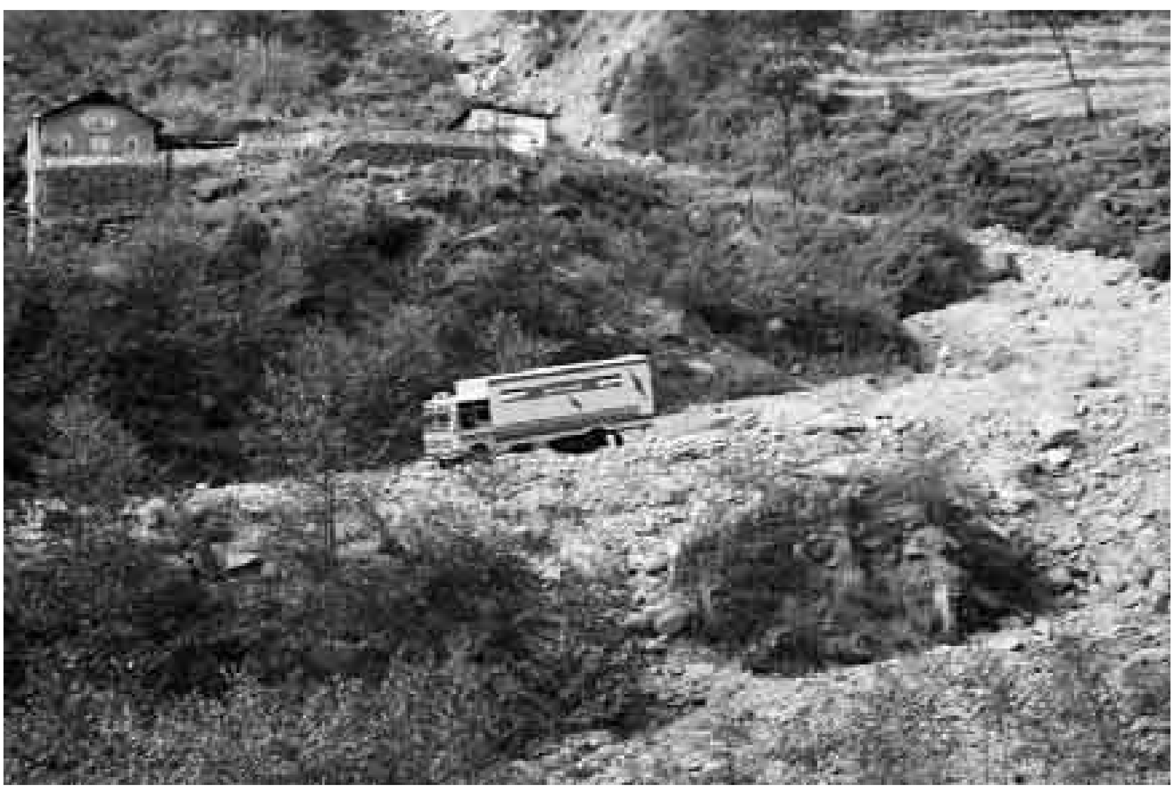
The people of Bangladesh are familiar with floods and their impacts. In the north-eastern area of the country they are also very aware of flash floods. They normally try to avoid flood plains and build their houses in elevated areas.

In India, villagers make necessary preparations in advance in areas where floods are frequent. This includes storing food, fodder, and other essential items in safe locations. They also stockpile boulders and sand bags.

Conclusions

In concluding his presentation, Dr. Merz pointed out that there is a great variability between the countries in terms of approaches to flash-flood management and the respective levels of implementation. The levels of sophistication also vary tremendously. The flood-forecasting systems are the most significant indicator of differences in sophistication. Some countries have radar equipment for precipitation forecasts, while others have to rely on forecasts from global satellite products and cannot predict small-scale precipitation events that might lead to destructive flash floods. Approaches to warning about destructive events are different. Some countries have detailed plans, whereas others rely on the innovativeness of the people in charge at the time of the event. With the exception of China, none of the countries focuses on flash floods particularly in their disaster management approaches. Afghanistan and Bhutan, on the other hand, are currently in the process of implementing total disaster management plans in which flash floods constitute only one potential hazard.

Two glacial lakes, a potential source of flash floods



Flash floods can easily damage mountain infrastructure

The need for structural and non-structural methods has been recognised in all countries, but methods vary from country to country.

Dr. Merz said this variability is a chance for regional learning and exchange. All the countries have interesting stories to tell and have more experience in some aspects of flood and flash-flood disaster management than others. Exchange of information and expertise, firstly between regional partners, before the involvement of regional and global institutions was recommended.

It is difficult to identify common gaps in capacity. Based on the country reports, all countries seem to be weak in working with communities, although in places there are attempts to work directly locally.

In general, Dr. Merz stated, it could be said that flash floods are still not recognised as a specific problem and different from riverine floods, that their causes are often different in nature, and that they require different measures to manage them.

Discussion Session 1: Flash Flood Risk Management Assessment in the Region

After Dr. Merz's presentation, the floor was open to discussion. The discussion was moderated and facilitated by Dr. Xu Jianchu and Dr. Juerg Merz of ICIMOD.

Discussions focused on the need for intersectoral collaboration in China and the need to document triggering events when it came to dam breaching. Following this, the 100-year old history of India in flood forecasting was discussed, and the possibility of accessing old records.

The participants then went on to regional issues and the need for regional cooperation. It was pointed out that Bangladesh, India, and Nepal are correlated in basin area, but there is no regional cooperation on riverine floods. The lead time of two weeks between India and Bangladesh in terms of data sharing was mentioned. Participants also commented on the restrictions in terms of data.

In terms of organisation, although in the Indian context, for example, the entire sector is taken care of by the government, some things are lacking – post disaster issues for example. Often information is not passed on to policy-makers because different ministries are secretive about their information. In Pakistan, too, all efforts are initiated by the government. Communities need to be involved.

Learning from disasters is seen as a lacuna in government responses and reconstruction efforts. Why are roads and bridges rebuilt in the same location, with the same strength, and the same capacities after being destroyed or damaged by floods?

The lack of insurance facilities in the region was lamented. In the aftermath of the hurricane 'Katrina' disaster in the United States 27 billion dollars were disbursed from insurance. In the HKH Region there is no insurance and this means that subsidies for the poor in the event of disasters are limited.

On the topic of technical knowledge, knowledge management was stressed.

Finally, recommendations were made on the basis of the country reports. These recommendations have been integrated into the conclusions and recommendations from the workshop as a whole (see last part). They can also be found in the full version of Dr. Merz's paper in the accompanying CD-ROM.

The second day of the workshop concluded with a poster session.

Session 2: Community Awareness and Preparedness

Session 2 on community awareness and preparedness was held on day 3 of the workshop. The Chairperson was **Dr. Wolfgang Grabs,** Chief, Water Resources Division, WMO. The keynote paper for this session was given by **Mr. N.M.S.I. Arambepola** of the Asian Disaster Preparedness Centre (APDC), Bangkok.

Keynote paper: Community-based disaster risk management

Mr. Arambepola commenced by outlining the community-based disaster risk management process. The process relies on a bottom up approach in which the community and its most vulnerable groups are the primary actors. The aim of the process is to reduce vulnerability and increase the capacity of communities to withstand damage caused by disasters. Hence the crucial elements involve not only selecting the community properly, but understanding it and involving its members in participatory planning for risk reduction. Following this, the community itself manages the implementation of the plans; monitoring and evaluation of the process is an essential part of the learning from the process.

Mr. Arambepola pointed out that educational/training opportunities should correspond with needs identified by the community, which in turn should demonstrate responsible use of financial inputs. Above all, it is important that the community itself becomes responsible for change.

The process means that the people most affected by disaster can be helped to become involved in building up their lives and livelihoods after the event. Communities are capable of carrying out search and rescue operations and training in first aid can be given locally.

Mr. Arambepola discussed the APDC disaster crunch model with the participants. An awareness poster of this model was shown (Figure 2).The disaster crunch model shows that in order for a disaster to occur, both hazard vulnerability and exposure are needed simultaneously. Vulnerability and exposure come from unsafe conditions; i.e., environmentally dangerous locations, dangerous buildings and infrastructure, a fragile local economy, livelihoods at risk, and low income levels.

Figure 2: A community awareness folder from ADPC

These can be caused by dynamic pressures such as lack of local institutions (health care, social services), markets, financial institutions and investment, press freedom, education and training, appropriate skills and technology, and ethical standards in public life. Examples of macro forces are population expansion, urbanisation, expenditure on arms, debt repayment, and deforestation. Dynamic pressures, in turn can be caused by limited access to the power structure, lack of resources, ideologies, political systems, economic systems, and conflicts.

Outsiders can play a supportive and facilitative role, for example, situational analysis, technical assistance in planning, and implementation of risk reduction and preparedness measures.

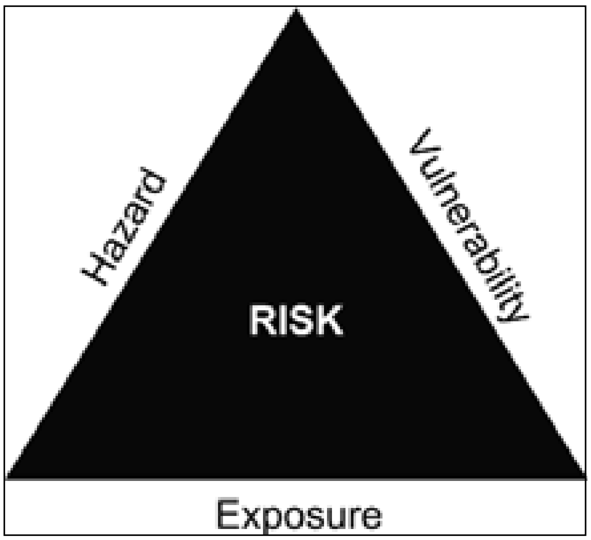


Figure 3: The risk triangle

The risk triangle was introduced to the participants (Figure 3). Risk can be understood by looking at the risk triangle. If the hazard, vulnerability, or exposure increases or decreases, the area of the triangle increases or decreases, and the amount of risk also increases. If one side is eliminated, there is no risk. Mr. Arambepola described ADPC's experience in community-based disaster risk mitigation. It has become an integral part of the Asian Urban Disaster Mitigation Programme and has been implemented by ADPC in ten countries in Asia over the last 10 years. It has helped build a common organisational framework, combining formal structures, such as committees, with informal village meetings and discussions such as non-formal courtyard meetings of housewives or volunteers. Hence community-based disaster risk management can be seen as a process towards sustainable development at community level, by channelling safety programmes towards improvement of livelihoods and by making safe construction techniques popular.

Case study 1: Disaster/flash-flood mitigation through community mobilisation and a rights-based approach

Mr. Anil Pant of Action Aid, Nepal, presented the first case study in Session 2, which focused on community mobilisation through a rights-based approach.

Mr. Pant told the workshop participants that Action Aid International was pursuing a rights-based approach as a cross cutting philosophy in its thematic development work; and this included disaster management. Mr. Pant outlined the key features of the approach.

The rights' approach, he stated, assumes that people have rights to and responsibilities for their circumstances and not only needs. For example, rights to protection, security, assistance, and participation in making decisions (empowerment).

In the rights-based approach, a community is seen as a diversified group of people in terms of vulnerability, resource access, and other coping capacities. In each particular circumstance, the approach identifies the responsibilities of the state and other institutions at different levels. The state is considered to have primary responsibility, however. Policies and practices that potentially discriminate against different groups of people are viewed seriously, such practices eventually analysed, and action taken against them. Community-based disaster preparedness (CBDP) begins with a participatory vulnerability analysis which is the key factor in rights-based disaster preparedness. The participants were informed that they can find comprehensive information on participatory vulnerability analysis on Action Aid's website. It was not dealt with in detail during the presentation.

Mr. Pant went on to explain that the CBDP process identifies a specific geographical area, focusing on people having multiple roles. In such areas, local NGO partners are then identified and Action Aid works through them. Partner NGOs first receive rights-based CBDP training on selected topics; viz., international human rights' instruments and national provisions; definitions of disasters and hazards; hazards, vulnerability, and stakeholder analysis; first aid; planning orientation; and disaster management committees. After the NGOs complete the training they are expected to prepare a six-month action plan and act upon it.

Mr. Pant outlined Action Aid's experiences with its approach, in particular those garnered from a CBDP programme that began in 2003 in Makwanpur district, Nepal, with groups in a number of village development committee (VDC) areas. Disaster management committees were established successfully in several communities, and the communities were enabled to prepare periodic plans which they revise twice a year. In some cases databases of households were prepared including vulnerability assessments and coping mechanisms. Communities lobbied the Department of Water Induced Disaster Prevention to support their plans; tree plantations were established; and emergency shelters were built through local resources with some help from relevant agencies. What seems to be more important is that communities now have a concept and understand the value of disaster preparedness and are ready to face events such as flash floods; communities know where they can get help; and communities understand that if they organise themselves they can influence government plans that affect their lives.

Mr. Pant concluded his presentation by stating that water-induced disasters were receiving more attention at national and international levels because of the Asian tsunami and hurricane Katrina. However, the CBDP programme had demonstrated that disasters do not receive the consistent attention that many other development issues receive and that some key government agencies merely carry out relief work.

Case study 2: Causes of flash floods in Chitral

Mr. Sardar Ayub Khan, of the Aga Khan Rural Support Programme (AKRSP), Chitral Regional Office, Pakistan, presented the second case study – on flash floods in Chitral. Mr. Khan stated that the Chitral district is a remote, desert, high altitude region of the most northwestern part of Pakistan. It covers an area of 15,000 sq.km and has a population of 370,000. Each winter the area is cut off from the rest of the world for about six months.

Since 1964, eight flash floods have been recorded, most recently two in 2005, which were caused by unexpected, heavy snowfall in the previous autumn. The main causes of flash floods in Chitral are rapid melting of snow and ice in high mountain areas; heavy precipitation in the foothills; and glacial lake outburst floods in high mountain areas.

Mr. Khan discussed 'phumbarrash' (fire signalling), an indigenous system of flood warning used in the past. In every village there used to be families who had expertise in this, particularly in high mountain villages and those close to glaciers. These families were responsible for collecting firewood and brushwood and storing it at high points visible throughout the Chitral Valley. In the event of flooding, first one then a succession of fires was lit, warning people up to 150 km away. In this indigenous system there used to be 61 fire-lighting locations within 32 valleys. The system was still in operation up to 1949. Mr. Khan explained to the participants that, in the case of invasion, two fires used to be lit for less than 2,000 invaders and five for less than 5,000. Each household had a member in the national army in those days, and the fires would mobilise them.

Despite this system, villages close to the source of flooding suffered and often the fires could not be seen because of the smoke or because they were hidden by the vegetation of the lower valleys.

Mr. Khan stated that, currently, with increasing literacy and education plus the role of the media, there is greater awareness about flood disasters. Access to technology such as geographic information systems (GIS), satellite phones, and other flood-warning systems is limited. However, although not a replacement for traditional institutions, AKRSP has mobilised communities into village organisations, women's organisations, and local support organisations; community support organisations provide an umbrella for the other groups. These organisations help bring communities into disaster mitigation work

In Chitral, the FOCUS Humanitarian Assistance organisation is responsible for training the communities and providing emergency relief. It has been recognised that much more is needed in terms of capacity building by strengthening local support organisations through awareness raising, development of natural resources, and helping them establish early warning systems through local radio stations and FM satellite phones.

