a Primer

Integrated Flood Risk Management in Asia

adpc

UNDP

The Primer for Integrated Flood Risk Management in Asia is a 'how-to' reference manual for all stakeholders engaged in development at all levels, who in their daily work need to understand basic concepts, terminologies, methodologies and available tools to address their risks. It provides examples from various parts of the world to demonstrate the use of tools and successful methodologies. It is hoped that the Primer will support stakeholders in assessing their risks, planning for actions, and forming collaborative partnerships, to reduce risks and ultimately save human lives.

This Primer is based on consultations with and inputs from a number of local, national, regional and international experts, and stakeholders. It is published by the Asian Disaster Preparedness Center, Bangkok, Thailand. Although all efforts have been made for correctness of information provided herein, neither Asian Disaster Preparedness Center nor United States Agency for International Development nor any individual(s) mentioned herein are responsible for accurateness of information. The readers are advised to further verify and obtain more information from other source(s) and individual(s).

a Primer

Integrated Flood Risk Management in Asia

2

International Advisory Committee

Mr. Stephen Bender
Organisation of American States
USA

Dr. Fouad Bendimerad
Earthquakes and Megacities Initiative
USA

Mr. Teddy Boen
World Seismic Safety Initiative
Indonesia

Mr. Tom Brennan
United Nations Development Programme
Thailand

Dr. Neil Britton
National Research Institute for Earth Science and Disaster Prevention
Japan

Prof. J.R. Choudhury
BRAC University
Bangladesh

Mr. Maxx Dilley
organisation
country

Mr. Amod Mani Dixit
National Society for Earthquake Technology
Nepal

Mr. Glenn Dolcemascolo
Pacific Disaster Centre
USA

Dr. Michael Ernst
United Nations Development Programme
Thailand

Mr. Manu Gupta
SEEDS, The Sustainable Environment and Ecological Development Society
India

Mr. David Hollister
United Nations Development Programme
Thailand

Mr. A.N. Akhter Hossain
Dhaka Water Supply and Sewerage Authority
Bangladesh

Ms. Geethi Karunaratne
Centre for Housing Planning and Building
Sri Lanka

Prof. H.R. Khan
Consulting Water Resources Engineer
Bangladesh

Mr. Saroj Kumar Jha
Ministry of Home Affairs
India

Mr. Kamal Kishore
United Nations Development Programme
India

Dr. Allan Lavell
FLACSO
Costa Rica

Ms. Shirley Mattingly
Consultant
USA

Dr. Guna Paudyal
DHI Water and Environment
Bangladesh

Ms. Rebecca Scheurer
United States Agency for International Development
USA

Prof. Haresh Shah
World Seismic Safety Initiative
USA

Dr. Ravi Sinha
Indian Institute of Technology, Mumbai
India

Mr. Dang Quang Tinh
Department of Dike Management and Flood Control
Vietnam

Dr. Ian Wilderspin
International Federation of Red Cross and Red Crescent Societies
Thailand

ADPC Advisory Committee

Dr. Suvit Yodmani, Executive Director
Mr. Earl Kessler, Deputy Executive Director
Mr. Aloysius J. Rego, Director, Disaster Management Systems
Mr. Merrick Chatfield, Director, Strategic Disaster Risk Management
Mr. Arjunapermal Subbiah, Director, Climate Risk Management
Dr. Marcel Dubouloz, Director, Public Health in Emergencies
Mr. NMSI Arambepola, Director, Urban Disaster Management

ADPC Primer Team

Mr. NMSI Arambepola
Mr. Rajesh Sharma
Dr. Buddhi Weerasinghe (up to 31 Dec. 2004)
Ms. Wei Choong
Ms. Clarence Carlos
Ms. Lekha Ratnayake

Content Contributions

Dr. Guna Paudyal, Bangladesh
Mr. Glenn Dolcemascolo, USA
Mr. Frederick John Abo, Philippines
Mr. Damien Riquet, France

Development and Technical Editing

Mr. NMSI Arambepola, Thailand
Ms. Wei Choong, Australia
Ms. Kaylene Williams, UK
Ms. Rachael Grivas, Australia

Research Assistance

Ms. Kaylene Williams, UK
Ms. Naomi Weidner, USA
Ms. Christine van Kuik, France

Layout Design

Mr. Lowil Fred Espada, Philippines

Final Editing

Dr. K. Iftekhar Ahmed, Bangladesh

Printed: May 2005
ISBN XXXX-XXXX-XXX-X

Printed by

Photo Credits

Cover	CARE Bangladesh
Inside Cover	Lowil Fred Espada
Chapters 1	Shams Mansoor Ghani
Chapters 2	CARE Bangladesh
Chapters 3	ADPC
Chapters 4	CARE Bangladesh
Chapters 5	Lowil Fred Espada
Chapters 6	Natalia Scurrah
Chapters 7	Wei Choong
Chapters 8	ADPC
Chapters 9	TUDMP, ADPC
Chapters 10	Wei Choong
Chapters 11	Lowil Fred Espada
Chapters 12	Lowil Fred Espada

ADPC dedicates this publication to

Late Colonel Brian Ward
(1932 - 2004)

who founded Asian Disaster Preparedness Center nearly two decades back and led it to became one of the premier centers in disaster management in Asia. ADPC will continue the work towards his vision of building safer communities with dedication and commitment.

foreword

It is with great pleasure that ADPC presents the Primer for Disaster Risk Management in Asia.

Recent decades have witnessed rapid pace of development across developing countries, particularly in Asia. With the rapid development, there have been significant increases in risk and vulnerabilities of the population in developing countries of Asia. The disasters expose the vulnerabilities of communities and reverse several decades of development.

Since the beginning of the International Decade for Natural Disaster Reduction (IDNDR) during 1990-2000, there have been significant advances in hazard forecasting, risk assessment, understanding sustainability and integrating risk reduction in development planning. The IDNDR and its successor, International Strategy for Disaster Reduction (ISDR), the World Bank and the Asian Development Bank and several other international and national initiatives have made significant contributions to the understanding of risks and its management and integration in development to achieve sustainable development. Most recently, the World Conference on Disaster Reduction (WCDR), Kobe in January 2005, emphasised on building the resilience of nations and communities to disasters.

ADPC, since its establishment in 1986, have been actively engaged in disaster risk management through its programmes and capacity building activities throughout Asia. Particularly, the Asian Urban Disaster Mitigation Programme (AUDMP), generously supported by the Office of Foreign Disaster Assistance (OFDA) of the United States Agency for International development (USAID) and implemented by ADPC in Bangladesh, Cambodia, India, Indonesia, Lao PDR, Nepal, the Philippines, Sri Lanka, Thailand and Vietnam during 1995-2005, has made significant contributions to the disaster risk management efforts in the region.

There has been a long-felt need of a reference document on disaster risk management in Asia for the practitioners to help them understand the recent concepts and advancements in understanding the risks and planning actions to reduce risks. The Primer has been conceived to serve as a reference manual for practitioners, who in their daily work need to understand basic concepts, terminologies, methodologies and available tools to become aware of their risks. It provides examples from various parts of the world to demonstrate the use of tools and successful methodologies. It is hoped that the Primer will help the practitioners in assessing their risks and in planning for actions, in partnerships with other stakeholders, to reduce risks and ultimately save human lives.

The Primer is a series of publications - the first volume provides an overview of disaster risk management, while the subsequent volumes are to be hazard specific. It is hoped that over a period of time, these volumes get translated to various languages and be used by a number of practitioners.

It has been a herculean task for ADPC to develop the Primer. Numerous local, national and international experts and practitioners have been consulted from time to time during its development. An International Advisory Group consisting of eminent experts was continuously consulted and their feedback and comments were incorporated. The Primer has been presented at several international, regional and national gatherings of experts, senior government officials, and various professional groups and their valuable inputs have been incorporated.

On behalf of ADPC, I would like to thank the members of the International Advisory Group for volunteering their time to participate in the meetings and reviewing the contents and providing valuable guidance and feedback. The ADPC Primer Team needs to be commended for working hard to meet the deadlines. Ms. Wei Choong, 'Australian Youth Ambassadors for Development' (AYAD) Programme, and Ms. Kaylene Williams, an intern from Coventry University (UK), deserve special mention for their dedication and hard work on the Primer. Mr. Lowil Fred Espada worked hard to layout the drafts to turn it into the final publication.

It is very difficult to list and thank each and every individual who contributed to this publication. ADPC remains grateful to everyone who has contributed to this publication by providing comments, photographs, and pointers to other sources of materials. The Primer has indeed been a collaborative effort of many and it would not have been possible for ADPC to publish it without the valuable inputs and comments. We see the Primer as as part of an on-going process in our efforts of learning and working together to reduce disaster risks and save valuable human lives.

The recent tsunami of December 2004 reminds us how much work still needs to be done.

We sincerely hope you will find the Primer useful and that the Primer contributes to our collective efforts in reducing disaster risks.