Mr. Khan believed that FOCUS should receive help in GIS mapping, database development, and a district-level flood-warning system, along with a meteorological unit for the district. This will not be possible without funds from local, provincial, national, and international sources.

Discussion Session 2: Community awareness and preparedness

Dr. Grabs moderated the discussions, which focused on a number of issues. On the subject of resettlement after a disaster, the refugee problem was a subject of debate. On the one hand people returning home after a disaster might find others settled on their land. Refugees tended to settle in flood-prone areas. In Afghanistan, it was stated, refugees had settled on the dry bed of the Kabul River during the seven-year drought. They actually built houses there, but in 2005 those houses were swept away. Relocation after a disaster is difficult. People do not like strangers receiving a share of their common resources.

Some discussion centred on the loss of indigenous knowledge and traditional practices – why have they died out? Some participants opined that migration is responsible. People who have lived in an area for generations adjust to disasters, but in-migrants do not. For example, in the Mekong delta the traditional houses are on stilts, those of newcomers are not, making them susceptible to being washed away when the river floods.

It was thought that in terms of building up community capacity, money is an issue, as well as access to other resources. Nevertheless, lack of cash does not mean communities are poor and capacities can be built on the basis of whatever resources are available, rather than seeking outside assistance. Some of the countries have had success in building up from a community base. Self-help is the way to go and good examples can be taken from Bangladesh, India, and Nepal.

The final discussion was on warning systems. Discussions focused on improving the understanding of the community of the warning systems in use; establishing early warning systems; community training by private companies involved in hydropower infrastructure; and creation of interfaces between flood-forecasting agencies and communities. It was suggested that community outreach programmes can carry out regular drills to familiarise people with the different signals and procedures.

Dr Grabs ended the session by summarising the discussions. He said that the gist of the discussions was that communities should be empowered. Empowerment of communities should, therefore, be part of national disaster plans.

Session 3: Hazard Control

The third technical session commenced after the morning break. The Chair for this session was Dr. Sazedul Karim Chowdhury, Superintending Engineer and National Project Director, Bangladesh Water Development Board.

Keynote paper: New strategies of prevention and mitigation of China's flood disasters – from flood control to flood management

Professor Cui Peng, of the Institute of Mountain Hazards and Environment, CAS, People's Republic of China, presented the keynote paper for Session 3. In discussing flash-flood management status in China, Professor Cui Peng said that most of China's territory is geologically diverse and tectonically very active with regular earthquakes. It has great differences in altitude and very steep slopes in many areas.

Flash-flood events have occurred almost all over the country, but South Western China and the areas surrounding the Tibetan Plateau are high risk areas. In these areas debris flows are also a problem. Almost half of the population, or 557.8 million people, are considered to be at risk from flash floods in China as a whole. In total, 111,428 events have been recorded with more than 6,000 dead, including casualties and structural damage.

Professor Cui Peng stated that China had improved mitigation measures by bringing many debris flows and landslides under control; protecting towns, roads, buildings, and facilities; creating safe spaces for people; and rehabilitating farm land.

China's approach to disasters is still mainly by control and use of structural measures. For example, a special type of checkdam has been developed to mitigate debris flows.

Professor Cui Peng suggested that the main flash-flood management problems in China are a poor monitoring system and forecasting capabilities; predominant use of structural measures to control hazards (the adoption rate for biological measures is poor); intensity of human activities that triggers hazards (building roads, dams, and other construction; cultivation on steep slopes); lack of training for local people; and not realising targets to mitigate loss of life and property.

Professor Cui Peng thought that a new management approach is needed. This approach should identify potential hazards and the key factors causing them; and then these key factors should be adjusted to prevent hazards occurring. He said it is also important to analyse risk; viz, probability of occurrence, possible scale, dangerous and safe zones, and evaluation of loss. This meant good planning for emergencies, and hence disaster prediction should cover all levels from the national to the gully level. Finally, integration of different types of measures – structural, biological, and non-structural – is essential and, most important, hazards should be used as resources and we should learn from them.

Professor Cui Peng closed his presentation with a summary of flash-flood management recommendations for China. These are to improve monitoring and warning systems at local level, to map hazards and relocate populations at risk, to make better use of biological measures, to practice environmental protection during construction, and to raise awareness – especially amongst the youth.

Case study 1: Glacial lake outburst flood inventory and mitigation

Mr. Pradeep Mool, Remote Sensing Specialist, ICIMOD, presented the single case study in Session 3.

Mr. Mool explained the impact of climate change on glacial lakes. Augmentation of the greenhouse effect increases the rate of glacial meltdown, and hence the risk of increased frequency of glacial lake outburst floods (GLOFs). Most glaciers in the Himalayas had retreated by approximately 1 km since 1850.

Climatic records suggest that the earth has become 0.5 degrees warmer over the last century. An analysis of temperature trends in the Nepal Himalayas and their vicinity shows that temperature changes are greater in the uplands than in the lowlands. On average, air temperatures in the Himalayas are one degree centigrade higher than in the 1970s and have risen by 0.06 degrees per year.

A study by the Chinese Academy of Sciences reported 5.5% shrinkage in China's 47,000 glaciers in the past 24 years. If this rate continues, two-thirds will have disappeared by 2050.

Mr. Mool said that since 1999, ICIMOD and a number of its partners have been carrying out a comprehensive glacier and glacial lake inventory in the Himalayan region. The main objective of the study is to identify glacial lakes in the region that are in danger of bursting as a result of global climate change; a change which in turn has direct impacts on human vulnerability and adaptation.

The results generated from the study provide baseline information on the region that will be useful for developing monitoring and early warning systems and for planning and prioritising disaster mitigation efforts. It is anticipated that the study will help in formulating planning guidelines for infrastructural development, water resources, and land use in the Himalayan region.

Mr. Mool told the participants that advanced scientific knowledge of potential GLOF hazards, building capacity among local institutions and agencies for undertaking studies or monitoring hazards, and linking this knowledge to policy and planning are of immense importance.

One of the outputs of this study shows that some of the glacial lakes in the Poiqu basin in TAR (a sub basin of the Ganges and upstream from the Bhote Kosi in Nepal) have almost doubled in size in the last 25 years. Mr Mool showed the changes in glaciers and glacial lakes in the mountains of the TAR of China, India, and Pakistan. ICIMOD's contributions to the study included consultations with collaborating institutions and agencies; training their personnel; acquiring the materials needed such as data, maps, and satellite images; preparing a digital database on glaciers and glacial lakes by remote sensing and GIS; and holding a workshop for policy-makers, planners, educationists, trainers, and media personnel.

It was recommended that a detailed inventory be made and that a spatial and attribute digital database be constructed of glaciers and glacial lakes. This can be done reliably using medium to large-scale topographic maps and remote-sensing data. A study of GLOFs for the entire Himalayan region should be carried out using similar methods. This is the first step. It is equally essential to identify and monitor potentially dangerous glacial lakes; establish physical monitoring systems around them; develop early warning systems; carry out mitigation work; solicit regional cooperation and interaction; disseminate findings and experiences as widely as possible; and raise public awareness.

Discussion Session 3: Hazard control

The moderator/facilitator for the discussion session was the Session Chairman **Dr. Sazedul Karim Chowdhury.** Discussions commenced by focusing on the keynote paper. Professor Cui Peng was asked to clarify certain points pertaining to the responsibilities of local governments and the central government. It was clarified that local governments carry out mitigation work whereas guidelines and support come from the central government.

A query was raised about farmland reallocation and possible objections of long-term residents in an area. Although it was acknowledged that people are reluctant to share resources with new people, when risks of disaster are high, discussions with people in possible areas for relocation have to be held and incentives given for relocation.

Participants stated that debris carries away trees and other parts of the terrain. Had anything been developed to control this? Professor Cui Peng said that a pillar after pillar structure downstream helps: the gravel flows down first, and there can be more checkdams downstream to collect different types of debris.

On the topic of GLOFs, participants asked how far down the GLOF impact would be? Mr. Mool replied that estimations and simulations had been carried out at several sites, but the impact varies from site to site.

On being asked what was missing from hazard assessments, he replied that models are based on clean water outbreaks and not debris, and models based on debris are needed to estimate possible, real damage. Mixed material can have very different impacts – debris flows or debris-filled water is more devastating.

Participants asked what ICIMOD's next steps would be. They were told that several proposals have been developed and submitted to the Government of India and overseas' donor agencies. ICIMOD is working with the WADIA Institute of Himalayan Geology, Uttaranchal. The report on mitigation areas has been submitted to donors and to the Global Environment Facility.

Mr. Mool was asked if GLOFs could be forecast. His answer was that there is insufficient meteorological information. In the eastern Himalayas glacial lakes are growing rapidly, but forecasting a GLOF is like forecasting an earthquake.

How possible would it be to receive information about the status of GLOFs, or receive an alert? Mr. Mool said it is not really possible. He outlined some of the problems that needed solving: reliable information on moraine dams is lacking; there are no models to predict the movement of water downstream accurately; and often there are lakes under the glaciers, which means they are floating. The conclusion was that, in the event of a GLOF, only with sirens and well-trained villagers can human damage be avoided. Another problem which he said was worth mentioning is that glacier studies are being carried out by research teams from all over the world without any internal coordination. It is difficult to get information from all these studies.

Session 4: Flash-flood Forecasting and Warning

The fourth session was chaired by Dr. Raghunandan Singh Tolia, Chief Secretary, Government of Uttaranchal. He introduced the keynote speakers who were to present a paper on state of the art flash-flood forecasting prepared by the United States Geological Survey (USGS) in collaboration with the National Oceanic and Atmospheric Administration (NOAA), the USAID Office of Foreign Disaster Assistance (OFDA), and the Hydrologic Research Centre.

Keynote paper: U.S. technology for flood and flash-flood forecasting and regional flash flood guidance system for flash flood alerts and warnings

Ms. Ayse Sezin Tokar, Hydrometeorological Hazard Adviser, USAID/OFDA, and **Mr. Robert Jubach,** Manager, International Technical Programmes, HRC, presented the keynote paper.

The presentation began by outlining the organisation of weather and flood-forecasting in the US. Participants were told that weather forecasting is organised through the National Centres for Environmental Prediction and Weather Forecast Offices. The NOAA National Weather Service is responsible for river and flood forecasts and warnings and dam break analysis.

The 13 regional River Forecast Centres under the NOAA are responsible for major river catchments. They make short-term and seasonal forecasts and give flash-flood guidance. The USGS operates the national streamflow monitoring network in about 8,000 locations of which about 6,500 are real time. It is responsible for streamflow measurements (rating curves) and for obtaining physiographic, GIS, and remote-sensing data. Other organisations working with flood forecasting are the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, Natural Resources' Conservation Service, and local and state agencies.

The presenters informed the participants that flash floods in the U.S. are caused by intense rainfall, dam and levee breaks, ice jam floods, and rapid snowmelt. Flood forecasting in the US is organised in an integrated manner to manage end-to-end hydro-meteorological mitigation and preparedness in order to give maximum lead time. The river and flood forecasting system consists of hydrologic and hydraulic models, snow melt models, rainfall-runoff models, channel-routing models, dynamic routing, dam break models, and ensemble prediction models.

The hydraulic model is used for real-time forecasting of dam-break floods from natural or constructed dams; dam-break scenarios for inundation mapping and preparedness; and a database of dam-break scenarios for dams with populations at risk.

In terms of cooperation with communities, it was stated that many flash-flood warning systems are community based and rely on USGS and NOAA data networks, community data networks, and close coordination with emergency response organisations. The system operators coordinate among themselves via regional user groups and welcome international participants to their meetings.

Next, the presenters talked about a regional flash-flood guidance system. OFDA funded implementation of a regionally-based flash-flood warning system in seven Central American countries. The Hydrologic Research Centre developed and implemented the Central America Flash Flood Guidance System, and this is used throughout the region as a diagnostic tool for flash-flood alerts and warnings.
The Flash Flood Warning System uses technology and modelling tools to produce flash-flood guidance and flash-flood threats; and it gives a regional, rapid evaluation of flash flooding at a high spatial resolution. The system also has the capability of indicating the likelihood of flooding of small streams over a large region. It is a regional system, but each country has unlimited access to data and information to make their own evaluations and decisions. The system is based on advances in remote-sensing technology, global digital spatial databases (topography, soil types, land use/land cover, stream characteristics), and distributed hydrologic modelling.

The system uses bias-corrected, satellite rainfall data and can be used with QPF (quantitative precipitation forecast). The satellite rainfall data are on a 4x4km grid though higher resolution input can be used based on requirements, real-time soil moisture state, and flash-flood guidance in 1, 3, and 6 hr intervals. Each country only needs a personal computer and Internet access to provide precipitation data, threat, and guidance information on an hourly basis.

Two key indices are displayed by the system – flash-flood guidance and flash-flood threat. The flash-flood guidance value consists of the volume of rainfall for a given duration (1-6 hrs) over a given small catchment that will be just enough to cause bank full flow at the outlet – this is a conservative index in that the amount of rainfall to just produce minor flooding is indicated, additional rain would be needed to cause major flooding. The flash-flood threat is the rainfall of a given duration in excess of the flash-flood guidance value and can be used to indicate where flooding is imminent or occurring.

Case Study 1: Bhote Kosi and the hydropower plant, Nepal

Mr. Sandip Shah, General Manager of the Bhote Kosi Power Company, Nepal, presented the first case study in Session 4.

Mr. Shah described the background of the Bhote Kosi River and surrounding area. The upper Bhote Kosi power plant is situated in the middle reaches of the Bhote Kosi River approximately 110 km north east of Kathmandu. The catchment covers 2,132 sq.km. The catchment above the intake of the Upper Bhote Kosi Power Plant is transboundary, shared by China and Nepal, with 96 % of the area being in the Tibet Autonomous Region.

Mr. Shah stated that the plant is designed to accommodate an annual maximum output flow of 36.8 m^3/s and a 100-year flood of 695 m^3/s. The catchment is prone to three types of flash floods: glacial lake outburst floods (GLOF), landslide dam outburst floods, and cloudburst floods. GLOFs occurred in 1935, 1964, and 1981. According to a study carried out in 1996, the catchment area has 42 glacial lakes, all lying in TAR. Many landslide dam outburst and cloudburst events occur every year in the monsoon season.

Mr. Shah then described the early warning flood system installed at the Friendship Bridge on the China-Nepal border. The system consists of seven GLOF detection sensors (one ultrasonic water-level measuring device and six float type water-level switches) and two remote-sensing stations with data loggers to receive, analyse, and transmit data.

Should the water level increase significantly, an evacuation warning signal will be transmitted to warning stations at the intake and the powerhouse by short-burst VHF radio, using meteorburst technology. The five warning sirens (127 dB of sound at 100 ft distances) along the river would then be activated. The time taken to give a warning from the Friendship Bridge (at the border) to the intake is only five minutes and to the powerhouse further downstream it is only nine minutes.

Certain plans have been formulated by the Plant to prepare for and respond to emergencies. These plans include operation of the gates and power station; evacuation procedures; regular monitoring of sensors, modems, and sirens; and regular drills.

Mountain towns are often exposed to flash floods

Early warning systems can be established for flash flood management

Mr Shah said that from the power plant's point of view, the GLOF risk is one among several risk factors that have to be taken into consideration and accepted. There are technical risks such as the hydrological (flash floods) and geological (earthquake) risks, contract performance risks, and political risks. The plant seeks to mitigate risk through data availability, analysis, and interpretation; the early warning system mentioned already; further investment to manage potential risks and damage; and insurance. The speaker did envisage, however, that in future there would be a need for data on growth of glacial lakes; identification of lakes, landslides, and mass movements; real-time data; warning systems that extended into China; linkages with disaster mitigation and management bodies; and access to comprehensive hydro-meteorological and sediment data.