Dr. Suvit Yodmani
Executive Director
ADPC

April 2005

acronyms

ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Center
ADRC	Asian Disaster Reduction Center
AMP	Advanced Medical Post
APFM	Associated Program on Flood Management
AUDMP	Asian Urban Disaster Mitigation Programme
BUDMP	Bangladesh Urban Disaster Mitigation Project
CBDRM	Community-based Disaster Risk Management
CBO	Community-based Organisation
DEFRA	Department of Environment Forestry Resources and Agriculture (UK)
DMRC	Disaster Management Relief Committee
DMT	Disaster Management Teams
ECHO	European Commission Humanitarian Aid Office
EIA	Environmental Impact Assessment
EMA	Emergency Management Australia
ENSO	El Niño Southern Oscillation
EOC	Emergency Operations Centre
EPA	Environmental Protection Agency (USA)
FAO	Food and Agriculture Organisation
FEMA	Federal Emergency Management Agency (USA)
FEWS	Flood Early Warning System
FRMC	Flood Risk Management Committee
GIS	Geographical Information Systems
GWP	Global Water Partnership
IDNDR	International Decade for Natural Disaster Reduction
IFM	Integrated Flood Management
IFRC	International Federation of Red Cross and Red Crescent Societies (Switzerland)
ITDG	Intermediate Technologies Development Group
IWM	Integrated Watershed Management
IWRM	Integrated Water Resource Management
MAC	Ministry of Agricultural Cooperatives
MET	Meteorology Department
MOI	Ministry of Interior
MRC	Mekong River Commission
MTC	Ministry of Transport and Communications
NDMO	National Disaster Mangement / Organisation
NFI	Non-Food Item
NGO	Non-Government Organisation
OFDA	Office of USA Federal Disaster Assistance
PAHO	Pan American Health Organisation (USA)

PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PRA	Participatory Rural Appraisal / Assessment
RS	Remote Sensing
SAR	Search and Rescue
SEISO	Society of Industrial Emergency Services Officers (UK)
SIA	Social Impact Assessment
SLUMDMP	Sri Lanka Urban Mitigation Disaster Management Programme
SOPAC	South Pacific Applied Geoscience Commission
TSFI	Telecom sans Frontier International
TUDMP	Thailand Urban Disaster Mitigation Project
UFM	Urban Flood Management
UN	United Nations
UNDMTP	United Nations Disaster Management Training Programme
UNDP	United Nations Development Programme
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
UNEP	United National Environment Program
UNESCAP	United Nations Economic and Social Commission for Asia Pacific
UNESCO	United Nations Education, Scientific and Cultural Organisation
UNESD	United Nations Economic and Social Development
UN-HABITAT	United Nations Human Settlements Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UNRCO	United Nations Residence of Coordinators Office
USACE	United States Army Corps of Engineers
USAID	United Stated Agency for International Development
USGS	United States Geological Survey
VCA	Vulnerabilities and Capacity Assessment
WB	World Bank
WCD	World Commission on Dams
WMO	World Meteorological Organisation

table of contents

purpose and objective of the primer

introduction to integrated flood risk management in asia

policies and legal and institutional arrangements for flood risk reduction

assessing flood risk

integrated watershed management

structural interventions

coping with floods

flood disaster preparedness planning

emergency response

recovery and rehabilitation

economics of flood risk management in asia

cross-cutting issues

lists of boxes, figures and graphs

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

Chapter 8

Chapter 9

list of Boxes

list of Figures

Chapter 10

list of Boxes

Chapter 11

list of Boxes

Chapter 12

list of Boxes

list of case studies

purpose and objective

1

Purpose and Objective of the Primer on Integrated Flood Risk Management in Asia

Flooding in Asia

Floods are among the most destructive natural hazards causing extensive damage to the built and natural environment, and devastation to human settlements. Economic losses due to the effects of damaging floods have increased significantly around the world. The Asian region experiences frequent flood disasters of high magnitude, and although the number of deaths caused by flooding has decreased, the number of affected populations and economic losses have increased significantly. These trends trigger a need to pay greater attention to the impact of flood hazards on human development.

Current development trends predict an exponential growth of the human population in urban environments leading to increasing demands on the production sectors, and increasing pressure on water resources. These trends will contribute to increasing risks associated with flood hazards. In response to the global attempt to shift away from responding to disasters, this Primer aims to present an integrated flood risk management approach as a part of the development process.

Floods frequently ignore political boundaries and are considered beneficial for their life-giving qualities and damaging due to their destructive force. The challenge for the Asian region is to develop strategies, action plans, policies, and implement activities, with coordination among different nations that aim to secure the social, political and economic livelihoods for people living with risk.

Objectives of the Primer

This Primer on Integrated Flood Risk Management in Asia is intended to gather together ans thereby share the advances in knowledge and experience gained in flood risk management since 1990. There is a gradual shift away from dealing with floods as a stand-alone or one-off event to managing it as part of an integrated water system within a watershed. Current research and literature, partnerships and collaborations, and formation of networks reflect this integrated approach. However, the region lacks a comprehensive resource and reference document for practitioners and professionals, which addresses the complexity of the flood environment in Asia.

This hazard specific Primer is a comprehensive, practical and updated resource on flood risk management. The main goal is to advocate for a common understanding regarding the need to acknowledge that flood risks must be managed as part of an integrated watershed management system.

The Primer aims to:

- Present concepts of integrated flood risk management and the important issues, considerations and limitations faced when implementing risk reduction activities and actions.
- Serve as a guide, reference and resource on current good practices in flood risk management in Asia.
- Advocate and provide options for considering an integrated flood risk management approach.
- Provide a process driven approach to each component of flood risk management as part of an integrated disaster risk management cycle.
- Contribute to current trends of integrating risk management into the development process.

Target Audience

The Primer is a practical how-to-guide for those already working in the field of disaster risk reduction, natural resources, water resources, land use planning, infrastructure development, urban planning and community development. It is also for those who can appreciate the potential benefits of adopting an integrated risk management approach. As the Primer advocates a multi-sector and multi-stakeholder approach to flood risk management, the target audience will be diverse. Some chapters are technically orientated and require a certain level of pre-existing knowledge, and not all chapters will be of interest to everyone.

The primer targets four groups consisting of people who (1) authorise programmes; (2) formulate decisions; (3) plan, develop and implement decisions; (4) support implementation of decisions:

Group 1 Authorisation (Elected representatives)
Primer Ministers, Ministers in charge of disaster management, Chief Ministers of Provinces, Mayors, Chairpersons of Local Authorities.
Group 2 Policy Formation (Administrative Heads)
Permanent Secretaries, Focal Points for Disaster Management Departments, Heads of Line Ministries, Chief Secretaries (State or Provincial Governments), Municipal Commissioners.
Group 3 Planning, Development and Implementation (Technical bodies, Utilities and Services)
National Departments responsible for project implementation, Natural resources departments, Water resources departments, Water boards, Utilities, Road and Transport departments, Housing authorities, Urban development

authorities, Provincial departments, Agriculture and Fisheries department, Infrastructure, Building and Construction departments, Forestry departments, Economic development departments, private sector, technical specialists (engineers, hydrologists, meteorologists).

Group 4: Implementation Support

Peripheral Ministries, International development / funding organisations, NGOs, CBOs, volunteer organisations and civil society.

Design

This is the second volume in the Primer collection specifically dealing with slow on-set riverine flood hazards. It builds on the information presented in the General Volume 1 and applies it to flood hazards. It is organised in the following way:

Chapter organisation

The Primer has a chapter format to help the reader access material easily. An outline is provided in a standard format at the beginning of each chapter with page numbers that link the outline to corresponding chapters sections. Generally the outline is as follows except for Chapter 2 - Setting the Scene and Chapter 12 - Cross-cutting Issues. Case studies of the Asian experience highlighting aspects of the concepts and processes are presented in various places throughout each chapter.

- **Chapter Brief** - Presents the chapter content in summarised bullet form
- **Key Words** - Vocabulary relevant to the chapter are listed in alphabetical order with a brief definition. Key words build upon each other in each subsequent chapter so that toward the end a larger array of key words are used.
- **Overview** - P rovides a brief introduction of the subject matter and main issues to be discussed in the chapter.
- **Concepts** - Relating to the specific flood risk reduction processes, activities and actions covered in the chapter.
- **Process** - Pertinent to the specific flood risk reduction activities covered in the chapter in step-by-step format.
- **Limitations** - Highlights the problems faced during implementation and factors hindering the adoption of activities and actions.
- **Checklists** - Provides a short list of questions that may assist in the development or implementations of the activities and actions presented.
- **Future Challenges** - Presents the specific challenges for the implementation of integrated flood risk reduction activities faced by the region.
- **References -** As per used to support and articulate the arguments presented in each chapter.
- **Resources -** A list of guidelines, resources, manuals and reference materials that may help the reader to carry out flood risk reduction work.
- **Icons** - Some pages display icons depicting links to other chapters where concepts and processes overlap, or are related to other topics; or underscores key themes that need to be considered.

section icons	navigational icons	key theme icons
keywords	see Box 1.1	case study
concepts	see Chapter 1	stakeholders
process	see Figure 1.1	policy
lessons learned	see Case Study 1.1	transboundary
checklist		participatory approach
future challenges		risk assessment
resources		risk assessment (specific)
references		finance

The Process of Development of the Primer

The series of consultations on the development of the Primer was initiated by ADPC under its Asian Urban Disaster Mitigation Programme (AUDMP). The AUDMP is a nine-year programme funded by USAID / OFDA. It commenced in 1995 with the goal of reducing disaster vulnerability of urban populations, infrastructure, critical facilities and shelter in nine Asian countries - Bangladesh, Cambodia, India, Indonesia, Lao PDR, Nepal, Philippines, Sri Lanka and Thailand.

ADPC drafted an outline for the Primer for discussion during the Mini-workshop on Development of the Primer on Disaster Risk Reduction in Asia organised in Bali, Indonesia on 27 September 2002 following the Regional Workshop on Best Practices in Disaster Mitigation on 24-26 September 2002. A concept paper outlining the details such as process, time frame, etc. on development of the Primer was subsequently prepared giving potential models that could be followed.

Since then, the framework for the development of the Primer was further consolidated through discussions with a range of stakeholders including national government institutions at ADPC's Third Meeting of the Consultative Committee on Regional Cooperation in Disaster Management, in India during 29-31 October 2002, and with potential donor organisations.

Funding

The General Primer for Disaster Risk Management was developed by ADPC with funding from the United States Agency for International Development's Office of Foreign Disaster Assistance (USAID / OFDA). The Second Primer for Integrated Flood Risk Management was developed by ADPC with funding from the United Nations Development Programme (UNDP).

Advisory Group

For developing the Primer, the services of an Advisory Group comprising of leading experts from diverse professional backgrounds with extensive knowledge and experience in the relevant fields were obtained. The advisory group members provided invaluable guidance to the framework, outline and drafts at different stages.

introduction

2

Chapter Brief

- Asia is the region most affected by floods.

- Flooding is a natural occurrence that is beneficial, however, flooding that exceeds normal flows and people's capacities to cope are regarded as damaging floods that have serious consequences on the human and natural environment.

- Integrated flood risk management provides a holistic way of addressing flood risks taking into account the need for cooperation of all stakeholders and ensuring all phases of the disaster cycle are equally addressed.

- It is essential to make the link between flood disasters and sustainable development. Integrated flood risk management should provide avenues for ensuring that long-term issues are considered.

Key words

Disaster Risk Management

The systematic process of using administrative decisions, organisations, operational skills and capacities to implement policies, as well as the strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid or limit the adverse effects of a hazard (UNISDR, 2004).

Development

In essence, it means positive change. In a social context it refers to expanding people's choices and options to lead lives that they value. This includes: better access to quality healthcare and education; employment opportunities; security from violence, conflict, crime and disasters; political and cultural freedom; and ability to participate in decision-making that impacts their lives.

Disaster Risk Managers / Practitioners

Those either directly or indirectly involved in decision-making, developing strategies and plans, implementing and / or advocating disaster risk reduction. They can be within government ministries and departments, production sectors, NGOs, CBOs, and the private sector.

Flood Risk Management

The management of floodplains through a systematic process requiring risk assessment, strategic planning, development of risk reduction measures and implementing activities. The process involves multiple stakeholder and sector cooperation, with the aim to reduce flood risks in a sustainable manner.

Flood Disasters

A damaging flood hazard that adversely affects human populations and the environment.

Integration

The act of combining separate entities into an integral whole; or consolidation. In the case of risk management, it implies a holistic approach spanning across sectors, stakeholders and transboundary administrations.

Stakeholders

Those with an interest in the making of a particular decision, generally because the result affects them. They can be an influencing individual or group.

Overview

Floods are a naturally occuring phenomena, with the power to impose the greatest impacts on both developed and developing countries. Asia experiences the greatest damages and losses to the physical environment and human population from devastating floods. It is widely recognised that there needs to be a new approach to managing flood risks.

Integrated flood risk management is a relatively new concept. It ensures that disaster risk management activities are carried out to suit the actual flood context as well as the human and environment contexts, providing a holistic approach and ensuring the inclusion of all stakeholders in the management of all phases of the disaster cycle.

This chapter will present the flood environment in Asia and describe how flood disasters impact on the livelihood security of the people. It will introduce the approach of integrated flood risk management by describing types of floods and their damaging impacts.

Concepts of Integrated Flood Risk Management

> *'Floods have the greatest damage potential of all natural disasters… and affect the greatest number of people' (UNDP, 2004).*

Why are floods so damaging?
Flooding occurs when river levels exceed their natural banks and water overflows. This is not a rare occurrence, it happens naturally and regularly. There are two types of flooding, normal and damaging. Normal flooding is expected because people's use of the land takes into account these naturally occuring overflows, hence, the impact is not considered a disaster. The impacts of normal flooding is within the boundaries of people's adaptive capacity, and over time communities have developed coping mechanisms and resilience enabling them to withstand and benefit from normal flooding.

When flooding exceeds their normal limits or when people fail to adapt their land-use, they can result in significant loss and damage to livelihoods by damaging crops, industry, commerce; disrupting education and other services; taking lives and displacing people. Severe and prolonged floods can hinder and undermine the achievements of human development. Due to the high population density and location of settlements, an increasing number of people are affected each year by floods. As the region experiences economic growth, the economic impacts also increase (UNISDR, 2004).

Types of Floods

This primer focuses on slow-onset floods mentioned below. They are prevalent throughout Asia presenting great challenges for disaster risk managers due to their recurring nature, complex contributing factors and wide ranging consequences.

Riverine floods (also referred to in Asia as monsoon floods). They occur when major rivers and their side channels overflow, causing extensive inundation. The rivers rise slowly and with slow recession may remain high for many weeks. Flood peaks may occur simultaneously on many interconnected rivers, which can cause particularly extensive flooding. There are two types of river flooding: slow-onset and rapid-onset or flash floods.

- *Slow-onset floods* - Occurs slowly and can last weeks or even months. Causes may consist of snowmelt or steady ongoing rainfall. Rising flood levels can be forecasted, giving people the opportunity to evacuate the areas at risk. There are often extensive damages and losses.
- *Rapid onset / flash floods* - Occurs mainly in steep rivers with small and steep mountainous catchments after periods of intense rainfall. These floods are

accompanied by a rapid rise and fall in water levels. The sudden onrush of water from mountains and high-flow velocity causes intense damages to crops and property and greater direct loss of life than slow-onset floods.

Localised and urban floods. Intense local rainfall in areas with inadequate drainage, stormwater management and flood evacuation systems tend to result in localised flooding. Floodwater collects in particular areas and may remain for a long duration of time.

Floods can have different levels of magnitude as shown in Figure 2.1. These magnitudes are normally quantified according to their recurrence interval. Flood severity is classified according to their impacts on the community and the extent of losses and damages. There are also a number of factors contributing to the causes of flood shown in Box 2.1.

see Chapter 4 & Box 2.1

Figure 2.1
Levels of magnitude

- **Normal flood (e.g. 1 year flood*):** Regular inundation of low-lying farmland is common in many tropical Asian countries. They occur almost every year and farming practices, especially rice cultivation, are well-adapted. Forecasts can be issued to give advice regarding cropping and sowing times to minimise losses.
- **Medium flood (e.g. 5 year flood*):** Causes some economic loss, but is not extensive or serious. It affects farmers and people living in low-lying areas and by rivers. Loss of life is unlikely as people are usually prepared for these regular events.
- **Severe flood (e.g. 20 year flood*):** River levels continue to rise and affect large geographic areas and people less familiar with flooding including those living in urban areas. Damages and losses to the physical environment and economic sector are generally significant.
- **Catastrophic flood (e.g. 100 year flood*):** Inundates extensive areas. They are extremely devastating with multi-fold impacts to life and property and the economy,

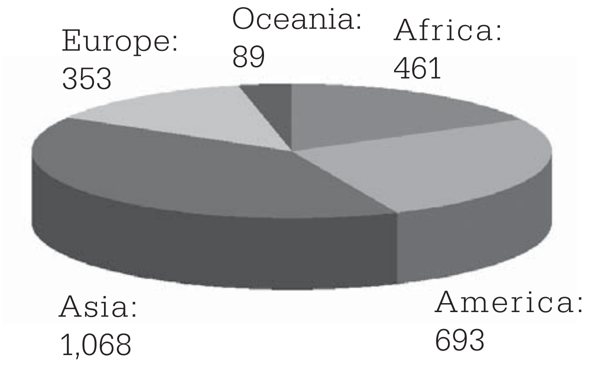
---

*** Floods may not occur at these exact intervals, this is just an example.**

Flooding does not only have a negative impact, riverine floods also deposit rich fertile sediments that enrich the nutrients lost through the intensive agricultural practices of deltaic farmers downstream. This natural action provides livelihood security for farmers and food security for the people. The surrounding watershed ecosystem also depends on flooding to enable the development of life. However, just as flooding can give life, it can also take it away quickly; the balance of biodiversity in a floodplain ecosystem is fragile and subject to changes and consequent rapid imbalance.

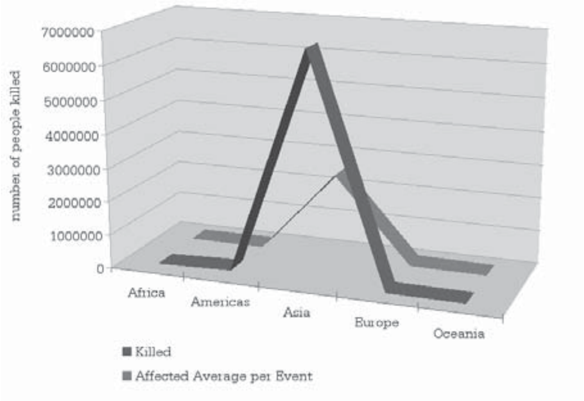
The region of Asia experiences most of the world's floods (illustrated in Graph 2.1). They are frequent and devastating. Although the total number of deaths caused by flooding has decreased significantly, the number of affected people has risen dramatically as shown in Graphs 2.2 and 2.3. This statistical shift can be attributed to investment in risk reduction measures over the past 20 years.