Case Study 2: Increasing effectiveness of flash-flood warning by advanced monitoring and modelling

The second case study in Session 4 was presented by **Dr. Guna Nidhi Paudyal,** Regional Manager/Senior Flood Management Expert, DHI Regional Office, India.

In introducing the subject of effective flash-flood forecasting, Dr Paudyal said that, although present day information and communication technology assisted by mathematical models has been used successfully for forecasting and warning in the case of slow-rising river floods, the application of such potentially useful systems has been less effective in the case of flash-flood forecast and warning.

One reason for the limited effectiveness of such systems for flash-flood warning is that there is no mechanism for rapid dissemination of flood warnings to the communities affected, especially in developing countries.

The effectiveness of a flash-flood forecasting and warning system depends upon how quickly the catchment response to rainfall events (runoff) can be studied and computed, and how quickly the propagation of resulting floods through the river channel and flood plain can be computed. After predicting the runoff, other associated hazards like landslides, embankment breaches, and so on can be identified.

Often extreme and short duration rainfall triggers flash floods. Hence, it is necessary to be able to monitor rainfall in an accurate and timely manner, preferably in real time and with a high degree of accuracy.
The need for flood warning systems is a challenge to both flood-forecasting authorities and flood-prone communities. Such systems should be built upon four principles: surety (no 'crying wolf'), accuracy (in magnitude and time), trust (by receivers), and official (responsibility).

Another important aspect of flash-flood analysis and management at local level is to know what impact a flood will have on larger river basins downstream. Some flash floods are also of a regional nature, a flashy catchment might be located in a territory other than the one in which the actual river flash flood occurs.

Dr. Paudyal presented an example of monitoring and modelling flash floods for forecasting as well as incorporating their impact on a larger regional basin in the case of Bangladesh.

The North East region of Bangladesh, unlike the rest of this flood-prone country, often suffers from flash floods which cause significant damage to life and property every year. A real-time rain-gauge system has been developed and implemented. The potential use of this system is as an end-to-end real-time data system transmitting warnings on SMS through mobile phones or via the Internet.

The effectiveness of flash-flood forecasting, warning, and dissemination can be improved by using affordable and appropriate science and technology such as real-time rain gauging, local weather radars, flood modelling, mobile phones, computers, Internet, radio, and television. Data and information should be free to all and easily understandable (transparency). Map-based products developed in Bangladesh and disseminated via the Internet are good examples.

In concluding, Dr. Paudyal stated that effective flash-flood management should be included in river basin flood management. He concluded by saying that although we cannot stop the rain, we can find out where it is raining and flooding and to what extent.

Case Study 3: Mountain meteorological disasters in China

The third case study in Session 4 was presented by **Mr. Zhou Qingliang,** Deputy Director, Division of Forecasting, China Meteorological Administration, China.

In his presentation, Mr. Quinliang focused on suggesting measures to improve the meteorological service in order to reduce disasters. He drew the attention of participants to the vastness of China's terrain and the frequency with which disasters brought about by weather events such as tropical cyclones, dense precipitation, hailstones, heavy fog, and extremes in temperature are inflicted upon the population. Since 1988, 7,421 people had been killed by typhoons alone, an average of 437 people annually.

The speaker proposed five measures to improve meteorological services. Improved capabilities in monitoring by upgrading atmospheric sound equipment, satellite sounding, and acquisition of Doppler radar networks to keep track of meteorological phenomena. Mr. Quinliang stated that intensifying research to discover why subnormal changes occur and field experiments on physical and chemical processes would bring about a better understanding of weather events and innovation in methods of dealing with them. In the latter respect he thought improvements in the new generation numerical weather prediction system to be essential. Convective weather forecasts have a short lead time and refined weather forecasts in terms of specific timing, location, and quantity are necessary. Accuracy of information helps emergency response measures.

Skills in disaster management are also in need of improvement to consolidate emergency response schemes at national and local levels; to mobilise national sectors and communities to engage in joint, integrated regional preparedness, mitigation, and relief; to improve planning; and, finally, to establish a unified mechanism for public response. Mr. Quinliang thought that, since 30 bilateral agreements for cooperation on meteorological science had been signed, there was plenty of scope for learning and for sharing technologies. The participants adjourned for an afternoon break, after which Dr. Wolfgang Grabs presented a special paper on WMO's Flood Initiatives.

WMO's Flood initiatives

Dr. Wolfgang Grabs, Chief, Water Resources' Division, WMO presented a comprehensive overview of WMO's flood initiatives. Dr. Grabs commenced by describing how the global operational network is run. He stated that the network consists of national metorological and hydrological services in 187 countries contributing to the Global Observation System. WMO also runs three world meteorological centres and 40 regional, specialised centres.

Another initiative is the World Hydrological Cycle Observing System (WHYCOS) through which two collaborative Hydrological Cycle Observing System projects related to floods are being undertaken in Asia: The Hindu Kush-Himalayan Flood Information System (HKH-HYCOS) in collaboration with ICIMOD and the Mekong Regional Flood Information System in collaboration with the Mekong River Commission.

Dr. Grabs told the participants that WMO is also carrying out diverse activities on natural disaster risk reduction. Different approaches are used to support activities to cope with multiple hazards, instead of developing strategies for each different disaster in isolation. The strategy uses a coordinated, user-driven approach; relies on strong international, regional and national partnerships; takes advantage of advanced global capabilities in space and land-based observations (including its own integrated global observation system); improves early warning capabilities, from global to regional to national; gives importance to the roles played by national meteorological and hydrological services; and builds national capacities through training, sharing best practices, and raising awareness.

Dr. Grabs went on to talk about the International Flood Initiative launched in January 2005 at the World Conference on Disaster Reduction and mainly driven by UNESCO and the WMO Flood Initiative to promote an integrated approach to flood management in order to maximise the long-term net benefits of floods and to minimise loss of life, assets, and hardships. Dr. Grabs gave details of the tentative plan of action for this initiative and also described the rationale for the WMO Flood Forecasting Initiative.

Dr. Grabs stated that many meteorological and hydrological services do not have adequate means or the knowledge to provide extended forecasting services in flood critical situations and to communicate effectively with disaster management authorities. Hence the overall goal of the initiative is to improve the capacities of these services and, in collaboration with disaster managers, ensure emergency preparedness and responses.

WMO has identified some of the weaknesses of national forecasting systems in general as a means of facilitating improvement. Dr Grabs outlined these as meteorological information and forecasting not being in forms useful for hydrological forecasting; forecasts are qualitative not quantitative; extreme events are not risk qualified; advanced methods are not widely used; data holdings are fragmented; there is a communication gap between the two types of service; forecasts are not driven by objectives; and the vocabulary used is often too technical for the public to understand.

The initiative seeks to promote inclusion of floods in all aspects of integrated water resource management; provide flood management tools including policy options and resource strategies; reduce negative and enhance positive impacts; promote regional coordination; develop projects and strategies; provide training; compile a set of integrated flood management tools; and demonstrate new approaches linking technical, economic, and social aspects of flood management.

Dr. Grabs then discussed integrated flood management as the integration of land and water management in a river basin within the context of integrated water resource management. He stated that integrated flood management begins with risk management and considers the water cycle as a whole. Its approach is a multiple hazard approach and it is oriented towards river basins, having linkages with upstream changes and downstream effects.

All activities are carried out through the Associated Programme on Flood Management jointly with the Global Water Partnership. Some other activities in flood estimation, forecasting, training, and technology transfer were also discussed.

In winding up, Dr. Grabs discussed two key workshops: one that had already taken place and one that was planned for 2006. The first was the International Workshop on Flash Flood Disaster Mitigation in Asia, which took place in March, 2005, in Tsukuba, Japan. The workshop had come up with a number of key recommendations on flash-flood mitigation; information and warning; coordination and improvement of national and local plans; research needs; methods that do not need instrumentation; recognition of flash floods as fundamentally different from riverine floods; improvement of collaboration between hydrologists and meteorologists; coordination among different organisations; and limits to accuracy in forecasting and awareness of the same.

Dr. Grabs told the participants that the Tsukuba and Lhasa recommendations would contribute to a workshop to be held in Costa Rica from March 13-17, 2006 – the International Workshop on Flash Flood Forecasting.

The objective of the workshop would be to 'provide information on the types of flash-flood prediction capabilities available for application in flash-flood prone regions in developing countries. A range of solutions is to be covered; from simple inexpensive tools and applications to more sophisticated, centralised forecasting systems'.

Participants will determine the 'weak links' in establishing end-to-end operational flash-flood warning systems and how to fill these gaps. The workshop also has a number of specific objectives such as discussing the state of the art in forecasting and emerging methods; low-cost/advanced methods; aspects of hydrology and meteorology; flash-flood, disaster management; national and regional needs; and development of project briefs.

Discussion Session 4: Flash-flood forecasting and warning

Dr. R.S. Tolia was the moderator/facilitator for the discussion on Session 4. Queries about the Bhote Kosi case study focused on whether or not an environmental impact assessment had been carried out and whether there had been any resettlement issues. Participants were told that an assessment had been carried out before construction and a post-audit had also taken place. Twelve families had to be resettled.

The representative of the Bhote Kosi Power Company was asked if the company would pay for monitoring. He stated that the company is more than willing to share whatever data it has, but costs of monitoring would first have to be identified to see how much can be contributed. He was also asked if the GLOF warning system was working in other places. The participants were told that the system was tested in British Columbia, Canada (mountainous terrain), and it does work.

Participants thought that flash-flood guidance works fine in general, but how does it translate to the communities? It was stated that the national hydrological and meteorological systems have direct contacts with communities and receive good feedback, although not for all areas.

Some discussion took place on satellite systems. It was stated that India had adopted the meteorburst in the 1960s but it does not function well, so, therefore, the Indian small aperture terminal (INSAT 1A) and other foreign satellites are also used. Now India has swapped to very small aperture terminals (VSATs). The latest addition is INSAT 3C and this has led to additional data transmissions.

Meteorburst technology is used by the US to monitor snow in over 70 stations. It is a proven and well-established technology. The meteorburst has been in use in Pakistan for quite some time, but it does not function well during thunderstorms and Pakistan has switched to VSAT.

There was some discussion concerning whether all these systems are interoperable. There is some cooperation apparently and some of the equipment works for all sorts of systems.

Discussions then focused on different types of warning system. In Japan improved communication of information on forthcoming weather hazards, mainly through TV, has resulted in a decrease in the number of deaths from hazards. Bangladesh has had a similar experience in effective use of simple technology. It is trying to integrate hydrological components to facilitate effective cyclone warnings.

Session 5: Institutions, Policies and Strategies

Session 5 commenced on the morning of October 27th. On the 26th of October, participants had been taken on a field trip to Yamdok Tso Lake, Langkazi Meteorological Station, and Kalula Glacier. An account of this field trip can be found on the CD-ROM.

Dr. Qaseem Naimi, Advisor, Ministry of Energy and Water, Afghanistan, chaired Session 5.

Keynote paper: Total disaster risk management (TDRM)

The keynote paper for Session 5 was delivered by **Mr. Shingo Kochi,** a researcher at the Asian Disaster Reduction Centre (ADRC). ADRC, in cooperation with the UN

Office for Coordination of Humanitarian Affairs (Kobe), and other key stakeholders in Asia, has established total disaster risk management (TDRM) as an effective and strategic approach to disaster reduction. The approach is based on many years' research on coping with disasters in the world and in Asia in particular.

Mr. Kochi told the participants that TDRM rests on the two crucial principles of involvement and cooperation of all stakeholders and implementation in all phases of the disaster-risk management cycle.

The four main benefits of TDRM were presented as cost-effective development investments; best use of limited resources; effective application of local knowledge and experience; and good governance. Mr Kochi said that some of the essentials to realise these benefits are cooperation, coordination, and sharing of information; active involvement from stakeholders; and effective policies and planning.

Mr. Kochi outlined the five essential strategies: developing stakeholder partnership and public involvement; establishing coordination mechanisms, legal frameworks, and policies; integrating concepts of disaster reduction into development policy and planning; improving the dissemination of information and management; and promoting education in disaster risk management and improving public awareness.

The presentation then covered the priorities for action according to the Hyogo Framework for Action (2005-2015), particularly priorities for action related to national and institutional frameworks in terms of the involvement and cooperation of stakeholders.

The speaker stated that TDRM encourages the collaborative and concerted action of all stakeholders: national governments, local governments, scientific and engineering experts, NGOs, and the private sector. In this way, disaster risk reduction becomes teamwork.

One example of stakeholder involvement is the 'Central Disaster Management Council' in Japan which has the prime minister as the chairman and all the ministers as members.
The Council also involves major public corporations such as the Central Bank, Red Cross Society, broadcasting organs, telecommunication organs, and academia. Under this Council, committees for technical Investigation have been established to enable preparation and implementation of a basic disaster management plan; deliberate on critical issues in disaster management as requested by the prime minister and minister of state for disaster management; and offer advice to these two ministers on matters pertinent to disaster management.

Mr. Kochi told participants that the disaster risk management cycle approach is in four phases: prevention/mitigation, preparedness, response, and rehabilitation/reconstruction.

Taking appropriate measures based on the concept of disaster risk management in each phase can reduce the overall disaster risks and their adverse impacts. This, too, fits into the Hyogo Framework of Action under priorities for action (4) – to reduce the underlying risk factors and address the response and rehabilitation phases.

To fulfil these goals, an International Recovery Platform was launched in May 2005. The platform is a joint initiative of UN/ISDR (International Strategy for Disaster Reduction), United Nations Development Programme (UNDP), UN Office for Coordination of Humanitarian Affairs (UN/OCHA), International Labour Organization (ILO), International Federation of the Red Cross/Red Crescent (IFRC), and the World Bank (WB) and is supported by ADRC, Japan. It has been realised that post-disaster recovery sometimes leads to rebuilding risk. It often returns a country to the conditions of normal development it enjoyed before a disaster occurred. Therefore, even in the post-disaster recovery phase, we should take disaster risk management into consideration.

The presentation concluded with a brief on the disaster management system in Japan in which the Central Disaster Management Council is responsible for preparing a basic disaster management plan. The basic disaster management plan describes the activities of all stakeholders in each disaster phase. All ministries and agencies and all designated public corporations and local disaster management councils are obliged to formulate disaster management operation plans describing what each section of their organisations must do both before and during disasters.

Case Study 1: Policy on water-induced disaster mitigation in Nepal with a focus on flash floods

Mr. Shital Babu Regmee, Director General of the Department of Water Induced Disaster Prevention, Ministry of Water Resources, Nepal, presented the first case study for Session 5. Mr. Regmee commenced his presentation by stating that the establishment of the Department in 2000 indicated the priority the government of Nepal is giving to disasters such as landslides and floods. Originally the concept of disasters was very conservative, and they were seen as acts of nature. Today it is recognised as mandatory that plans and policies have to be in place to mitigate and deal with disasters.

Mr. Regmee briefed the participants on the salient features of the National Calamity Relief Act formulated in 1982. The purpose of the act is to provide rescue and relief from natural calamities. This relief is organised through a series of committees: a central one under the Ministry of Home Affairs, regional committees (5), district committees (75), and local committees and sub-committees as required. The government can declare a disaster for a designated area for a specific time period, during which time a central calamity relief fund can be established – such funds can also be established at regional and district level.