Graph 2.1
Number of flood events, 1900 to 2005



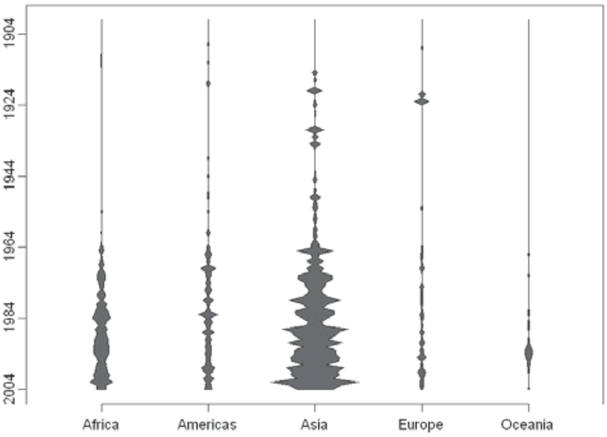
(Source: Data from CRED, 2005)

Graph 2.2
Number killed per affected average per event by region, 1900-2005



(Source: Data from CRED, 2005)

Graph 2.3
Number reported affected by natural disasters by continent, 1900-2004 (square-rooted)



EM-DAT: The OFDA/CRED international disaster database - www.em-dat.net - Université Catholique de Louvain, Brussels - Belgium

Floods result from interactions between natural processes as well as human activity as listed in Box 2.1. The causes of the hazard need to be understood in order for it to be properly addressed.

Box 2.1

Causes of flooding

Meteorological
Most flood damages are the result of extreme, intense and long-duration floods caused by meteorological phenomena such as:

- Prolonged and intense rainfall
- Cyclones
- Typhoons, storms and tidal surges

Hydrological
Flooding can also be caused by increased run-off due to:

- Ice and snow melt
- Impermeable surfaces
- Saturated land
- Poor infiltration rates
- Land erosion

Anthropogenic
Floods are also influenced by both natural and human activities for example:

- Population growth
- Land-use - deforestation, intensive agriculture, unplanned flood control measures
- Socio-economic development activities
- Urbanisation
- Climate change

Integrated Flood Risk Management

Evolving flood risk management
Since the global initiative of the International Decade for Natural Disaster Reduction (IDNDR), and its predecessor, the International Strategy for Disaster Reduction (ISDR), there has been a slow, but significant shift in the approach to managing disasters. It is now understood that disasters cannot be prevented, but rather, disaster risks can be reduced.

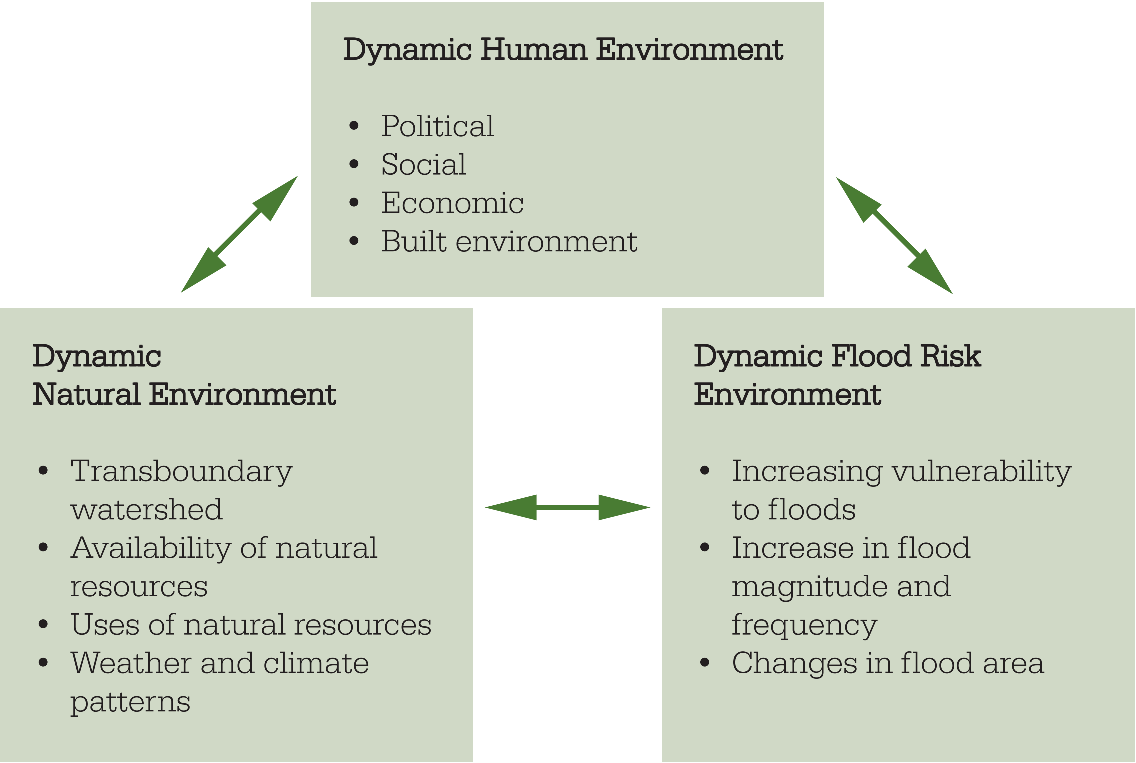
In the event of a flood disaster, focus was directed to emergency response and relief of the immediate needs of the people. Now there is a focus on reducing flood risks through a comprehensive process based on risk assessments, then developing and applying strategies to treat risks. Greater interest and focus has been placed on risk reduction activities aimed to mitigate against and prepare people for floods.

Integration and linkage

The flood environment is in a state of constant flux. The human, natural and flood risk environment have an intricate relationship whereby each influences the other resulting in either negative or positive impacts. An integrated approach to risk management reflects this complexity.

Figure 2.2 illustrates the links and dynamics of human activities, the natural environment and the flood risk environment.

Figure 2.2



Five major river systems meander throughout Asia, and many countries share the transboundary benefits of these valuable water resources. There is currently conflict arising over the use of these rivers by each country they pass through. The use of the river upstream affects the flow of the river downstream and vice-versa. A political balance suitable to all countries concerned is yet to be achieved regarding the shared use of these complex and dynamic river systems.

Ganges River - India, Bangladesh
Brahmaptra River - China, Bhutan, India, Bangladesh
Meghna River - India and Bangladesh
Indus River - China, India, Pakistan
Mekong River - China, Myanmar, Lao PDR, Cambodia, Thailand, Vietnam
Salween River - China and Myanmar

The river systems in continental Asia

These large river systems and many other smaller ones in the region are prone to flooding during times of high rainfall. The damaging floods cause extensive area damage and affect a large segment of people. Those most vulnerable tend to live on low-lying land, have low-incomes, less employment opportunities and less access to essential services. Generally marginalised and often impoverished groups, tend to be the most affected.

This complex flood environment demands the adoption of an integrated flood risk management approach to address the inter-connected nature of the river systems. Contemporary approaches to integrated flood risk management considers, '*land and water resources, (and) development in the river basin within the context of Integrated Water Resource Management (IWRM). The goal is to maximise the use of the floodplain whilst considering minimum loss to life and biodiversity. This approach favours the occasional loss through flooding, but seeks to attain long-term increases in effective flood plain management' (PFPM 2004)*. Evidence of the past has proven that any single flood intervention will have implications on the whole system.

The integrated approach involves the coordination and management of measures that take into account the flooding, flood risk, characteristics of the geographic area and socio-economic systems in the community, as well as existing resource management strategies and policies (UNDP, 2004). In this approach, it is essential to have multi-stakeholder participation and multi- and cross-sector involvement. This catalyses the formation of links and networks of dialogue between government ministries and departments, planners, implementers, NGO's and the community.

Integrated flood risk management is a comprehensive approach where equal emphasis is placed on mitigation, preparedness, relief and recovery through the involvement of all relevant sectors and stakeholders with the overall goal to reduce flood risks.

Floods and the development challenge

The challenge faced by Asia is to mirror the links of the physical system and transform them into a working strategy complemented by committed actions that strike a balance between the sustainable uses of the river systems and the need to address flood risks.

The impact of severe floods poses a development challenge for Asia. Poverty is a significant contributor to people's vulnerability to flooding and frequent flood impact leads to increase in poverty and hence vulnerability. Although there has been fast and steady economic growth in most countries in the region, the majority of the people are still agrarian-based. They live in settlements in low-lying areas, relying on agriculture and depending on the land for their livelihood security. The last 20 years has also seen massive migration of people to urban centres in search of employment and better access to services. This has led to an increase in urban flood risk as people settle in high-density urban slums on city fringes, on or next to flood protection embankments and along riverbanks.

Rural and urban Bangladesh

Poverty affects people's capacity to cope with floods. Factors contributing to poverty and vulnerability to flood disasters are:

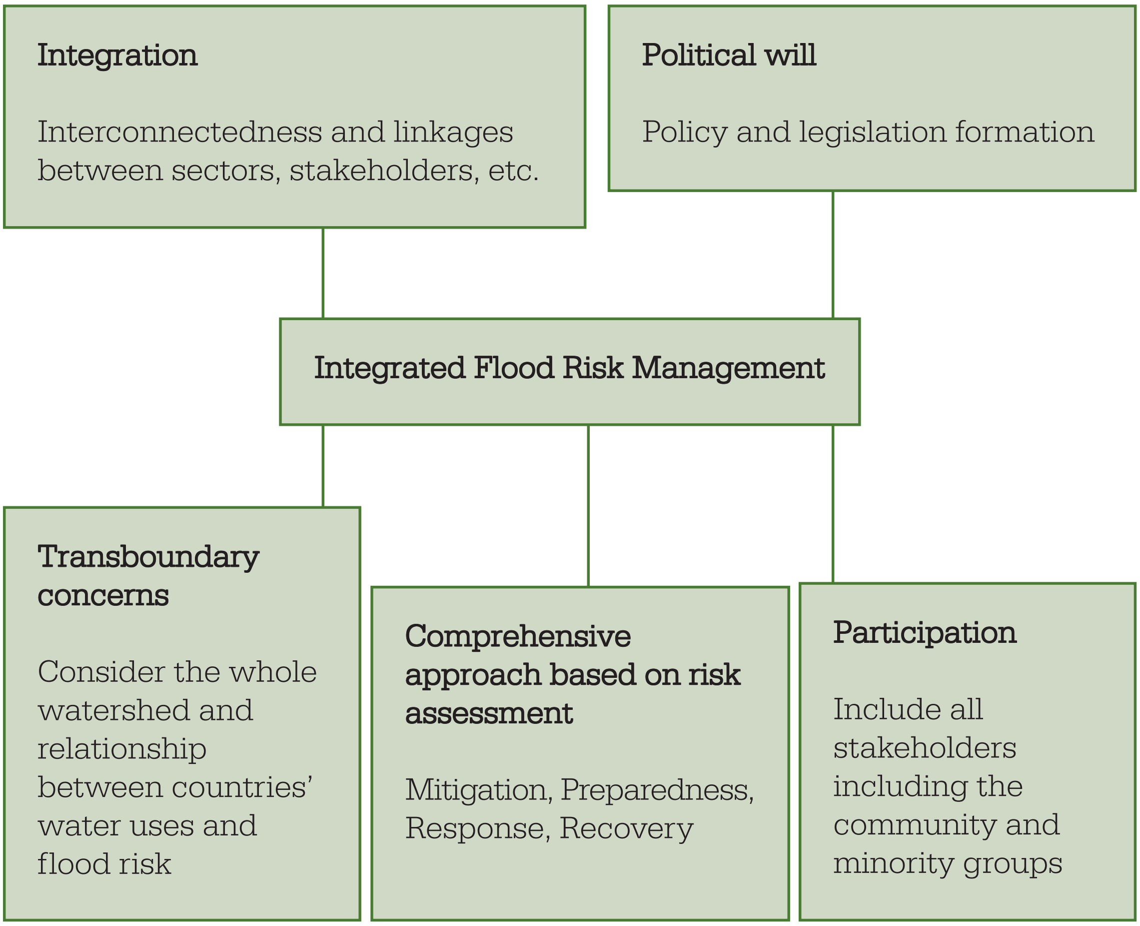
- Low income
- Poor shelter / housing provision
- Lack of access to public services
- Lack of savings or insurance
- Conflict
- Unstable political system and corruption
- Weak national economy

During medium and severe floods, many of these people are the most vulnerable, and incur significant losses and damages.

This primer aims to present various options for reducing flood risks through an integrated approach to flood risk management. Flood hazards are not isolated phenomena; there are multiple causes and factors contributing to flood, as well as multiple consequences. Managing flood risk requires an acknowledgement of the complexity of the entire flood environment. A selection of important themes have been incorporated into the concepts and processes to present a holistic approach to flood risk reduction as shown in Figure 2.3.

Due consideration must be given to ensure these themes become actions within the overall framework of integrated flood risk management.

Figure 2.3



References

APFM (2004) *Integrated Flood Management - Concept Paper.* Associated Program on Flood Management (part of WMO and GWP).
http://www.apfm.info/publications.htm
Accessed March 2004

CRED (2005) *EM-DAT Emergency Disasters Database.*
http://www.em-dat.net/disasters/Visualisation/profiles/natural-table-emdat_disasters.php?dis_type=Flood&Submit=Display+Disaster+Profile
Accessed April 2005

UNISDR (2004) *Guidelines for Reducing Flood Losses*. Geneva, UNISDR.

UNISDR (2004) *Living with Risk.* Geneva, UNISDR.

UNDP (2004) *Reducing Disaster Risk: A Challenge for Development*. New York, UNDP.

3

policies & legal & institutional arrangements

This chapter is linked to all the chapters in this book as it describes the foundation on which integrated flood risk reduction must be based.

Chapter Brief

- Flood hazards should significantly influence the management of the watershed.
- At present there are few binding policies or legislations to directly support flood risk reduction measures in Asia. The challenge is to examine existing related policies that could be linked to flooding and incorporate risk management processes within an integrated approach.
- Total flood control is no longer an option to consider for policy because the flood environment is complex and dynamic. It spans across political borders, and poses a challenge for future national policy-makers to address.
- Creating an environment conducive for flood policy formation remains a challenge for Asia. There is need for political will and commitment to foster good governance and compliance.
- Developing and implementing policy, legislation and institutional arrangements demand a long-term commitment by key stakeholders within the watershed. The first steps begin with dialogue and discussion, active participation and sharing of information.

Key Words

Policy

Policies express a government's political philosophy. They establish a course of action pursued by a government, political party, organisation, etc. Policies form the framework for legal and institutional arrangements necessary to put policies into action, such as local state and national level legislation, resolutions, programmes, appropriations, administrative practices, and/or court decisions.

Legal Arrangements

Include a framework of laws, executive orders and other legal instruments that establish basic guidelines for governmental and non-governmental actions. Legal arrangements define authorities' responsibilities, official institutions and organisations as they relate to disaster mitigation and management.

Institutional Framework

An institutional framework establishes the structure and relationships of governmental and non-governmental organisations including ministries, departments, individuals and the private sector. For example, a framework can dictate the institutional arrangements for disaster mitigation and management which includes the establishment of a single entity at each level of government, such as a National Disaster Management Office (NDMO) responsible for coordinating such activities and maintaining communication and coordination.

Institutionalisation

Institutionalisation is the formalisation of concepts, ideology, action and process through recognition, validation and common social practice.

Overview

The flood environment is set in a dynamic river basin system, influenced by the fluxes between the land, water and human activity. This unique relationship demands the adoption of an integrated approach, presenting a considerable challenge for governments to form policies directed at flood risk reduction. Similar to general disaster risk management policies, flood risk management should be integrated into development practice and efforts for mainstreaming should be reflected in national policies. Three elements - policy, legislation and institutional arrangements - together form the foundation for a community or society's approach to disaster risk management. If any of the three elements is weak, the entire system will be prone to failure (Mattingly, 2002). The government must take the lead in promoting policy formation through consultation and participation at every step.

The government has a responsibility to protect the rights, welfare and safety of their citizens and institutionalise a constitution that supports the common societal goals of sustainable development. Therefore, disaster risk management needs to be explicitly recognised as a core function of the government. The assigning of functions, responsibilities and roles of different key ministries, institutions, organisations and sectors must be formalised through specific disaster risk management frameworks containing legislation and implementing regulations within a plan (Refer to Primer 1 - Chapter 2). Enforceable laws mandating the execution and coordination of activities that contribute to reducing risk must be developed and implemented by courts of law. However, compliance to existing regulations are commonly neglected in most parts of Asia.

see Volume 1 Chapter 2

Frameworks advocating 'total flood control' have now been abandoned as it is realised that it is impossible to ensure total control over the flood environment. In the ADB's recent Water Policy (2003), they admitted that large and costly structural interventions have only contributed to lulling people into a false sense of security through *'encouraged unimpeded development in areas where devastating floods will nevertheless inevitably occur'* (ADB, 2003). Policies need to address factors contributing to vulnerability, such as urbanisation, poverty, poor environmental management and uncontrolled development. These factors can also contribute to flood risk. Therefore, flood risk reduction policies must be integrated into development planning to ensure flood risk is considered in the development process.

Concepts of the Flood Risk Management Framework

The flood risk management framework must reflect all aspects of the flood environment. This section addresses the following:

- The integrated approach
- The need to mainstream risk reduction into development
- Addressing flood risk through existing arrangements
- Characteristics of good policies
- Assessing the importance of legislation
- How policies work in a given context

The Integrated Approach

Integration

Policies, legislation and institutional arrangements need to reflect the complexities of flood risk, and solutions need be mutually beneficial for all stakeholders.

see Chapters 2 & 5

see Boxes 3.1 & 2.2

Flood policies should be considered within the concept of Integrated Flood Risk Management (IFRM). Participation of various sectors and stakeholders is needed for finding a comprehensive solution to the flood problem. Therefore, the flood policy context must include multi-disciplinary, multi-sector, multi-stakeholder participation, initiatives and activities to address the flood environment characterised by the transboundary nature and influences of an integrated water system. Ideally, policies need to acknowledge and formalise the interconnectedness of the systems in the watershed.

The following measures are essential for developing flood policy:

- Consider flood risk in all sectors at all levels.
- Identify key stakeholders in all stages of flood risk management.
- Build coalitions and partnerships to encourage the support of local community groups.
- Encourage participation of all stakeholders.
- Review and amend according to the dynamic flood environment.

The management of floods should fall under a central agency such as the NDMO responsible for coordinating different stakeholders. Institutional arrangements need to delegate legal responsibility to other agencies to carry out specific roles and activities. Communication between and within key agencies and institutions

Box 3.1

Stakeholders can include:

- The emergency planning and response agency or committee
- Government ministries and departments at all levels
- National Disaster Management Office (NDMO)
- Services providers (water, sewerage, highways, transport, public works, energy and telecommunications, etc.)
- Sectors (construction, education, health, industry, agriculture, etc.)
- Universities, research groups and training organisations
- Local voluntary and community organisations
- Flood, storm and earthquake control commissions
- Private / Business sector
- Insurance sector
- International agencies / NGOs
- Armed forces, police and fire service
- Marginalised and minority groups

is imperative for effective and efficient functioning. The design of institutional arrangements should consider coordination with development, rather than focusing on the response and relief paradigm. Participation of various sectors and stakeholders is needed for finding a comprehensive solution to the flood problem.

Transboundary

All policies must take into account the transboundary nature of the flood environment. Mechanisms for open discussion and dialogue is essential to reduce the conflicts arising over use of the watershed. For example, an action in a country located in the upper watershed can result in negative or positive flood related problems to countries located in the lower watershed. The ideal situation should be that countries sharing the watershed have bilateral or sub-regional arrangements to maintain the uniformity of action so that all the countries within the watershed collectively find solutions to the problem.

see Chapters 5 & 12

Mainstreaming

Policies, legal arrangements and institutional arrangements need to reflect all aspects of flood risk management such as structural and non-structural measures, preparedness, response and recovery. Many governments already have institutional arrangements for emergency response, however, an integrated approach demands the institutionalisation of all other activities.

Case Study 3.1

Mechanisms of Disaster Management and Relief in Malaysia

The National Security Division

The National Security Division (NSD) in the Prime Minister's Department is responsible for coordination of all activities related to disaster. The National Security Council (NSC) Directive No. 20 was issued to provide guidelines on the management of disasters including the responsibilities and functions of the various agencies under an integrated emergency management system.

Disaster Management and Relief Committee

A Disaster Management and Relief Committee was established at Federal, State and District levels whereby the NSD is the Secretariat, to implement the activities of the NSC. The main functions of the Disaster Management and Relief Committee (DMRC) are as follows:

- At **Federal level**, DMRC is responsible in the formulation of national polices and strategies regarding the alertness and preparation of various agencies involved in the handling of disasters. The DMRCs at the **State and District levels** are required to implement and carry out such policies and strategies.
- Ensure sound coordination among the agencies involved in the handling of disasters and determine the roles of the principal emergency services (Police, Medical and Fire Department) and other supporting services.
- Activate the **Disaster Operation Control Centre at District, State or Federal Level** whenever required.
- Coordinate and mobilise whatever resources and logistics available from government agencies and if necessary also from the private sector.
- Coordinate assistance to and rehabilitation of disaster victims.
- Carry out post-mortem and report upon completion of the disaster operations for the purpose of recording and performance evaluation for future reference and planning.

On-Scene Control Post (OSCP)

see Chapter 9

An On-Scene Control Post (OSCP) for operation management of the disaster is set-up immediately. The On-Scene Commander will either be the OCPD, CPO, or the Director, Internal Security and Public Order Royal Malaysia Police, depending on the level of disaster.

- Make an early assessment at the scene of potential or actual disaster and immediately activate OSCP if deemed necessary.
- Identify the equipment and logistic requirement in handling the disaster.
- Coordinate the functions of various agencies involved in search and rescue operation.
- Report and advise the Disaster Management and Relief Committee at their respective level.

Special Malaysia Disaster Assistance and Rescue Team (SMART)
SMART was established in 1995 as directed by the NSC Directive No. 19. SMART is directly responsible to the Director, Crisis and Disaster Management Unit, NSD. SMART comprises of 85 officers and personnel from the Fire and Rescue Department, Royal Malaysia Police and the Armed Forces. The Team is equipped with specialised skills and equipment to respond to any search and rescue operation in any major disaster on land which is beyond the capabilities of the existing principal emergency services Search and Rescue (SAR) teams. The team members were trained in SAR training institutions abroad such as in the USA, Sweden, Australia and Singapore. The decision on the mobilisation and deployment of the SMART team is made by the Director, General of the NSD or the Director, Crisis and Disaster Management Unit.

The role of the Malaysian Meteorological Service in disaster management

The Malaysian Meteorological Service (MMS) is the agency responsible to provide information and warning occurrences of adverse weather phenomena to the general public through the mass media or to other government agencies directly involved in disaster mitigation. A Central Forecasting Office has been established in the Meteorological Headquarters to monitor closely the weather and sea conditions over the Malaysian region.

see Chapter 8

Role and functions of the Social Welfare Department in disaster management

The Social Welfare Department has the following functions:

Preparedness	Response	Recovery	Relief Assistance Schemes
• Identify the locations of evacuation centres. • Update the list of names of officials to be contacted and mobilised in the event of a disaster. • Identify suppliers of relief assistance supply, • Update the operation rooms. • Set up the corps of volunteers/task force. • Provide training for the officials and volunteers. • Prepare duty lists for the officials and volunteers. • Send supplies to forward-supply bases.	• Register the affected people. • Manage the evacuation centres. • Distribute supplies and mobilise the volunteers/task force to help in registration and food distribution. • Organise activities for the evacuees in the evacuation centres. • Provide post-trauma counselling services to affected people suffering from stress, depression, etc.	• Evaluate the damage incurred. • Propose an appropriate rehabilitation programme. • Provide short and long-term relief from the financial aid schemes.	Short-term • Provide food and temporary shelter. • Give compensation to the affected population. Long-term • Provide monthly financial assistance. • Give start-up grants. • Give compensation for loss of crops and livestock.

Disaster management arrangement can be put in place to address preparedness, response and recovery. It is essential to have predetermined arrangements such as these as it enables a state of readiness and methodology for speedy action. The challenge is to expand disaster risk management activities to have specific roles to address (flood) disaster risk reduction.

Contemporary ideologies regarding disasters have shifted from emphasis on the response-based approach to comprehensive risk reduction. Over the past 20 years, some governments throughout Asia have established government department specifically to address disaster risk reduction. The challenge now is to institutionalise risk management into all government sectors.

Flood risk management is not a stand-alone sector, but an essential concern that spans all levels and sectors. Mainstreaming and integrating flood risk management into development policy, planning and implementation requires clarifying roles and placing the responsibility not only into the hands of decision-makers and planners, but also the general public.

Development planning

Flood risk management needs to be considered within the overall national development planning strategy. Floods impact negatively on the achievements of development, and damages can have bearing on economic development and social welfare. Institutional arrangements must include collaboration with development planning, so that progress itself does not contribute to increasing flood risk. For example, economic development policies seeking to expand the logging industry, should consider the causal link between deforestation and flood risk.

see Chapter 5

Countries sharing a watershed have differing development goals and strategies that do not always coincide with the risk reduction plans of the watershed. For example, one country upstream may prioritise hydroelectric power and build a dam, whereas another country downstream may prioritise agriculture, relying on irrigation. This may result in conflict over the use of the water resources.

Addressing Flood Risk through Existing Arrangements

Flood risk management policies of each country may focus on a number of approaches to reduce flood risk. However, in Asia, policies are few and far between.

Policies in each country should be developed to include flood risk, for example control of land use, enactment and enforcement of engineering and building codes and standards, and forecasting and warning. Experience is proving that mitigation policies are more likely to be successfully implemented if they are

see Case Study 3.2

consistent, integrated with, and linked to other policies and goals of society such as economic and social development and reduction of poverty (Mattingly, 2002). Chapter 5 presents the case study of how Japan integrated points of Agenda 21 into their existing natural resource management policies.

see Case Study 5.3

Case Study 3.2

Positions of Agencies Responsible for Aspects of Flood Risk Reduction in South-east Asian Countries

The following table shows how flood risk reduction has been incorporated into different sectors. Specific government departments are responsible for different aspects related to flood risk management (as of 2001).

Country	Agency	Responsibility
Lao PDR	Department of Agriculture and Extension (Under Ministry of Agriculture and Forestry)	Preparation of sectoral land-use development plans.
	Office of Forest Inventory Planning (Under National Agriculture and Forestry Research Unit)	Implementation of watershed management plans.
	National Disaster Management Office	Disaster preparedness and management and acts as the coordinator of disaster management in Lao PDR.
Thailand	Department of Land Development	Management and protection of land and soil resources.
	Office of Environmental Policy and Planning	Important role in producing flood hazard maps.
	Royal Forest Department (within Ministry of Agriculture and Cooperatives)	Enforcement of forest laws, issuance of permits and control of logging concessions, study and protection of watershed areas, planning forest replanting programmes.
Cambodia	Ministry of Water Resources and Meteorology (MOWRAM)	Design and construction of floodplain developments, development of water resources law and policy.
	Department of Hydrology and River Works (within MOWRAM)	Specific floodplain development e.g. Construction of irrigation and drainage schemes, rehabilitation of canals, assessing hydraulic impacts on floodplain development.
Vietnam	Department of Dyke Management and Flood Control (part of Ministry of Agriculture and Rural Development)	Construction and management of river and sea dykes. Emergency response activities.
	National Centre for Hydro-meteorological Forecasting	Forecasting and development of technology and research.

(Source: MRC, 2001)

Aspects of flood risk can be managed by a number of different departments and organisations and be incorporated into their existing responsibilities. There is a need for coordination of flood risk management throughout all the different departments.

How to Make Good Policies

‘Policy should have a vision, be guided by a philosophy, and be easy to understand’ (Mattingly, 2002). It begins as a concept, and is then developed into a plan or course of action, which is subsequently approved and adopted by a government, community, or other entities.

Good policies should be:

- Comprehensive and integrated
- Equitable
- Sustainable
- Efficient
- Flexible (to address emerging needs and concerns)

(Extracted from Mattingly, 2002)

The timing for policy development and formation is crucial. It should be instigated at national government level to provide political momentum to push ideas forward (refer to Case Study 3.3). However, the formation of flood policy is usually catalysed by events drawing attention to the need to employ sustainable management practices within the flood environment. A flood disaster of giant proportions can motivate people at most levels, from citizens affected to politicians, to consider the creation of policies and binding legislations to guide actions and activities to reduce flood risk.

Most policies are forced on people rather than implemented with the support of the people, therefore many policies in Asia are not followed. Governments must ensure that policies are formulated and implemented through dialogue with all stakeholders including the communities directly affected. It is advisable to carry out a public awareness campaign to explain the need for policy implementation. It is good practice to inform people and provide a platform for participatory dialogue so views can be expressed and people are aware of decisions leading to change.