In 2002, the government formulated a National Water Resources' Strategy for which DWIDP was designated as the lead implementing agency; other institutions involved include the Department of Hydrology and Meteorology, the Department of Irrigation, and the Ministry of Home.

The first output of this strategy for short-term (5 years), medium-term (15 years, and long-term (25 years) mentions water-induced disaster prevention and outlines the steps to carry out the strategy which includes policies and plans, mapping disaster-prone areas, establishing systems, strengthening information networks, awareness campaigns, establishing flood committees with respect to neighbouring countries, and implementing measures planned. The strategy gives target years and goals: by 2007 disaster-prone areas should have been mapped and emergency measures established regionally; by 2017 infrastructure for disaster mitigation should have become available in 20 districts and warning systems established country-wide; and by 2027 social and economic losses should have been reduced to the level of those in developed countries.

Mr. Regmee discussed in some detail the Water-induced Disaster Management Policy prepared by the Ministry of Water Resources, HMG-Nepal. The plan defines five policy areas: emergency protection; information dissemination for effective relief, rescue, and protection; awareness-raising; warehouses for rescue and relief supplies; and a rehabilitation fund

The policy also categorises areas as highly vulnerable, moderately vulnerable, and safe and standards have been set for the infrastructure to be developed in affected areas. Conservation of watershed areas is seen to be essential and integral to infrastructural development. Other features of the policy, which was due to be passed in 2005, included involving communities, using floodplains, protection of vulnerable areas and their designation, participation of the private sector, and institutional arrangements and human resource development. The lead role played by the Department has given it the responsibility of establishing warning systems, and, in doing so, it collaborates with universities and technical institutions.

In terms of policy gaps, Mr. Regmee mentioned that the concept of state involvement in disaster management is new to Nepal. The Act introduced in 1982 mainly focuses on relief and rescue operations. The measures proposed and resources available limit the scope of work to short-term rescue and relief activities such as providing temporary shelters and distributing food and clothes. The Water-induced Disaster Management Policy has still to be approved. He believed that the aspirations of the general public, international exposure, present global trends, and donor requirements are resulting in priority being given to this sector. Nevertheless, involvement of the private sector, activation of an insurance system, and adoption of measures favouring vulnerable people and communities are lacking.

Case Study 2: Policy and institutional arrangements for disaster management in China

The second case study for Session 5 was presented by **Dr. Zheng Yuanchang** of the Ministry of Civil Affairs of the People's Republic of China. Dr Zheng Yuangchang explained the institutional set-up: the National Commission for Disaster Reduction is designated to coordinate natural disaster relief/emergency efforts and the Office of Comprehensive Coordination for Nationwide Fight against Disaster and Relief Efforts is committed to mitigating disasters and relief efforts as a comprehensive coordinator and to facilitating the access of relevant departments to information about the development of disasters, rescue, and relief efforts for disaster-stricken areas.

A Board of Experts has been established as an advisory body and it is committed to providing advice and suggestions for key decisions and planning concerning disaster reduction. In 2002, a national centre for disaster reduction was established.

China has already formulated a National Disaster Management Policy to establish a national system for disaster relief planning and improvement of the national system for natural disaster monitoring, early warning, and forecasting. This system plays a key role in responding to devastating disasters and has turned out to be a strong guarantee for effective and efficient emergency response management. Relief stockpiles have already been established and improved; a well regulated emergency response system is being established; various funds for disaster relief, rehabilitation and reconstruction, and food aid have been established; and a civil society response mechanism has been established. Dr. Zheng Yuanchang said he believes this demonstrates strong commitment on the part of the state to the International Decade for Natural Disaster Reduction. Since the establishment of a national committee, a small satellite constellation has been established and active participation in international exchange and cooperation has increased.

Efforts will be intensified to improve disaster management and to optimise the operational mechanism through the implementation of the State Overall Emergency Response Planning for the Outbreak of Public Incidents and the State Emergency Response Planning for Natural Disasters. Efforts will also take place to popularise the application of advanced technology for across-the-board improvement of disaster response and relief capabilities.

Methods will include training at all levels, improvement in public awareness, and establishment of role-model communities.

Case Study 3: 'Katrina'

Case study 3 of Session 5 was presented by **Ms. Rebecca Scheurer,** Regional Advisor, USAID, Nepal. Ms. Scheurer described the events of August 29, 2005, when a grade 4 hurricane (230 kmph), Katrina, hit the coast of the Mexican Gulf and triggered an unprecedented response. Eighty per cent of New Orleans was under water, 95% of the refineries were closed down, and power was cut off for over a week – 1.7 million people were affected.

Ms. Scheurer told participants that they had still to learn what went right and what went wrong. In terms of institutional response, it is understood that if local communities can not respond, the state will intervene and if the state can not manage, the Federal Emergency Management Agency (FEMA) will enter the scene.

FEMA is mandated to coordinate disaster responses and coordinate and collect data from 26 federal agencies. All the representatives from these 26 federal agencies met after the hurricane. There were briefing meetings every day.

It was the first time that the USA had ever accepted relief donations from abroad and new systems had to be set up by OFDA to administer this process. The USAID with FEMA coordinated to see whether people needed donations; and to carry out the logistics and operations for distributing the aid. Ms. Scheurer said that her job is to make sense of the donations: they rely heavily on the Department of Defence.

On reflection Ms. Scheurer said that disasters are normally dealt with by local communities – if needs are greater the national level taps in (FEMA); cash donations are best, as they allow flexibility; NOAA has been very supportive with predictions and its satellite images have been life-saving; a budget should be allocated for disaster preparedness but how much, where to get materials? Congress is looking into this; communities are important as they are the first to be affected and should be empowered to deal with disasters; the chain of command is not without glitches, so how to ensure a smooth, flawless bureaucracy in times of emergency? The poor are the most affected, hence the ability of the community to respond should be strengthened.

Discussion Session 5: Institutions, policies and strategies

The Chairman, **Mr. Qaseem Naimi,** facilitated the discussion for Session 5. Participants commenced their discussions by focusing on policies. They said they believed that flash-flood policies are not effective, because flash floods are too small and occur in isolated areas. Flash floods are not big enough to count as national disasters and hence receive insufficient attention. There is clearly a policy gap.

In the case of Nepal, the Act formulated concentrates on rescue and relief. In the case of flash-flood events and mitigation management in Bangladesh by the Bangladesh Water Development Board, the 2005 'Standing Orders on Disaster' created the opportunity to establish disaster-management committees at every level. These committees are activated during a disaster. The standing order for disaster management provides ample scope for the government, NGOs, and private sector to think locally and plan a needs' based programme involving the community.

Isolated flash floods are not considered national disasters, hence emphasis should be placed on policy gaps; and ICIMOD and its partners should work on gaps and implementation at local level.

A query was put to the participant from the Bhote Kosi Power Company: can a private sector company like Bhote Kosi Power Company influence political will? If so how? Mr. Shah responded that the key is to lobby for political will. He said that the private sector can play a role by focusing its attention on disasters.

Discussion then moved on to integrated water resource management. Some participants stated that on a large scale we all applaud integrated water resource management, but its concepts do not give much attention to floods and similar disasters. Other participants considered that this approach has been an important and valuable way forward regarding the management of water resources, and flood management and mitigation are important parts.

Finally, participants discussed case study 3 on Katrina: they wondered whether a top-down approach or a bottom-up approach to disaster response is better? In the US, after Katrina, the bottom-up approach provided a late response, whereas, in Pakistan, after the recent earthquake, a top-down approach ensured that relief was provided quickly and effectively. This conceptual difference should be addressed

Participants were informed that the US has a decentralised system; therefore the bottom-up approach is prevalent. After this experience, however, FEMA might be provided with added authority to overlook the structure in the case of extreme disasters.

Flash-flood training and warnings are carried out as a federal exercise in the US and NOAA is already a part of this system. In addition, NOAA has other mandates and has to forecast other events.

After Katrina, the initial responses were from banks, insurance companies, retailers, and others from the private sector. Walmart was the first to respond. Therefore, the private sector also plays an important role. Every state and county in the US has emergency planning agencies.

Discussion session 5 was followed by a poster session and lunch break.

conclusion

Session 6: Towards better Flash-flood Risk Management in the Region

Session 6 began in the afternoon of October 27th. The Chairman for this, the final session of the workshop, was **Dr. J. Gabriel Campbell,** Director General of ICIMOD. The Session commenced with the following reflections by Dr. Mats Eriksson of ICIMOD.

Dr Eriksson, in his reflections on the workshop, gave a concise summary and compilation of what had been said during the previous sessions. Particular emphasis was placed on issues that had been addressed several times and by different speakers. The purpose of these reflections was to summarise what the workshop had achieved so far and to provide a platform for the next phase, i.e., the group discussions and fine tuning of the Lhasa Declaration.

As a starting point, Dr Eriksson said that it was clearly beyond doubt that flash floods pose a real threat to mountain people, their lives, and livelihoods. Flash floods, for instance, cause damage to health and property and displacement: they also reduce working ability. Poor people, especially women, the elderly, and children are the most vulnerable. Annually in the Himalayas an unknown number of people are affected by flash floods. Statistics are poor or non-existent, but it is estimated that at least 5,000 people are killed in the Himalayan region annually as a result of flash floods. Management of flash floods has to be improved – the problem cannot be overlooked.

Additional general conclusions were that flash floods with their catastrophic nature and rapid onset are different from riverine floods and therefore need special attention. It was also stated that no country in the region has a sufficient network for collection and monitoring of hydro-meteorological data for flash-flood management. All the countries in the region expect flash floods to increase in future.

Dr. Eriksson summed up what had been emphasised concerning the principal topics of the workshop.

Regarding **community awareness and preparedness** – there is awareness among technical staff (hydrologists and meteorologists) but it is poor or lacking among others. Some communities and ethnic groups perceive natural disasters as an act of God, which may hamper action on preparedness. In conclusion, there is a great need to raise awareness among politicians, policy-makers, communities, and the public at large. Moreover, it was emphasised that communities themselves have a major role to play in flash-flood management (as well as in management of other natural disasters) and in the implementation of community based disaster risk management.

On the topic of **hazard control,** it was stated that a number of interventions can be undertaken to mitigate the impact of flash floods. Among these are mapping and monitoring glacial lakes; mapping landslide hazards; conserving and managing watersheds; monitoring landslide dams; inspecting dam safety; and mapping flood hazards. Dr. Eriksson mentioned a particular suggestion to encourage hazard control. It was suggested that a small grant fund for flood mitigation and hazard control at community level should be established. Such an initiative could provide funding for small improvements in the communities such as improved paths, roads and bridges; relocation of buildings in dangerous positions; stabilisation of river banks; and implementation of training courses. A fund like this would be demand driven; it would empower communities, alleviate poverty through work opportunities, build capacity, disseminate knowledge, and emphasise local ownership.

Systems for **forecasting and warning** of flash floods are inadequate throughout the Himalayan region. Warning systems have been installed in only a few cases; for example, for the Bhote Kosi Hydropower Company where river-level gauges and sirens have been installed. However, no consequent efforts have been made at national or regional level. Nevertheless, appropriate technology is available and is being used or tested in other parts of the world. It was suggested that a feasibility study should be undertaken to explore which of the available techniques and forecasting and warning systems would be appropriate for the Himalayan region.

In relation to **institutions, policies and strategies,** Dr. Eriksson drew a parallel to the water world where it was concluded in the World Water Forum 2000 that the water 'crisis' is a 'crisis' of water governance; i.e., sufficient technological solutions are available, the problem lies in the way these are administered and implemented in society. Similarly, the disaster 'crisis' can be said to be a 'crisis' in disaster governance. Capacity building is needed for institutions at all levels as well as an integrated approach to managing flash floods. The governance structure normally falls under three headings: a) the enabling environment incorporating policies and legislation as well as people's empowerment ; b) institutional roles in which different institutions have different roles (decentralisation is important here as well as demarcation of management boundaries); and c) management instruments. In efficient, integrated flash-flood management, a number of institutions should be involved: central government, local government, district government, the private sector, media, individuals, informal institutions, donors, and NGOs. Since there are so many different players in the field, there is a great need for improved dialogue between different governance levels and between different sectors and institutions. Both vertical and horizontal dialogue need to be improved.

In concluding, Dr. Eriksson re-emphasised that flash-flood management needed to be improved, the problem cannot be overlooked; that there is an urgent need for awareness creation among politicians, policy-makers, communities, and the general public; that communities have a major role to play in flash-flood management; that


Glaciers store freshwater but can also cause flash floods


Flash floods are a common mountain hazard

there is a need for improved dialogue between different sectors and different governance levels; and that there is a strong need for a catchment approach in the efforts to improve flash-flood management.

Following Dr. Eriksson's conclusions, Dr. Xu Jianchu, Manager of the WHEM Programme of ICIMOD briefed the participants about ICIMOD's agenda for flash-flood risk management. He also gave the participants an introduction to group work and the expectations for the outcomes. The participants separated into their various groups and group work continued for the rest of the afternoon.

The final part of Session 6 and the Closing of the workshop took place on Friday the October 28th. It commenced with a short feedback by group representatives of their work the previous day, and the groups then reassembled and continued with their meetings until the morning break. The morning break was followed by presentations of the group work results and discussions.

Group work discussions had focused on six issues: the needs of each country; sites proposed for establishing equipment and carrying out activities related to these needs; partners proposed to assist in these endeavours; means of improving dialogue; country-to-country learning; and other related issues. Needs include establishment of hydro-meteorological stations and networks, early warning systems, flood-forecasting systems, hazard assessment mechanisms, real-time data acquisition, specific site studies, mapping and preparedness skills, and identification of communities where equipment could be established or work carried out. Each country had suggested suitable sites for these. The groups had also identified different partners in their respective countries to carry out specific actions and strategies. These ranged from government departments to NGOs and international organisations. One issue of discussion had been how to improve dialogue and channels for communication. Country-to-country learning was also discussed and groups made suggestions about what each country could learn from the others. In addition, there were issues such as impacts of upstream watershed practices, plant-cover conservation, and standardisation of databases and technologies across and within countries. An analysis of the group work results and discussions given by Dr.Xu Jianchu is presented in Annex 3.

The afternoon session was chaired by **Ms. Mandira Shrestha** of ICIMOD. A presentation was given by Dr. Xu Jianchu and Dr. Mats Eriksson of ICIMOD on 'Perspectives for Capacity Building for Flash Flood Management in the Himalayas' and this was followed by a discussion on the Lhasa Declaration. Conclusions and recommendations including suggestions for follow up to the workshop were derived from this and other discussions and have been included below in the section on 'The Lhasa Declaration'.

Closing

At the commencement of the closing session participants were given an opportunity to give their own remarks and observations. In addition, participants also had an opportunity to evaluate the workshop on an evaluation form prepared for feedback. The closing remarks were given by Dr. J. Gabriel Campbell, Director General of ICIMOD, after which Dr. Campbell invited the participants to an informal farewell get together.

The Lhasa Declaration on Flash Flood Management

The following statement – The Lhasa Declaration – was adopted by participants at the workshop and includes conclusions, recommendations, and an outreach proposal.

Flash floods are severe flood events triggered by extreme cloudbursts; glacial lake outbursts; or the failure of man-made dams or dams caused by landslides, debris, ice, or snow. Flash floods can have an impact hundreds of kilometres downstream; yet the warning time available is counted in minutes or, at the most, hours.

Thousands of people, their lives, livelihoods, and homes – along with expensive infrastructural investments – are at great risk from flash floods in the Himalayan region every year. Despite this severe exposure to flash-flood risks, in most of Asia there are still no forecasting, warning, and management systems in operation to prevent or mitigate flash-flood disasters.

In the Himalayan region, there is an urgent need for new and improved mechanisms for forecasting and real-time warning, both nationally as well as across country borders. There is an urgent need to strengthen preparedness among all government and private stakeholders, with a special emphasis on community preparedness and response.

The 'International Workshop on Flash Flood Management and Sustainable Development in the Himalayan Region' was held in Lhasa, Tibet Autonomous Region, the People's Republic of China, from 23 to 28 October 2005. The workshop was organised by the International Centre for Integrated Mountain Development (ICIMOD), the China Meteorological Administration (CMA), and the World Meteorological Organization (WMO). The objective of the workshop was to collect information on the current status of flash-flood management in the eight member countries of ICIMOD (Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Pakistan) and to discuss the preparedness, mitigation, and management of flash-flood events in the context of sustainable development in the Himalayan region.

The workshop was attended by participants representing a wide range of institutions from seven of the ICIMOD member countries: Afghanistan, Bangladesh, China, India, Myanmar, Nepal, and Pakistan. The representatives of Bhutan contributed with a report describing the current status of flash-flood management in their country; unfortunately they were unable to attend the workshop. Experts from the WMO, ICIMOD, the Asian Disaster Reduction Centre (ADRC), the Asian Disaster Preparedness Centre (ADPC), Switzerland, the United States, and other national and international institutions also participated.

The workshop was supported financially by the Government of Norway and the USAID Office of US Foreign Disaster Assistance (OFDA).

Conclusions from the workshop

General

- Flash floods pose a serious threat to people's lives and livelihoods in the greater Himalayan region, as well as to the people living downstream in the flood plains. Valuable infrastructure, such as hydropower plants, roads, bridges, and communication systems, is also at risk. Therefore, management of flash floods has to be improved – the problem cannot be overlooked.
- Flash floods are of a different physical nature to riverine, or seasonal, floods and therefore need different attention in terms of forecasting and management. Landslides and debris flows also pose serious hazards that may be triggered by flash floods.
- Vulnerable groups, including the urban and rural poor, women, children, and the elderly, should be given special attention with regard to flash floods and their management.
- Scientific projections indicate that the magnitude and frequency of flash floods in the greater Himalayan region may increase in the future as a result of change in climate and its variability.
- It is expected that without effective counter-measures, the adverse socioeconomic impact of flash floods in the greater Himalayan region will increase in future.

Institutions and policies

- National disaster management strategies that integrate many types of disasters are needed.
- Communities have a major role to play in the management of flash floods. The concept of 'community-based disaster risk management' should be promoted in parallel with the concept of 'community-based natural resource management' since the management of resources and risks goes hand in hand.
- The private sector and civil society are important partners in all phases of the disaster-management cycle: prevention/mitigation, preparedness, response, and recovery.

Creation of awareness and knowledge

- There is inadequate awareness and knowledge generally about the nature of flash floods and their threat to communities and infrastructure.
- Improved understanding of the nature of flash floods and their causes, development, and impact is needed.

Communication and cooperation

- The nature of flash floods calls for a strong 'catchment approach' to management, including a functional upstream-downstream dialogue in a transboundary context.

- Dialogue between different sectors and different governance levels regarding the management of flash floods and other disasters needs improving. An 'integrated flash- flood management' approach should be adopted.

Forecasting, warning, and hazard control

- The existing meteorological and hydrological networks for data collection and transmission in the region are inadequate for forecasting and early warning.
- Improved forecasting, warning, and communication systems are needed for flash floods in all countries within the greater Himalayan region. Since many flash floods are transboundary in nature, mechanisms need to function in a transboundary context.

Recommendations from the workshop

Institutions and policies

- Countries should develop adequate disaster-management policies and plans, including for flash floods, at both local and national level.
- The capacities of institutional entities responsible for disaster management, in general, and flash-flood management, in particular, should be strengthened. The roles and responsibilities of all institutions involved must be clearly defined and appropriate institutional arrangements should be in place at all administrative levels.
- Communities should be empowered to play a central role in flash-flood management – including preparedness, adaptation, and mitigation.

Creation of awareness and knowledge

- A standard methodology for documenting flash-flood events, their causes, and impacts should be established.
- Awareness should be raised among politicians, policy-makers, communities, and the public at large about the threats posed to communities by flash floods. Vulnerable groups need particular attention. Awareness-raising programmes should be launched through, for example, the mass media, social institutions, and community-based organisations as well as through formal and informal education systems. Specially-designed awareness campaigns should be prepared for non- and semi-literate people.
- Knowledge about flash floods and their management, including their nature, origin, impact, and mitigation, should be improved and increased resources made available for research of this kind.

Communication and cooperation

- Communication and coordination among relevant institutions, both laterally and vertically, from community to national levels should be fostered. In doing so, national stakeholders should be encouraged to establish formal and informal platforms to facilitate cross-sectoral dialogues to improve flash-flood management.

- Regional and transboundary cooperation to increase the exchange of data, information, and knowledge crucial for flash-flood forecasting and warning services and for the implementation of improved flash-flood management should be promoted. International collaboration in areas of research, exchange, and regional learning is also recommended.

Forecasting, warning, and hazard control

- Countries in the region should implement reliable and accurate flash-flood forecasting and warning systems. Improvement of cooperation between and within the forecasting and warning agencies and the end-users should be given priority.
- Models for improved flash-flood forecasting, mitigation, and planning should be adapted and applied. Special procedures should be developed for flows with extremely high sediment loads.
- More attention should be given to hazard control, for example, integrated strategies for watershed management, hazard mapping, and dam safety inspection.

Outreach process

Participants agreed that the workshop could serve as a starting point to initiate a process having the principal objective of reducing flash-flood vulnerability in the region within the context of sustainable development and poverty reduction.

While a specific outreach strategy needs to be developed in the near future, key elements of this regional approach could include the following objectives.

a) To improve national capabilities including the regional exchange of data, information technologies, and know-how
b) To promote and implement national and transboundary projects to reduce flash-flood disasters
c) To facilitate partnerships between key national agencies and non-government organisations region-wide and to reach out to the general public to create and increase awareness of flash-flood challenges and options for their mitigation

annex 1
conference keynote paper: approaches to flash flood management in mountain regions

Manfred Spreafico, Swiss National Hydrological Survey

From Protection against Natural Hazards to Risk Management

In order to cope properly with the problem of natural hazards, a change in approach from natural hazard protection to risk management is essential.

The two approaches are distinct in many ways, as can be seen from the following table.

Characteristics of Hazard Protection and Risk Management

Indicator	Hazard Protection	Risk Management
Message	How can we protect ourselves?	What security at what price?
Events	Frequent	Frequent and rare
Importance of the hazard	Unknown	Known, assessment taken into account
Planning of measures	Specific	Interdisciplinary
Management of the funds committed	Nearly impossible	Comparably efficient, acceptance taken into account
Comparison of measures	Sector-based	Priorities according to a global approach
Security	For present generation – high in certain sectors	Solidarity with future generations – balanced for the overall system

Coping with Risk: Flood Risk Management in Switzerland

Structural flood protection measures were established in Switzerland during previous centuries. However, damage potential has increased because of increasing intensity of land use and augmentation of economic value in endangered areas. Furthermore, urbanisation and accompanying construction have resulted in there being little open land left today as a buffer against big flood events.

In Switzerland there are also many deficiencies in the protective measures; and, finally, climate change has become an uncertain parameter which has to be taken into account in terms of future flooding and the needs of flood risk management.

A Federal Law on Flood Control, which was adopted in 1993, enforces the following measures: i) comprehensive hazard assessments; ii) differentiation between protection measures; iii) adequate planning of measures; and iv) limitation of remaining risks (emergency planning).

This law is based upon the following five flood-protection principles.

1. Comprehensive analysis and documentation of hazards
2. Areas and objects of great value require a greater degree of protection than those of less value
3. Retardation of flood discharge by means of retention areas in order to minimise flood peaks
4. Guaranteed appropriate maintenance of river and stream channels
5. Flood safety measures should have a minimum impact on natural habitats

Comprehensive flood risk management

The logical procedure for implementing flood risk management is as follows.

1. Investigation and analysis of flood events
   - Hydro-meteorological (appropriate monitoring of water level and discharge – the technology is dependent on the river type), topographical, geological, vegetation, and hydraulic conditions
   - Damage and hazard potential
   - Protection of the economic and ecological situation
2. Documentation and analysis of extreme flood events
   - What has caused floods? (meteorology, hydrology, sediment, damage process)
   - Investigation of historical floods and possible changes in future (growth in economy, climate change)
   - Analysis and consequences (planning, protection goals, land-use planning, protection measures)
3. Determination of protection, economic, and ecological goals
4. Planning of measures
5. Judgment and prioritisation of measures
6. Realisation of measures, controlling (loop to 2)
7. Handling of remaining risks
   - Preventative measures
   - Emergency planning

Flash-flood Management in the Mountainous Region of Switzerland

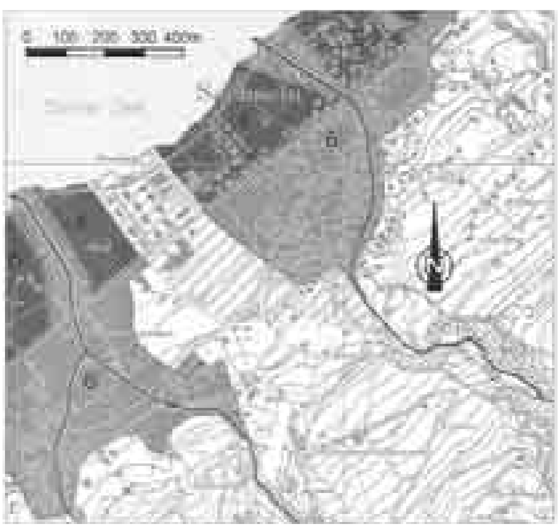
The guiding principles for flash-flood management in Switzerland are as follows: i) diversion of water and sediment to locations where they will cause least harm; ii) distribution of the water over larger areas to break the high energy impact; iii) ensuring there is enough space on both sides of a torrent, because the force is too strong to be managed; iv) keep in mind the former natural hydraulics of the rivers; v) construct houses with strong foundations and entrances sufficiently high above the ground; and vi) provide or design safe places to which people can escape.

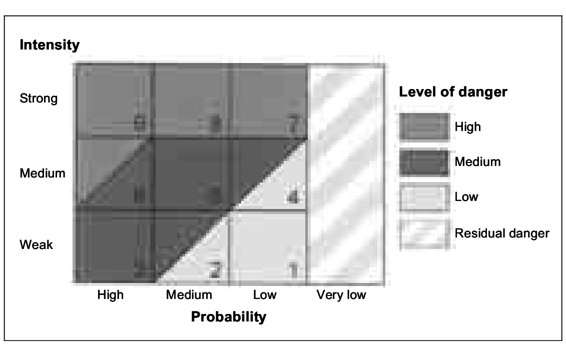
Examples of flash-flood events and protection measures

A slide presentation was given which included six examples of different flash-flood events in Switzerland and the protection measures used. These can be found on the CD-ROM of the workshop. One example is described below – a flash flood on 15 August 1997 in Sachseln caused by a cloudburst.

A small, mountain catchment, 7.7 sq. km. in area, was under pressure for several hours with 90 mm/h rainfall; and this resulted in discharge of up to 49 m^3/s in an area where the capacity was only 23 m^3/s; as a result 100,000 cubic metres of sediment and 5,000 cubic metres of wood were transported by the discharge. The total cost of the damage incurred was US$ 120 million for housing, infrastructure, rehabilitation, and flood protection.

The disaster occurred as a result of the low discharge capacities of the three main river torrents in terms of handling a 100-year flood occurrence; the number of trees transported by the torrents (logging at bridge points); a below par discharge cross-section meaning there was not enough freeboard; and construction of buildings in endangered zones.





The Sachseln flash flood example – hazard mapping before (left) and after (right) implementation of structural protection measures

The protection measures used following this event were as follows: construction of a screen dam to retain transported wood; enlargement of the sediment retention basin in the Dorfbach (8,000 to 32,000 m^3); enlargement of the beds of the three torrents (HQ100); construction of a new bed for the Dorfbach; diversion of the water from all the torrents to an area without costly damage potential; introduction of a rough torrent bed to reduce flow velocity and erosion; demolition of four houses; and construction of eight new bridges, plus a number of ecological measures

The hazard levels before and after the introduction of protection measures in the surrounding areas can be seen in the figures above.

annex 2
summary country reports

This annex presents the executive summaries of the country reports from Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. The full reports of these studies with figures can be retrieved from the CD-ROM. They are included in the folder 'Country Studies'. The power point presentations can be found on the CD-ROM under the heading 'Presentations/Session 1 Country Report Presentations'.

Country Report Afghanistan – Executive Summary

Afghanistan has an arid to semi-arid climate and is composed of interconnected, high mountain ranges that in some places reach more than 6,000 masl and extend about 1,300 km from northeast to southwest. The water sources of all the nation's rivers are deposited in these ranges during winter precipitation. Annual rainfall ranges from 100 mm in the southwest to 1,200 mm in the higher altitudes of the northeast.

Runoff from the northeast and central catchment areas is the main source of water, about 55 billion cubic metres (bcm) for the rivers flowing into the five major river basins in the country. Most of the precipitation, which is orographic in nature, is accumulated above 2,000m, thus contributing to flash floods. The floods cause severe damage and various types of erosion leading to millions of dollars in economic loss. Past conflicts, lack of governance, the poor local economy, and the latest drought, together imposed a heavy toll on the natural land cover – including forests. This heavy degradation of the environment and accelerated soil erosion aggravate floods, and the consequent damage to infrastructure, agricultural fields, housing, and water supply systems in the lower valleys and plains.

Flash floods are a common phenomenon in the country, occurring in spring and early summer, particularly when heavy downpour is accompanied by rapid snowmelt. The magnitude of damage and human and economic loss is not recorded consistently and hence there is little basis for a thorough analysis of the situation. Detailed figures provided by aid agencies and/or ad hoc committees (government, private, NGO) and discussed in this paper may be based on limited access to the real information. Some sources estimate the annual economic loss to be as high as $400 million in rainy years. The damage incurred mainly consists of substantial river bank erosion, sedimentation of canals and reservoirs, devastation of agricultural fields and housing, and displacement of the affected population. In 2005 there was a dam break in Ghazni province. It seems that increasing degradation of the environment and inefficient governance have caused an increase in the trend of flash flood events.

In accordance with the present institutional set up, and because of the involvement of multiple stakeholders in the natural resource sector, study and mitigation of flash floods are crosscutting issues that should be jointly addressed by all parties. It seems that the Joint Operation Centre established in 2005 in collaboration with the Department of Disaster Preparedness under the chairmanship of the Vice-President as an inter-ministerial committee was a good response to flash-flood mitigation. The structure is still in place and operational. The Ministry of Energy and Water, as the main stakeholder, has the capacity to take the initiative and establish a sub-office under the Department of Hydrology for the time being and gradually upgrade and develop it into an independent organisational set up to deal solely with flash-flood studies and mitigation and/or strengthen the Department of Disaster Preparedness under the Ministry of Rural Rehabilitation and Development to cope with the situation. In this case, the Ministry of Energy and Water will be contributing the technical inputs and the Department of Disaster Preparedness will have the operational mandate. Participation of other actors is also vital for efficient and timely operations. In either case, a policy framework and an action plan for flash-flood studies and mitigation have to be finalised, approved, and enforced as soon as possible.