Case Study 3.3

Adoption of Flood Policies

Vietnam: After major floods in 2000, the Government of Vietnam introduced the ‘*Living with Floods*’ concept that became the strategy for disaster risk reduction in the Mekong river delta. The strategy promotes regional and international cooperation through the implementation of long, medium and short-term measures to reduce flood risks (ADRC, 2004).

Bangladesh: The 1998 flood prompted the government to adopt an Integrated Water Resource Policy in the National Water Policy and National Water Management Plan. Roles and responsibilities were reviewed and emphasis shifted towards preparedness, early warning and planning response (Hossain, 2003).

The advantages of clear policies are:

- Demonstrated government commitment
- Good leadership
- Foundation for legislation, regulations and plans
- Basis for sound organisation and allocation of responsibilities
- Optimum utilisation of resources
- Demonstrated competence

(Extracted from Rego, 2000)

Box 3.2 demonstrates the wide range of policy types and their relevance to flood risk reduction.

Box 3.2

Policy Type	Description	Example
Action-forcing	Adopted by higher-level jurisdictions and intended to force loss-reducing activities by lower level jurisdictions.	National level binding policies and legislations that force provincial and municipal level preparedness and mitigation planning.
Attention-focusing	Intended to stimulate citizen, group and governmental interest in hazard losses, and to promote voluntary action to reduce such losses.	Public awareness campaigns.
Disaster recovery	Intended to assist affected parties to recover from the losses.	Mandating government level recovery planning.
Technology development	Focused on developing new knowledge and technology to support hazard mitigation policies.	Commitment to the improvement of early warning systems.
Technology transfer	Focused on transferring knowledge to consumers, governments and others, and the use of that knowledge to reduce hazard losses.	National governments to be represented in regional institutions (e.g. MRC).
Regulatory	Regulate decisions and behaviours of private parties and governments associated with exposure to natural hazards.	Land zoning and conservation of natural resources, building codes, etc.
Investment and cost allocation	Specify conditions for governments' acquisition and allocation of resources to sustain other policies: how much will be spent, how, where, for what purpose and at whose expense.	National disaster annual budget allocation for risk reduction measures, relief and recovery.
System optimisation	Intended to ensure that other policies are effective, compatible with system goals and internally consistent.	Monitoring, evaluation, review and revision to check the effectiveness of all policies as a whole.
Direct action	Authorise direct governmental action to implement a policy.	Construction of flood-proof housing. Removal of flood control structures.

(Source: Petak and Atkisson, 1982)

Assessing the importance of legislation

see Chapter 5

Laws, acts, mandates, regulations, and guidelines are all forms of legal structures established to support policy implementation (refer to Box 3.3). Without binding legal enforcement, policies are ineffective. Legal processes must be considered as part of flood mitigation measures eg. land-use plans, building codes, engineering design, monitoring and control of construction and zonation.

Box 3.3

The importance of legislation

- It provides a formal basis for disaster countermeasures, formally supporting plans, organisational arrangements, preparedness measures, response actions, and recovery and reconstruction programmes.
- It allocates major responsibilities in legal form, which helps to secure their proper implementation.
- Legislation can be made to have a uniform national effect, thus ensuring that all levels of the national counter-disaster structure receive the full benefit of its support.
- It does not need to be complicated to be effective. It can provide common sense backing for common sense requirements.
- Legislation can provide a wide measure of protection for governments, organisations and individuals who may be affected by a disaster.
- Disaster legislation can augment and supplement other legislation related to environmental protection, economic development, etc.

(Rego, 2000)

Other key attributes of effective legal arrangements for Disaster Management (DM) include:

- Clear mandate and roles, including line of command and coordination, within political units.
- Integrated, comprehensive and hazard specific.
- Incorporated in the law of the land/constitution.
- Sensitivity to indigenous customary law.
- Implementing rules and regulations.
- Appropriate sanctions and enforcement mechanisms.
- Recognition of collateral law, which may include mitigation and other aspects of DM components.

see Case Study 3.4

Despite all the challenges facing the proper establishment and implementation of policies, legislations and institutional arrangements, the task is possible. Commitment and political will, and the lead role of a strong government can, over time make the necessary changes to have a sustainable floodplain with reduced flood risk.

Case Study 3.4

River Administration in Japan

The River Bureau plans and implements a variety of projects to protect people from disasters caused by rivers, sediment, storm surge, and other natural phenomena, and to ensure sufficient water resources to support lifestyles and develop attractive waterside environments.

The River Bureau also drafts laws, manages river administration, issues licenses for water use and maintains facilities for the proper management of rivers, sediment control and coastal protection.

River administration classification

Two main objectives have motivated river administration in Japan since early times:

- To control river flooding.
- Ensure availability of river water for daily and industrial use.

Recently, conservation and creation of river environments have become increasingly important aspects of river administration. In accordance with the River Law, river administration is done by:

i. Classifying rivers.
ii. Dividing them into sections.
iii. Delegating responsibility for the administration of their various subdivisions.

River systems deemed important for the national economy and people's lives are designated as "Class A river systems" and administrated by the Ministry of Construction. Others are designated as "Class B river systems" and administrated by the prefectural governors. River Law is applied on some sections of small tributaries of both class A and class B rivers. Administration of the 'others' is carried out by the mayors of cities, towns and villages.

The River Law stipulates that any utilisation of land and river water within the sections defined by the River Law must obtain approval from the designated river administrator.

Profile of related laws

The objectives of river administration are upgrading the safety of the nation's land against flood disasters, stabilisation of the water supply and improvement of the living environment. River administration centres on River Law are also regulated by the Specified-Multipurpose Dam Law, the Sabo Law and the Seacoast Law.

Organisation
The Ministry of Construction was established, and the River Bureau was provided as its internal bureau for managing various matters related to rivers, by the enactment of the Ministry of Construction Establishment Law in 1948. Now the River Bureau department comprises of ten divisions and five sections involved in river planning, river improvement, dam construction, disaster recovery, sand control measures and coastal preservation. The Bureau also maintains eight Regional Construction Bureaus.

(Source: Ministry of Land, Infrastructure and Transport, Japan)

Flood risk policies in the urban environment

Asian mega-cities with their high-density populations within a relatively small geographic area present a unique environment for attempting to develop flood risk policies. Flood problems are becoming an increasing concern to the urban sector. As the concrete built environment, bitumen roads and pavements do not allow natural run-off to occur, water will run to the lowest points of the city and accumulate. Industrial and domestic wastes also pose a threat as they can contaminate the floodwaters and create a health hazard. Proper drainage systems to handle intense run-off is not always present in some urban areas. For example, Dhaka, Bangladesh, experiences severe inundation problems during monsoons. On the other hand, Bangkok, Thailand has developed a policy on drainage. Also, Malaysia has enforced drainage policies to help curb their urban flooding problems.

see Chapter 5

City planning should guide and control development activities of private developers and governmental agencies through a set of policies that also address flood risk. A high level of public consultation will ensure support to comply with regulations. Policies that aim to and contribute to reducing vulnerability to natural disaster are likely to command respect if people are made aware of their main functions and priority.

A semi-autonomous authority can bring flood mitigation practices into its location choices, and design and construction work, ahead of any decision by a higher authority. It can co-operate with community groups, non-governmental organisations and transport authorities on a one-to-one basis. At the same time it can promote a shared concern for flood risk reduction through citywide discussion groups and committees. It can offer a service to others in the fields of:
- Infrastructure data management.
- Mapping: geological, surface and settlement.
- Geographical Information Systems (GIS).
- Preparation of risk maps showing areas liable to flood and other hazards.
- Provision of public information.

Process

Step 1. Establishing the flood policy context

The preparation of a strategy document will provide criteria for assessing the existing situation and determine if there is a need to raise pragmatism to new levels or replace it with a new programme.

- Establish a team or taskforce consisting of identified key stakeholders with vested interests in proper management and good governance of the floodplain.
- What do you know about your environment? This is an information collection exercise where databases and inventories of information need to be initiated, collected and maintained. The database should include all the information collected when conducting a comprehensive Risk Assessment.

Remember:

Consultation
Communication
Initiation

An information sharing structure should be established in the host Ministry or Agency. This would feed the Flood Risk Management Committee (FRMC) and facilitate information exchange with other stakeholder agencies through the following activities:

- ***Review existing flood policies***. It is important to use/revisit existing policies, legal frameworks and arrangements. Sometimes the process will be one of revision and learning from past experience. An extensive audit process will provide this information.
- ***Conduct a risk assessment*** to determine the nature of flooding, peoples' vulnerabilities and how flood policies can be applied.
- ***Establish a consultation process*** to inform the public of any potential decisions and allow them to contribute. This can be done in public meetings held at different locations over a designated period of time.

see Chapter 4

Step 2. Formulate a strategic document

- ***Arrange a task force (FRMC) to prepare a flood risk management strategy***. A strategy sets objectives identifying programmes and projects, and relates those to time frames, such as 15 year perspectives and annual budgets.
- ***Agree on a common vision***. What do you want to achieve? It will take considerable time and effort to resolve conflicts between key stakeholders. For example, someone with vested interest in providing electricity may conflict with the views of those who need the floodplain to grow rice.
- ***Agreement on a strategy cannot be achieved without a parallel agreement upon the meaning of words and use of terminology***. In committee life the membership will represent a wide range of professions and interests. It is important to agree on the terms to be used, and the ways they are used, before committee life commences.

- *Develop a conflict resolution mechanism* to deal with conflicts so negotiations and dialogue do not grind to a halt.