In order to reduce flash-flood hazards, an efficient and reliable early-warning system network with good coverage of the areas at risk is essential. The reconstruction of countrywide hydro-meteorological stations by the Ministry of Energy and Water will provide the opportunity to have the information required for forecasting and for running such a system.

However, a mass awareness programme is also extremely important as far as emergencies and long-term measures for flood mitigation are concerned. To launch a successful awareness programme at all levels, there is a strong need for active participation of local 'shuras' and other community organisations, of non-government organisations (NGOs), of the government, and of the private sector.

Other measures contributing to a considerable reduction in flash-flood risks include the regeneration of rangelands and forests through conservation practices, an afforestation programme, the implementation of water-harvesting techniques and watershed management, the construction of reservoirs and dams to store flood water, and the undertaking of embankment and other protection activities in flood-prone areas.

Country Report Bangladesh – Executive Summary

Flash floods in Bangladesh are assaults of nature in an unpredictable manner. Normally riverine flooding is a common feature and the people of Bangladesh are accustomed to such events. Adaptability to riverine flooding is increasing day by day: it is also the lifeline of the ecosystem in the flood system. But the devastation caused by flash floods has different dimensions. In April 2004 severe flash floods occurred in the northeastern region of Bangladesh. This was the worst flash flood event in the recorded history of Bangladesh in this region. This part of the country experienced nearly 1.5 times the normal monthly rainfall which caused widespread damage to standing crops as well as to the infrastructure. For the purpose of mitigation both structural and non-structural measures have been undertaken. The

Flood Forecasting and Warning Services' Centre of the Bangladesh Water Development Board is disseminating model forecast results and, for safety and return on investments, infrastructure has been built with rehabilitation features. These protect the crops from risk of inundation as well as from shifting channels. Disaster management issues involve integration of prevention and mitigation measures into overall development planning and activities, preparedness plans, and related warning messages. The government of Bangladesh historically has been keen to initiate and expand dialogue fostering regional cooperation in water-resource management – including flood disasters. Hydro-meteorological information from far inside Indian territory is a sine qua non for meaningful flash-flood forecasting. Bangladesh is gradually becoming more vulnerable to different types of floods. Climate change as a result of global warming in this region is going to mean more catastrophic riverine and flash floods in future.

Country Report Bhutan – Executive Summary

Bhutan is a landlocked country located on the eastern fringes of the Himalayas. The terrain is rugged and wholly mountainous, thereby providing an ideal setting for development of hydropower. While this setting is considered advantageous, the disadvantages lie in being prone to numerous water-related disasters. The glacial lakes that feed most of the main rivers of Bhutan do cause problems due to outbursts. While inundation caused by outbursts is limited by the terrain, the sheer force causes huge losses of life and property. Landslips are regular occurrences due to the steep nature of the topography. These landslips create temporary dams across river courses and, in a few cases, have resulted in breaching and, consequently, huge floods. Bhutan is prone to flash floods especially in the southern foothills caused mainly by intense precipitation during the monsoon season.

It is strongly felt that disasters caused by flash floods need to be dealt with adequately. Past events indicate that these are occurring at an accelerated rate, apparently due to climate change. The need to reduce risk to life and property has assumed dimensions that warrant urgent attention.

In Bhutan, while formal mechanisms do not exist to deal with disasters associated with floods, responses have been adequate whenever disasters have occurred. Organisations at the national, district, and local level have responded in a timely manner during disasters. However, with increasing frequency and with the fear that larger events might occur, a coordinated approach to deal with these disasters has become a necessity.

Realising the importance of having a response system in place, the Royal Government has designated the Department of Local Governance under the Ministry of Home and Cultural Affairs to come up with a comprehensive national disaster management strategy. The formulation of this strategy is in process.

This paper looks at causes of flash floods in Bhutan, the problems they have created, the scale of the events, and how these have been handled. It also looks at institutional, policy, and legal frameworks that need to be in place to deal with disasters; the importance of creating awareness for people living in risky areas; and establishment of a warning system.

Country Report China – Executive Summary

China is a mountainous country in which mountainous areas account for two-thirds of the territory. The combined influence of climate, geography, and human activities means that serious flash floods often take place in China.

This report describes a large number of typical flash-flood events that have occurred, summarises the characteristics of flash floods and main causes for their formation and development, analyses the trends in their development, and examines the current, austere measures taken to prevent flash-flood hazards in China. It also describes the Chinese system, policies, regulations, implementation plans, and objectives in the context of flash-flood hazard prevention and management; the current situation, existing problems and strategies of flash-flood hazard prevention in China are analysed; the current situation and planning of flash-flood forecasting and warning systems are illustrated; and pertinent advice is also given.

The aggravation and development of flash floods have become focal issues today in the field of flood control and hazard reduction around the world. Because of the late start to research into flash floods in China and the lack of international exchange, this report will enable other countries to learn about the current situation, policies, regulations, and development trends in flash-flood hazard prevention in China, and it will also facilitate and promote international cooperation in this forum.

Country Report India – Executive Summary

Flash floods occur in the northernmost states of Himachal Pradesh and Arunachal Pradesh in the Indian Himalayas. The biggest cause of flash floods is cloudbursts and the consequent excessive rainfall. Other causes of sudden and high magnitude flows are breaching of landslide dams and rapid melting of snow and glaciers. Steep slope gradients in the hills are instrumental in causing high velocities of flow, which is a characteristic of flash floods. Flash floods also take place in the Western Ghats and the Vindhya Range of hills in the interior peninsula, although less frequently and of less intensity than in the northernmost states. Flash floods also occur in the desert areas. Human activities in the flood plains, too, cause damage.

Although flash floods have been occurring in India for centuries, they have always been categorised as 'floods' and no distinction has been made between 'riverine floods' and 'flash floods'. There is no documentation of flood events. Flash flood events have been gleaned from published papers, reports, manuals, office records, internet, newspapers, journals, and so on. Efforts have been made to find as many events as possible, and these have been listed. (N.B. Table 1 and Figures 1 and 2 of the full paper on the CD show the flood-prone areas in the country and the locations of flash-flood events superimposed on the maps.)

Perusal of available events leads one to believe that the instances of flash floods due to cloudbursts and excessive rainfall are on the increase in the Himalayan states of India. However, no such evaluation can be made since insufficient numbers of events are recorded. The Sutlej River in Himachal Pradesh is repeatedly facing flash floods due to landslide dam breaches occurring in the Tibet Autonomous Region of the People's Republic of China.

Mitigation measures in India emphasise non-structural measures such as flood fighting, relief, restoration, and reliable and efficient flood forecasting and timely warning.

The organisational structure and administrative systems responsible for flood management can be found at central, state, and local level. A number of organisations working at central level provide guidance to the states on flood mitigation. In turn, research institutions engaged in flash-flood research provide assistance to organisations responsible for mitigation work.

The first policy statement came in 1954 following severe floods in the country, followed by a high-level committee on floods in 1957. It recommended flood-plain zoning, flood forecasting, and warning. Several committees and commissions followed including the National Floods Commission (1980). In 1987 and 2002 national water policy documents proposed many policies on flood management.

Four main strategies have been adopted over the years: modification of floods, modification of susceptibility to floods, modification of the loss burden, and bearing the loss. For flash-flood mitigation, the non-structural methods of flood-plain management, flood proofing, flood forecasting and warning, disaster preparedness and response planning, flood fighting, flood relief and rehabilitation, and flood insurance are being used.

The full country paper details many of the measures taken by India such as flood-plain zoning, flood proofing; planning in disaster preparedness and response; flood relief and rehabilitation; insurance; use of indigenous knowledge and community awareness; dam safety; structural measures; and flood forecasting and monitoring systems. It also discusses transboundary issues and the different commissions and offices in the government responsible for these.

Country Report Myanmar – Executive Summary

Myanmar suffers from natural disasters such as tropical cyclones associated with surges, floods, earthquakes, and drought. These natural disasters occur in one place or other from time to time. Other natural disasters that appear infrequently are landslides, tornados, thunderstorms, heat waves, and heavy downpours. The disaster that occurs most frequently and which is often caused by human error is fire; and this affects most towns in the country. Water pollution is another disaster that is caused often by human impact and measures should be taken to prevent this also.

During the 10-year fiscal period from 1993/1994 to 2002/2003, (2524), many small and moderate disasters occurred in Myanmar. Among these 70% were fires, 10% were storms, 11% were floods, and 9% fell into other categories.

In central Myanmar, normal annual rainfall in the dry zone is below 40 inches [102 cm], and the drainage system in these areas is sufficient to cope with this. However, once in a period of about 60 to 70 years, it rains heavily in a small area over a short period of time and the ditches and creeks in such an area cannot hold the water, resulting in flash floods. For a short time, the floods pose a threat to the local people and fatalities and loss of property occur. The Manchaung (stream) in Magway division in 1987; the Shwegyin in Bago division in 1997; and Wundwin town in Mandalay division in 2001 were all subjected to flash floods.

In Myanmar, different types of flooding occur almost every year. However, most floods take place in a limited area and losses are negligible. Severe floods may occur on average once in 10 to 20 years. Whether floods are small or severe, prevention, preparedness, and mitigation are essential. Reduction in flood vulnerability lessens risks. In this respect, coordination between disaster-focused organisations is very important in the context of fulfilling requirements to prevent and mitigate disasters. In this way we can achieve sustainable development and safety for the community in future.

Country Report Nepal – Executive Summary

Due to a highly varied natural environment and human pressure on natural resources, different disasters occur frequently in Nepal. Water-induced disasters such as flash floods are among the most frequent. Glacial lake outburst floods (GLOFs), landslide dam outburst floods, and extreme rainfall floods are common types of flash floods occurring in Nepal.

Twenty-five GLOF events have occurred either in the territory of Nepal or in Tibet – the latter having impacts on the territory of Nepal. There is an indication that the frequency of GLOFs has increased from the 1960s onwards, although the data prior to that period may not be complete as GLOFs were not really recognised too well then. However, there is a clear indication that the Himalayas and areas surrounding them have been subject to significant warming in recent decades. Since the formation, growth, and outbreak of glacial lakes are directly related to glacial retreat and global warming, continued warming in this region is certain to cause more GLOFs in future.

The GLOF early warning system and GLOF mitigation measures implemented at Tsho Rolpa are unique in Nepal. Systematic study of the risk of a GLOF and gradual implementation of early warning systems and mitigation measures were adopted after the successful implementation of the Tsho Rolpa GLOF Risk Reduction Project.

The 13 landslide dam outburst floods reported in this paper are probably not a complete list. There must be several more events that have not been documented due to poor data collection systems and remoteness of the places in which such events take place. Furthermore, information on recorded events often does not provide the details required. It is, therefore, important to improve the database related to natural disasters such as flash floods. The present system of disaster data collection by the Ministry of Home Affairs needs significant improvement. Disasters should be disaggregated to the greatest extent possible and technical details of each disaster, such as river water level, peak flow, duration of flood, cause of the flood, and so on, should be recorded. Introduction of a geographic information system (GIS) could improve the disaster database significantly and facilitate effective and easy data visualisation and analysis.

Nepal seems to be a late starter in disaster management as the Natural Disaster Relief Act was promulgated only in 1982, and for a long period disaster management was limited to post-disaster activities such as rescue and relief. Very little importance was given to pre-disaster activities such as preparedness, early warning, and mitigation. The Act, which has been amended twice in the past, has been a landmark in systematic disaster management in Nepal. The Act provided a national framework for disaster management. It recognises the Ministry of Home Affairs as the main body concerned with disaster management. A central natural disaster relief committee formed by the Act has 23 members representing various government and non-government organisations. However, the Act only defines the role of the Ministry of Home Affairs and the roles of other organisations involved in disaster management have not yet been defined. Furthermore, no natural disaster relief regulation has been formulated to date, and this is essential for efficient disaster management.

In recent years, policy-makers and planners have slowly started to show an interest in looking into the problems of disaster management. It has received increased priority in recent government planning, policy, and strategy documents such as the Tenth Plan, Water Plan, Water Resource Strategy, and so on. Linking disaster management to the economy and development of the country has been a positive trend in recent years. The Tenth Plan has given significant impetus to disaster management and has put forward strategies and programmes to address this issue. Unlike in the past, the Tenth Plan emphasises the management of the whole disaster cycle and has given importance to technical aspects of disaster management.

The formation of the International Decade for Natural Disaster Reduction National Committee has given impetus to disaster management in the country and has promoted development of a National Action Plan for disaster management. The plan provides important policy and institutional perspectives as well as a log frame of activities, although, implementation of all the plans, policies, and strategies – including the National Action Plan – needs serious improvement.

Country Report Pakistan – Executive Summary

Pakistan has experienced flash flooding almost every year, except in the El Niño period. Geographically, Pakistan has a variety of geological features: sea, rivers, streams, deserts, hills, high mountains, plains, valleys, and terraces. The country comes under the influence of high and low latitude weather systems, resulting in flash flooding in winters and summers alike. The River Indus is the principal river (its tributaries are the Sutlej, Ravi, Jhelum, Chenab, and Kabul rivers) and flows from north to south across Pakistan. The main causes behind flash floods in Pakistan are snow/glacier melt, monsoon depressions, southeast and southwest monsoon incursions, and the interaction of high latitude weather systems (westerly waves) with low latitude weather systems (monsoon). Typical examples are the 1992, 2001, and 2003 flash-flood events.

The Flood Forecasting Division, a wing of the Pakistan Meteorological Department, is the main agency for issuing forecasts/warnings of flash floods/floods for the entire country. The flood-forecasting system in Pakistan is equipped with state-of-the-art meteorological and hydrological equipment such as 10-cm QPM Doppler weather radar, a telemetric gauging stations' network, and a network of manual hydro-meteorological observatories throughout the country. Besides the Meteorological Department, other agencies such as the Water and Power Development Authority and the Provincial Irrigation Department also have their own networks of hydro-meteorological stations for the collection of data to facilitate the work of the Flood Forecasting Division. These data are transmitted through a reliable and speedy communication system to the Division through V-sat, Meteorburst technology, high frequency radio, and Internet.

In Pakistan flash flood and flood management is a multifunctional process involving many government agencies and NGOs. Flood forecasts are updated daily on a website (www.pakmet.com.pk) at 0400 UTC and transmitted to 200 national, regional and district addresses daily by fax. In the event of flash-flood warnings, the authorities in the areas under threat are informed by fax and telephone. The warnings are also disseminated to the population/community under threat through radio, television, special editions of newspapers, and loudspeakers installed in mosques. The flash-flood monitoring and warning system in Pakistan seems to be reliable and effective as the number of human fatalities from such events has been decreasing, but the system still needs improvement in collaboration with developed and developing countries through sharing successful practices in their countries.

annex 3
group work

Inputs to the development of a flash flood initiative provided by the regional member countries

	Afghanistan	Bangladesh
Country needs	Establishment of hydromet stations and networks • Equipment (collection, transmission etc); training (equipment, operation and maintenance); data management (software, format, quality control, analysis, dissemination) Forecasting and early warning systems • Floods/flash floods, weather forecasting, early warning system, capacity building, equipment/software/hardware Policies, protocols, and guidelines on flash flood forecasting, warning, preparedness, and response • Clear line of authority, coordinated activities, communications, include floods/flash floods into draft water resource policies • Capacity building on emergency response Hazard control • Watershed management (strengthen capacity), technology/activities (rainwater harvesting, re-forestation, erosion control) • Hazard mapping (land-use management, flood zoning, vulnerability assessment) Awareness • Training (national, provincial, local, community level, media, gender and age groups)	Improved early warning and forecasting of flash floods (FF) • Technical assistance • Equipment to improve networks • Telecommunications equipment • Forecasting methods and procedures Improvement of institutional coordination for dissemination of FF warnings • Fast track – direct communication from Flood Forecasting and Warning Centre (FFWC) to Upazilla Disaster Management Committee (UDMC) (village level) • Establish/strengthen CFMCs (community flood management committees) Mitigation measures against FF • Improve DEM (100m resolution) • Flood hazard mapping at community level (50km^2) • Structural mitigation • Improved habitat management
Sites proposed	Upper Kabul River including Badakshan, Kunar Valley and Khugiani River of Nangarhar Province	In northeast part of country, SURMA-KUSIARA-MANU River basin
Partners proposed	Ministry of Energy and Water Ministry of Agriculture and Rural Development Dept. of Disaster Programmes Afghanistan Red Crescent Society AKDN	BMD BWDB DMB Mo. Est. Media Private Sector Roads and Highways Fisheries

Cont.

	Afghanistan, cont.	**Bangladesh,** cont.
Means of improving dialogue	Improve coordination meetings at national and provincial levels Strengthen the link from mirabs/water user associations to district, to provincial and national levels	Intercommunity cooperation through exchange of information and expertise • Interagency • Relevant ministries and line departments • Regular stakeholder work-shops at local level/project sites
Country-to-country learning	Data/information Experience/knowledge on watershed management Friendship and goodwill	Bangladesh technical expertise on flood forecasting and warning
Other issues	Impacts of upstream watershed practices Improve knowledge on terracing, check dam, plant-cover conservation	
	China	**India**
Country needs	Policy-making • Establishment and improvement of FF hazard assessment mechanism for construction lands • Establishment of a universal FF hazard prevention investment mechanism • The establishment of criteria for FF disaster investigation • Public awareness Prevention of FF • Identification of pilot sites • Improvement of hydrological and meteorological station networks • Establishment of forecasting system • Establishment of warning system • Establishment of emergency response system; Information sharing • Inter-sectors: rainfall data sharing between TMB and THB; Training • Officials: pay more attention to the FF hazard • Technicians: GIS, remote sensing • Community people: increase awareness about FF	To recognise FF as national calamity and to distinguish from riverine floods • To strengthen FF forecasting technical know how, capacity building, training, and technical support • Strengthening monitoring network for hydrological and meteorological data
Sites proposed	In southwest China including Sichuan, Yunnan, Tibet, as well as Himalayan transboundary corridors with Nepal	Identification of pilot sites in a national workshop involving all stakeholders including WMO and ICIMOD • To consider national and transboundary issues

Cont.

	China, cont.	**India,** cont.
Partners proposed	China Meteorological Administration • NMC: satellite rainfall estimating and NWP rainfall forecasting (mean quantitative rainfall forecasting for the pilot site) contact: Zhou Qingliang • TMB: rainfall data collecting and verification, contact: Chodok Ministry of Water Resources • BOH: development of hydrological model at pilot site, contact: Liang Jiazhi • THB: hydrological info. collecting and flood forecasting and verification for the model, contact: Xie Yuhong Ministry of Civil Affairs • Training contact: Zheng Yuanchang Others include • Tibet Institute of Water Resources Planning and Design • IMHE • TAAAS • Tibetan University	National Disaster Management Authority • MHA- dm division • MOEF • MOWR-CWC State level • SDMCs • DDMCs • VLIS- Panchayat Research and Training • G.B. Pant Institute of Himalayan Environment and Development • Central Water and Power Research Station • National Institute of Hydrology • Wadia Institute of Himalayan Geology • Central Water Commission • NGOs with proven records • Others
Means of improving dialogue	• Establishment of mechanisms for regular communication (vertical/lateral) • Annual or quarterly meetings (vertical/lateral)	Organising national workshop to create awareness and to prioritise issues of FF management • Involving key stakeholders including policy-makers, national and local institutions, and CBOs • Follow-up of the workshop at country level
Country-to-country learning	Contribution: training for • FY-2 satellite rainfall estimation technology • Mesoscale NWP model application technology • Flood forecasting system • Monitoring technologies for debris flows and landslides Learning • Community-based FF hazard prevention	Disaster management response system including standard operating practices with partner countries • Sharing technical know how on existing flood forecasting models
Other issues		Standardise database on flash flood events including losses and damage and update at regular intervals • Country to country technology transfer to reduce impacts of FF • Recommendations from Lhasa workshop to be presented at Costa Rica conference • Next Asian conference on disaster reduction to be hosted by India should include a session on FF

Cont.

	Myanmar	Nepal	Pakistan
Country needs	Dept. of Meteorology and Hydrology • Technical assistance for forecasting and early warning • Irrigation Dept. • Improve coordination with other stakeholders • Technical assistance for specific site studies, e.g., maintenance • Relief and resettlement dept. • Increase public awareness of flash flood issues	Real time hydro/met data acquisition • Networked hydro-meteorological equipment, training Meso-level forecast • Training, hardware/ software Early warning communic-ations • Telemetric equipment, media training/workshop • Sensitise and replicate community preparedness best practices • Publications, radio, street theatre – streamline preparedness and response mechanisms • Advocacy, streamline institutional mechanisms Technical assistance, advocacy, strengthen disaster cell (PMO)	Hydrology stations (in country) • Hydrometeorological stations • Glacier monitoring model systems • Exchange of transboundary information (radar + river gauge data) • Community-level capacity building on flash flood awareness
Sites proposed	Win-Dwin, Mandalay Division beside Shaw bin Chaung stream (early warning system and public awareness) Manchaung, Magwe Division (upgrading monitoring and forecasting, early warning)	Makwanpur (Rapti Basin) • High frequency, extreme precipitation, (origin Mahabharat) Bhote Koshi catchment • GLOF, transboundary with China (origin Himalayas) Lal Bakaiya catchment • Transboundary with India (origin Siwaliks)	Transboundary Chitral River Transboundary Kabul River Swat River (major inflow and population hazard)
Partners proposed	Department of Meteorology and Hydrology, Irrigation Department, Relief and Resettlement Department, Myanmar Red Cross Society	Cross-cutting partners • DWIDP, DHM, MoHA, Red Cross, NEA, RNA, DSCWM, Nepal Police, UNDP, DP-Net, Dept. of Roads Bhote Koshi • BKPC, HPL, IUCN, SchEMS Lal Bakaiya • Rautahat Flood Concern Group Rapti • Action Aid, Red Cross, PS, RCNP	Meteorological Dept. Irrigation Dept. Relief Dept. Local Government Local Support Organisations Aga Khan Rural Support Programme FOCUS (NGO) WAPDA (Govt)

Cont.

	Myanmar, cont.	**Nepal,** cont.	**Pakistan,** cont.
Means of improving dialogue	Vertical • Identify and line-up communication flow from national, regional, to community • Take measures, e.g. town meeting, drill and simulation Lateral • Develop plans for action • Build institutional framework for better coordination • Identify communication gaps across ministries	Bottom-up information flow • Reestablish communication chain from community level up Public dialogue through media	With India (Central Water Commission and Commissioner for Indus Water) With Afghanistan (Hydromet Organisation) Local Govt. to Prov. Govt. & Fed Govt. Among communities of upstream and downstream
Country-to-country learning	No strong area observed ICIMOD can facilitate learning opportunities for other countries from which Myanmar will benefit	Strengths • GLOF studies (Tsho Rolpa experience) • EWS (Bhote Koshi, Tsho Rolpa) • Community- based disaster preparedness Learning • Bilateral data sharing • Cross border exposure visits • Sharing of best practices	Radar tech (Pak) Flow forecasting (India and Bangladesh)'
Other issues	Identify all potential flash flood sites • Conduct risk assessment Short-term/long-term measures • Capacity building at all levels: people, local government officials, community leaders	Disaster relief and rehabilitation fund • Central level • Community level Capacity building	Flash flood capacity building • Check dams • Afforestation

KEY: AKDN = Aga Khan Development Network; BKPC = Bhote Kosi Power Company; BMD = Bangladesh Meteorological Dept.; BOH = Bureau of Hydology, CMWC = Chinese Ministry of Water Conservancy; BWDB = Bangladesh Water Development Board; CBO = community-based organisation; DDMC = district disaster management committee; DEM = digital elevation model; Dept. = Department; DHM = Dept. of Hydrology and Meteorology; DMB = Disaster Management Bureau; DP = Net-Disaster Preparedness Network (Nepal); DSCWM = Dept. of Soil Conservation and Watershed Management; DWIDP = Dept. of Water Induced Disaster Prevention; EWS = Early Warning System; FF = flash floods; FFWC = Flood Forecasting and Warning Centre; FOCUS = Pakistan- an international non-government organization, Pakistani office; FY-2 = Feng-Yun 2- China's earth observation satellite; GIS = geographical information systems; GLOF = glacial lake outburst flood; HPL = Himal PowerLlimited; IUCN = International Union for the Conservation of Nature; MHA-dm = Ministry of Home Affairs-disaster management; MOEFPS = Ministry of Environment and Forests; Mo. Est. = Ministry of Establishment

annex 4
programme

Saturday, 22 October 2005

13:45	Arrival in Lhasa of participants from Kathmandu
16:00-1700	Registration

Day 1: Sunday, 23 October 2005

09:15 – 13:30	Tour to Potala Palace and acclimatisation
16:00-18:00	**Inaugural Session (Chaired by Dr. Xu Jianchu, ICIMOD)**
16:00-17:00	Inaugural address by Vice Governor, Mr. Dorji Zeren
	Welcome address by Dr. Xu Xiaofeng, Vice Administrator, CMA
	Opening remarks by Dr. J. Gabriel Campbell, Director General, ICIMOD
	Opening remarks by Dr. Wolfgang Grabs, Chief, Water Resources' Department, WMO
	Opening remarks by Katharine Koch, Director, U.S. Department of State, Regional Office for South Asia, American Embassy, Nepal
17:00-17:45	Keynote Paper: *Flash Floods in the Context of Disaster Risk Management* by Professor, Dr. Manfred Spreafico, Swiss National Hydrological Survey
17:45-18:00	Group photo
18:30-21:00	Reception and dinner hosted by China Meteorological Administration and Tibetan Meteorological Bureau, PR. China

Day 2: Monday, 24 October 2005

09:30-09:40	Welcome and programme overview by Mr. Jacob Ferdinand, ICIMOD
09:40-10:00	Introduction to the Flash Floods' Initiative by Dr. Xu Jianchu, ICIMOD
10:00-17:00	**Session 1: Flash Flood Risk Management Assessment in the Region**
	Chairperson: Professor Cui Peng, Institute of Mountain Hazards and Environment, CAS, P.R. China
10:00-10:15	Regional Floods: Early Warning and Introduction to Country Reports by Ms. Mandira Shrestha, ICIMOD
10:15-10:35	Country Report 1: Nepal
10:35-10:55	Country Report 2: Myanmar
10:55-11:30	*Tea/coffee*

Session 1: cont.

	Chairperson: Mr. Arun Shrestha, DHM, Nepal
11:30-11:50	Country Report 3: India
11:50-12:10	Country Report 4: China
12:10-12:30	Country Report 5: Bangladesh
12:30-12:50	Country Report 6: Pakistan
12:50-15:00	*Lunch*
15:00-15:20	Country Report 7: Afghanistan
15:20-16:00	Regional overview by Dr. Juerg Merz, ICIMOD
16:00-17:00	Discussion session 1 moderated and facilitated by Dr. Xu Jianchu and Dr. Juerg Merz
17:00-18:00	Poster Session

Day 3: Tuesday, 25 October 2005

09:30-11:00	**Session 2: Community Awareness and Preparedness**
	Chairperson: Dr. Wolfgang E. Grabs, Chief, Water Resources' Division, WMO
09:30-10:00	Keynote paper: *Community-based Disaster Risk Management* by Mr. N. M. S. I. Arambepola, Asian Disaster Preparedness Centre (ADPC)
10:00-10:20	Case study 1: *Disaster/Flash Flood Mitigation through Community Mobilisation and a Rights-based Approach* by Anil Pant, Action Aid, Nepal
10:20-10:40	Case study 2: *Community Awareness and Preparedness: Causes of Flash Floods in Chitral* by Mr. Sardar Ayub Khan, Aga Khan Rural Support Programme, Chitral Regional Office, AKRSP, Pakistan
10:40-11:00	Discussion Session 2 moderated and facilitated by the chairperson
11:00-11:30	*Tea/coffee*
11:30-13:00	**Session 3: Hazard Control**
	Chairperson: Dr. Sazedul Karim Chowdhury, Superintending Engineer & National Project Director, Bangladesh Water Development Board
11:30-12:00	Keynote paper: *New Strategies of Prevention and Mitigation of China's Flood Disasters: from Flood Control to Flood Management* by Cui Peng, Institute of Mountain Hazards and Environment, CAS, P.R. China
12:00-12:20	Case study 1: *GLOF Inventory and Mitigation* by Pradeep Mool, Remote Sensing Specialist, ICIMOD
12:20-13:00	Discussion Session 3 moderated and facilitated by the chairperson
13:00-15:00	*Lunch*

15:00-18:00	**Session 4: Flash Flood Forecasting and Warning**
	Chairperson: Dr. R.S. Tolia, Chief Secretary, Government of Uttaranchal, India,
15:00-15:30	Keynote paper: *State-of-the-Art Flash Flood Forecasting* by USGS in collaboration with NOAA and USAID/OFDA
15:30-15:50	Case study 1: *Bhote Kosi and Hydro Power Plant, Nepal* by Sandip Shah, General Manager, Bhote Kosi Power Company, Nepal
15:50-16:10	Case study 2: *Increasing Effectiveness of Flash Flood Warning by Advanced Monitoring and Modelling* by Guna Paudyal, DHI Regional Office, India
16:10-16:30	Case Study 3: *Mountain Meteorological Disasters in China* by Mr. Zhou Qingliang, Deputy Director, Division of Forecasting, China Meteorological Administration, China
16:10-16:40	*Tea/coffee*
16:40-17:00	*WMO's Initiatives on Floods by Dr. Wolfgang Grabs, Chief, Water Resources Division, WMO*
17:00-18:00	Discussion Session 4 moderated and facilitated by the chairperson

Day 4: Wednesday, 26 October 2005

09:30-18:00	Field trip to Yamdok Tso Lake, Langkazi Meteorological Station and Kalula Glacier

Day 5: Thursday, 27 October 2005

09:30-11:20	**Session 5: Institutions, Policies, and Strategies**
	Chairperson: Mr. Qaseem Naimi, Advisor, Ministry of Energy and Water, Afghanistan
09:30-10:00	Keynote paper: *Total Disaster Risk Management* by Mr. Shingo Kochi, Researcher, Asian Disaster Reduction Centre
10:00-10:20	Case study 1: *Policy on Water Induced Disaster Mitigation in Nepal with a Focus on Flash Floods* by Mr. Shital Babu Regmee, Director General, Department of Water Induced Disaster Prevention (DWIDP), Ministry of Water Resources, Nepal
10:20-10:40	Case Study 2: *Policy and Institutional Arrangements for Disaster Management in China*, by Dr. Zheng Yuanchang, Ministry of Civil Affairs, P.R. China
10:40-10:50	Case Study 3: *'Katrina'* by Rebecca Scheurer, Regional Advisor, USAID, Nepal
10:50-11:20	*Tea/coffee*
11:20-12:00	Discussion Session 5 moderated and facilitated by the chairperson
12:00-13:00	Poster Session
13:00-14:00	*Lunch*
14:00-14:40	Country Rapporteurs' Meeting

14:40-17:30	**Session 6: Towards Better Flash Flood Risk Management in the Region**
	Chairperson: Dr. Gabriel Campbell, Director General, ICIMOD
14:40-15:00	Reflections by Dr. Mats Eriksson, ICIMOD
15:00-15:20	*ICIMOD's Agenda on Flash Flood Risk Management and Introduction to Group Work* by Dr. Xu Jianchu, Programme Manager, WHEM, ICIMOD
15:20-16:00	Group Work
16:00-16:20	*Tea/Coffee*
16:20-17:30	Group Work
19:00	*Dinner*
20:00-21:00	Volunteer Committee Meeting on Recommendations

Day 6: Friday, 28 October 2005

09:30-16:00	**Session 6 cont.: Towards Better Flash Flood Risk Management in the Region**
	Chairperson: Ms. Mandira Shrestha, ICIMOD
09:30-09:45	Short feedback on group work
09:45-11:00	Group work continued
11:00-11:30	*Tea/coffee*
11:30-13:15	Presentation of group work results and discussion
13:15-15:00	*Lunch*
15:00-16:00	*Perspectives on Capacity Building for Flash Flood Management in the Himalayas* and *Discussion of the Lhasa Declaration* by Dr. Xu Jianchu and Dr. Mats Eriksson, ICIMOD
16:00-16:15	Follow-up on workshop
16:15-16:45	*Tea/coffee*
16:45-17:30	**Closing**
16:45-17:20	Remarks and observations by participants
17:20-17:30	Closing remarks by Dr. J. Gabriel Campbell, Director General, ICIMOD

annex 5
list of participants

AFGHANISTAN

Mr. Qaseem Naimi
Advisor
Ministry of Energy and Water
Darul Aman Road, Kabul, Afghanistan
Tel: +93 (0) 7028 7673
Email: mqnaimi@yahoo.com

Mr. Abdul Haq
Director of Planning
Forests and Ranges Department
Ministry of Agriculture
Animal Husbandry and Food
Karte-Sakhi, Kabul, Afghanistan
Tel: +93 (0) 7028 6677
Email: ghuriani2003@yahoo.com

Mr. Sayed Aminullah Fakhri
Director of Man Made Forest
Forests and Ranges' Department
Ministry of Agriculture
Animal Husbandry and Food
Karte-Sakhi, Kabul, Afghanistan
Tel: +93 (0) 7028 6677
Email: sayedaminullah73@yahoo.com

BANGLADESH

Mr. Sazedul Karim Chowdhury
Superintending Engineer & National Project Director
Processing and Flood Forecasting Circle,
Bangladesh Water Development Board
72, Green Road, Dhaka, Bangladesh
Tel: +880 2812 1491
Fax: +880 29564 7630
Email: chowmsk@dhaka.net

CHINA

Mr. Chodok Kang
Tibet Meteorological Bureau, Lhasa
850003, Tibet, China
Email: chu_d22@yahoo.com

Mr. Gong Tong-liang
Director
Tibet Hydrology & Water Resources Bureau
No. 1, Zhaji Road, Lhasa 850003
Tibet, China
Fax: +86 89 1632 4834
Email: swgtl201@public.ls.xz.cn

Dr. Xu Xiaofeng
Deputy Administrator
China Meteorological Administration
No. 46 Zhongguancun South Street
Beijing, 1000 81, China
Tel: +86 10 6217 2721
Fax: +86 10 6217 4797

Mr. Li Zhangjun
Deputy Director General
China Meteorological Administration
No. 46 Zhongguancun South Street,
Beijing, 1000 81, China
Tel: +86 10 6217 2721
Fax: +86 10 6217 4797

Ms. Xiang Liying
Bureau of Hydrology & Water Resources,
Tibet, 9 Gongbutang Road
Lhasa 850000, Tibet, China
Tel: +86 89 1635 2834
Email: Liying41@hotmail.com

Mr. Yu Jun
Programme Officer
China Meteorological Administration
No. 46 Zhongguancun South Street
Beijing, 1000 81, China
Tel: 86 10 6217 2721
Fax: 86 10 6217 4797
Email: lfish3@hotmail.com

Mr. Ye Xiaodong
Senior Engineer
China Meteorological Administration
No. 46 Zhongguancun South Street,
Beijing, 1000 81, China
Tel: +86 10 6217 2721
Fax: +86 10 6217 4797

Dr. Zhou Qingliang
Deputy Director
China Meteorological Administration, CMA
No. 46 Zhongguancun South Street
Beijing, 1000 81, China
Tel: +86 10 6840 6184
Email: zhouql@cma.gov.cn

Mr. Xie Yuhong
Division Head
Tibet Hydrology & Water Research Bureau
33 Gongbutang Road
Lhasa 850003, Tibet, China
Tel: +86 89 1635 3354 (O),
+86 89 1683 5903 /3126
Email: txieyh@sina.com

Ms. Li Zhou
Engineer
Bureau of Hydrology
Ministry of Water Resources
2, Lane 2, Bai Guang Road
Xuan Wu District
Beijing, 100053, China
Tel: +86 10 6320 2531
Fax: +86 10 6320 2471
Email: lizhou@mwr.gov.cn

Mr. Tashi (inauguration only)
Director
Tibet Erosion Department,
Lhasa 850003, Tibet, China

Mr. Tashi Dundrop (inauguration only)
Vice Director
Tibet Water Conservancy Bureau
Lhasa 850003, Tibet, China

Prof. Cui Peng
Deputy Director
Institute of Mountain Hazards and
Environment, CAS
P.O. Box 417, Chengdu
Sichuan 610041, China
Tel: +86 28 8521 4421
Fax: +86 28 8522 2258
Email: pengcui@imde.ac.cn

Dr. Wang Dongyong
Deputy Chief Engineering
Meteorological Centre of Anhui Province of
China, China

Mr. Che Tao
Research Assistant
Laboratory of Remote Sensing and
Geospatial Science, Cold and Arid Regions'
Environmental and Engineering Research
Institute, Chinese Academy of Sciences.
260 Donggang West Road
Lanzhou, Gansu, China
Tel: +86 93 1496 7298
Email: chetao@lzb.ac.cn

Dr. Zheng Yuanchang
Chief
Disaster Relief Division of Department of
Disaster and Social Relief
Department of International Cooperation of
Natural Centre on Disaster Reduction
Ministry of Civil Affairs, China
Tel: +86 10 5812 3151
Fax: +86 10 8352 9991
Email: yczheng@cndr.gov.cn

Mr. Cong Fengjun
Programme Officer
International Department, Ministry of Civil
Affairs, China
Tel: +86 10 5812 3286
Email: cfj@mca.gov.cn

Mr. Jingsli Liu
Professor
Institute of Tibetan Plateau Research, CAS
Shuangqing Rd. 18, Haidian, Beijing,
100085, China
Tel: +86 10 6284 9373
Email: jsliu@itpcas.ac.cn

INDIA

Mr. R. B. S. Rawat
IFS, Chief Project Director
Watershed Management Directorate
Indira Nagar Forest Colony, Dehradun, India
Tel: +91 (0) 13 5276 8712
Fax: +91 (0)13 5276 2839
Email: wmd@vsnl.com

Dr. R. S. Tolia
Chief Secretary
Government of Uttaranchal
Uttaranchal Sachivalaya
4, Subhash Marg
Dehradun, Uttaranchal, India
Tel: +91 (0)13 5271 2100/2200
Fax: +91 (0)13 5271 2500
Email: rstoliacs@yahoo.co.in

Mr. Suresh Chandra
Chairman (retired)
Central Water Commission
C-3/117, Sector 36, NOIDA, Gautam Budh Nagar, Uttar Pradesh 201303, India
Tel: +91 (0) 12 0257 1108
Fax: +91 (0) 12 0243 1275
Email: schandra42@yahoo.com

Mr. Kireet Kumar
Head, Land and Water Resource Management
GB Pant Institute of Himalayan Environment and Development
Kosi-Katarmal, Almora 163 643, India
Tel: +91 59 6224 1014 /2 4115
Fax: +91 59 6224 1150 /23 1507
Email: kireet@gbpihed.nic.in

MYANMAR

Mr. Ye Ni
Staff Officer
Department of Meteorology and Hydrology
Mayangon 11061
Kaba-Aye Pagoda Road
Yangoon, Myanmar
Tel: +95 166 5669
Fax: +95 166 5944 /66 5705
Email: dg.dmh@mptmail.net.mm

NEPAL

Mr. Anil Kumar Pant
Team Leader, Human Security and Governance Team
Action Aid Nepal
P.O. Box : 6257, Lazimpat
Kathmandu, Nepal
Tel: +977 1443 6477 /1 9115 /2 1232
Fax: +977 1441 9718
Email: anil.pant@actionaid.org

Dr. Arun Bhakta Shrestha
Hydrologist
Department of Hydrology and Meteorology
P.O. Box 406, Babar Mahal
Kathmandu, Nepal
Tel: +977 1426 2411
Fax: +977 1426 2348
Email: arun@dhm.gov.np

Dr. Sandip Shah
General Manager
Bhote Koshi Power Company
158/80 Red Cross Marg-1
P.O. Box 15153, Kalimati, Tahachal, Kathmandu
Tel: +977 1428 1658 /1659
Fax: +977 1527 3516
Email: sandips@bkpc.com.np

Mr. Shital Babu Regmee
Director General
Department of Water Induced Disaster Prevention (DWIDP)
Pulchowk, Lalitpur, Nepal
Tel: +977 1553 5502 /5503
Fax: +977 1552 3528
Email: dwidp@ntc.net.np

Mr. Kunda Dixit
Editor
Nepali Times
Patan Dhoka, Lalitpur
Himalmedia plc, GPO Box 7251, Kathmandu, Nepal
Tel: +977 1554 3333
Fax: +977 1552 1013
Email: kunda@nepalitimes.com

PAKISTAN

Mr. Sardar Ayub Khan
Civil Engineer/Area Manager
Aga Khan Rural Support Programme
Chitral Regional Office
Babar Road, Gilgit, P.O.Box 506, Pakistan
Tel: +92 9 3341 2736
Fax: +92 9 3341 2516
Email: sardarayubcl@yahoo.co.uk

Mr. Shaukat Ali Awan
Chief Meteorologist (Hydrological Advisor of Pakistan with WMO)
Pakistan Meteorological Department
Flood Forecasting Division
46-Jail Road, Lahore, Pakistan
Tel: +92 04 2920 0139 /0208
Fax: +92 94 2920 0209
Email: saliawan2002@yahoo.com

OTHER INTERNATIONAL

Dr. Manfred Spreafico
Professor
Swiss National Hydrological Survey,
Switzerland
Tel: +41 3 1324 7667
Fax:+41 3 1324 7681
Email: spreafico@bwg.admin.ch

Mr. Richard W. (Dick) Paulson
Water-Resources and Flood-Management
Consulting, LLC
1325 East West Highway
Silver Spring MD 20910, USA
Tel: +1 70 3264 8849
Fax: +1 70 3264 0456
Email: Richard.Paulson@noaa.gov

Mr. Robert Jubach
Manager
International Technical Programmes
Hydrologic Research Centre
12780 High Bluff Drive, Ste 250
San Diego, CA 92130, USA
Tel: +85 8794 2726
Fax: +85 8792 2519
Email: rjubach@hrc-lab.org

Dr. Wolfgang E. Grabs
Chief
Water Resources' Division
World Meteorological Organization (WMO)
Case Postale No. 2300,
7 Bis Avenue de la Paix
CH – 1211 Geneva 2, Switzerland
Tel: +41 2 2730 8353
Fax: +41 2 2730 8043
Email: wgrabs@wmo.int

Ms. Katharine E. Koch
Director
U.S. Department of State, Regional Office
for South Asia, American Embassy
P.O. Box 295, Panipokhari, Kathmandu,
Nepal
Tel: +977 1441 1179 /x4643
Fax: +977 1441 9485
Email: KochKE@state.gov

Ms. Rebecca Scheurer
Regional Advisor
USAID/OFDA
Rabibhawan, Kathmandu, Nepal
Tel: +977 1427 0144
Email: Rscheurer@usaid.gov

Ms. Ayse Sezin Tokar
Hydrometeorological Hazard Advisor, USAID
OFDA, 1300 Pennsylvania Ave., NW,
DCHA/OFDA/ DRM/ TAG 8.06.46,
Washington DC 20523-8602, USA
Tel: +1 20 2712 4033
Fax: +1 20 2216 3706 /07
Email: stokar@USAID.GOV

Dr. Guna Nidhi Paudyal
Regional Manager/Sr. Flood Management
Expert
DHI Regional Office
K-71, 1st floor, Hauz Khas Enclave
New Delhi 110016, India
Tel: +91 98 7126 6060
Fax: +91 11 2660 2276
Email: gnp@dhi.dk

Mr. Shingo Kochi
Researcher
Asian Disaster Reduction Centre (ADRC), 1-
5-2 Wakinohamakaigan-dori
Chuo-ku, Kobe, 651-0073 Japan
Tel: +81 7 8262 5540
Fax: +81 7 8262 5546
Email: kochi@adrc.or.jp

Mr. N. M. S. I. Arambepola
Director and Team Leader
Urban Disaster Risk Management Team
Programme Manager, Programme for
Hydro-Meteorological Disaster Mitigation in
Secondary Cities in South and South East
Asia (PROMISE)
Asian Disaster Preparedness Centre (ADPC)
AIT Campus, P.O. Box 4
58 Moo 9, Km. 42, Paholyothin Highway
Klong Luang, Pathumthani 12120, Thailand
Tel: +66 2516 5900 to 5910 (Ext. 401)
Fax: +66 2524 5360 /5350 /5382
Email: arambepola@adpc.net

ICIMOD

P.O. Box 3226
Kathmandu, Nepal
Tel: 977-1-5525313
Fax: 977-1-5524509, 977-1-5536747

Dr. J. Gabriel Campbell
Director General, ICIMOD
Email: gcampbell@icimod.org

Dr. Xu Jianchu
Programme Manager
Email: jxu@icimod.org

Mr. Jacob Fritz Ferdinand
Workshop Coordinator
Email: jferdinand@icimod.org

Dr. Juerg Merz
Flash Flood Consultant
Email: jmerz@icimod.org

Dr. Mats Eriksson
Water Resources' Specialist
Email: meriksson@icimod.org

Ms. Mandira Shrestha
Water Resources Specialist
Email: mshrestha@icimod.org

Mr. Pradeep Kumar Mool
Remote Sensing Specialist
Email: pmool@icimod.org

Mr. Rajen Upreti
Travel Officer
Email: rupreti@icimod.org

Mr. Rajendra Mali
Budget and Finance Officer
Email: rmali@icimod.org

Mr. Samjwal Ratna Bajracharya
GIS Analyst
Email: sabajracharya@icimod.org

Mr. Vijay R Khadgi
Rapporteur
Email: vkhadgi@icimod.org

International Centre for Integrated Mountain Development (ICIMOD)
Khumaltar, Lalitpur
GPO Box 3226, Kathmandu, Nepal

Tel: + 977 1 5525313
Fax: + 977 1 5524509 / 5536747
Email: distri@icimod.org
www.icimod.org

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