Step 3. Formulate flood risk management policies

- *Applying constant participatory review and consultation* of key stakeholder groups. The established team or taskforce should compile and build consensus upon a list of key issues to address in the policy.
- *Communicate with and involve other countries that share the water resource*. Where countries share water regimes (such as Nepal, India and Bangladesh or Vietnam, Cambodia and Thailand) then planning, policy-making and large-project conception and implementation need to be supra-nationally based. Some countries have already recognised the need for formation of sub-regional bodies (such as, the formation of the MRC).
- In all activities level of responsibility, reporting lines and legal powers need closed definition. The achievement of this often results from long and delicate negotiations.

Remember that this is a long process and needs mechanisms for conflict management and resolution so that stakeholders do not reach stalemate on particular contentious issues.

Step 4. Establish legal arrangements to enact or encourage implementation

- Laws, executive orders, acts and mandates need to complement adherence to the policies established.
- There must be a body responsible for enforcement and monitoring strict compliance.
- The public needs to agree with and support the policies and accompanying legal arrangements. They must also be aware of the changes and the impact on their present livelihoods.
- Incentives both financial and non-financial should be launched by the government to show political motivation and support behind the policy.

Step 5. Establish an institutional framework to enact policies

The challenge of flood risk mitigation is that policy implementation structures should be conceptualised horizontally (across ministries and departments at many levels of government) and should be implemented vertically by specific departments, local committees and NGOs. All such institutions will have other interests that may reduce their commitment to the strategy.

While the lead ministry or municipality / committee / agency for a flood management strategy is at the centre of executive action, the contributions of others is vital to achieve success in policy formulation and in later implementation. The activities should be integrated in other developmental projects such as:

- Agricultural development
- Fisheries development
- Physical planning & development
- Infrastructure development

- Irrigation development
- Wetlands management
- Employment-generation policies
- Forestry rehabilitation
- Conservation and the environment
- Natural resource management

Monitoring, evaluation and review

After floods, the effectiveness of policies and legal arrangements should be evaluated and reviewed. This will provide an opportunity for stakeholders to discuss matters and review the applicability. Floods tend to reveal the vulnerabilities of a society. A flood disaster presents an opportunity to review the effectiveness of policies, legal and institutional arrangements so that necessary revisions can be made to encourage effective management and operation. The practice of reviewing legal arrangements and policies is not commonly conducted after a flood event in Asia.

Limitations

Governance

see Chapter 12

Policy and legal arrangements can only be effective and have credibility against a backdrop of good governance. The lack of accountability and transparency undermines the functioning of existing and new arrangements, and can even lead to new avenues for corruption.

Compliance

Enforceable laws mandating the execution and coordination of activities that contribute to reducing risk must be developed and implemented by courts of law. Compliance to existing regulations is commonly neglected in most parts of Asia. Although most countries in Asia have developed mechanisms, compliance is rare and enforcement is practically non-existent. A culture of cost-cutting encourages developers and builders to ignore existing regulations; this practice is common and widespread. Lack of incentive to comply and political will to enforce contributes to the problem.

Conflict and consensus

The importance of water resources has resulted in conflict between neighbouring countries sharing a watershed. This has been a major issue dating back through centuries of civilisation. Conflict and consensus mechanisms currently do not exist to resolve these on-going long-term problems. This issue is the biggest contention facing transboundary consensus over policies in a shared watershed.

Checklist

☑ Is there an environment conducive for policy formation?

☑ Are there existing related policies or frameworks that can be amended to include flood risk reduction measures?

☑ Do you have an institutional arrangement to guide your administration?

☑ Have you identified the key flood stakeholders in the watershed?

☑ What are the roles and responsibilities of the key stakeholders?

☑ Have you conducted an audit of the policy context to identify gaps in capacities, potential problems and scope for future action?

☑ Have you provided an environment for dialogue and discussion?

☑ Are you, as a government - the central decision-maker, the manager, or the implementer?

☑ Have you developed strategies, guidelines and action plans at all levels for long-term risk management?

☑ Are there mechanisms to monitor compliance of land-use regulations, building codes, etc?

☑ Have you considered how to mobilise support, coordination, involvement and contributions of a multi-disciplinary stakeholder community to implement a flood risk management action plan for long-term disaster risk reduction?

Future Challenges

- *There is a need to place greater emphasis on risk reduction.* During emergencies many agencies show great commitment, sympathy and involvement in emergency response activities. However, the enthusiasm fades away when officials are faced with disaster preparedness and mitigation. Changing the attitude of officials to show more commitment to long-term risk management is as important as changing the perception of risk of communities living in flood-prone areas. This is more so in flood risk management as floods are recurrent disaster events in many countries and any failure to act can be recognised as a prevailing fault in the system.

- *Ongoing political support is essential for driving the policy-making process.* Political will and desire to implement change can fluctuate due to a number of reasons. In many cases, ideas and ideals are created, but lack of commitment, finances and recognition hinder the continuation of policy formation. There is also a tendency for politicians to create policies in order to win support for campaigns, which they have no actual intention of implementing. Regular changes in political leadership, is also a problem as it slows the policy making process. It is a big challenge for policy-makers to retain support and continue in their personal commitment.

- *Disaster risk management needs to be placed in a position that enables integration into development.* The position of the NDMO within government ministries or departments defines its authority and power. It must have the authority to sway policy and the power to advocate change. One of the ways to achieve this is through decentralisation. The challenge is to assign greater authority to enable influencing sectors to make risk reduction a core part of their development strategies.

- *Adequate human and financial resources are essential for forming policies, legal and institutional arrangements.* The financial allocations and other resources needed for maintaining the institutional set-up is often inadequate and such constraints hamper the appropriate implementation of policy. The loss of skilled and trained staff is a problem leading to lack of continuity and commitment. Programmes should be established for capacity building so that a larger skill base remains. It is essential that authorities consider training and research as components in the policy framework and the need to be supported through provision of additional resources.

Resources

Petak, Wand Atkisson, A. (1982) *Natural Hazard Risk Assessment and Public Policy: Anticipating the Unexpected.* New York, Springer-Verlag, MRC *http://www.mrcmekong.org*

Brown, et al (1995) *The Challenge of Changing Environmental Management in Risks and Opportunities*. London, Earthscan.

References

ADRC (2004)
www.adrc.or.jp
Accessed September 2004

Bruntland, G. (ed.) (1987) *Our Common Future: World Commission on Environment and Development.* Oxford, Oxford University Press.

Hossain, A. (2003) *Integrated Flood Management Case Study Bangladesh: Flood Management*. Global Water Partnership, WMO Technical Support Unit.
http://www.gwpforum.org
Accessed March 2005

Matingley, S. (2002) *Policy, Legal and Institutional Arrangements.* Proceedings of the Regional Workshop on Best Practices in Disaster Mitigation, 24-26 September, Bali. Bangkok, ADPC.

Ministry of Land, Infrastructure and Transport. *River Administration in Japan.* Japan.
http://www.mlit.go.jp/river/english/admin.html
Accessed April 2005

MRC (2001) *MRC Strategy on Flood Management and Mitigation on the Lower Mekong Basin*. Draft. Phnom Penh, MRC.

Petak, W. and Atkisson, A. (1982) *Natural Hazard Risk Assessment and Public Policy: Anticipating the Unexpected.* New York, Springer-Verlag.

Rego, L (2000) *Reforming of Policy, Legal and Institutional Arrangements and Planning for Disaster Mitigation in Asia: Trends, Issues and Challenges.* Regional Workshop on Policy, Legal and Institutional Arrangement Planning for Disaster Management. Bangkok, ADPC.

4

assessing flood risk

Chapter Brief

- Risk assessment forms the basis for developing and implementing flood risk reduction strategies, plans and actions.
- Risk assessment involves the assessment of the flood hazard exposure, vulnerability and capacities.
- Flood risk assessments should also consider the occurrence of secondary hazards and include them in all sections of analysis.
- Information collection and data analysis is a key part of risk assessment.
- Risk assessment should be participatory and can be a starting point for raising awareness of flood risk in the community.

Key Words

Annual Flood

The annual flood of a stream is the highest instantaneous peak discharge of the water year.

Climate

The average weather conditions in a given region over time based on statistics and records.

Design Flood

Design floods are hypothetical floods used for planning and floodplain management investigations. A design flood is defined by its probability of occurrence. It represents a flood which has a particular probability of occurring in any one year. For example, the 1% Annual Exceedence Probability (AEP) or 1 in 100 Average Recurrence Interval (ARI) flood is a best estimate of a flood which has 1 chance in 100 of occurring in any one year (Earth Science, 2005).

Discharge (Q)

The volume of water per unit time that passes a specified point on a stream. Discharge can be measured in cubic metres / centimetres per second (m3/sec or cms).

$$Q = wdv$$

where w = water width; d = mean water depth; v = mean water velocity

Environmental Impact Assessment (EIA)

Studies undertaken in order to assess the effect on a specified environment of the introduction of any new factor, which may affect the current ecological balance (UNISDR, 2004).

Flood Magnitude

The size of a flood peak in discharge units (eg., ft^3/sec or m^3/sec).

Flood-frequency Curve

A graph showing the relationship between flood magnitude and their recurrence interval for a specified site.

Forecast

Definite statement or statistical estimate of the occurrence of a future event (UNISDR, 2004).

Geographic Information Systems (GIS)

Analysis that combines relational databases with spatial interpretation and outputs are often in the form of maps. Computer programs are used for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced (UNISDR, 2004).

Hazard

A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can be single, sequential or combined in their origin and effects. Hazards may be characterised by their location, intensity, frequency and probability of occurrence (UNISDR, 2004).

Risk

The probability of harmful consequences or expected losses (death, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions.

Risk depends on exposure to the consequences of uncertainty or potential deviations from what is planned or expected (disruption to everyday life). Current disaster risk reduction frameworks see ‘risk’ as a negative consequence, so positive results can also arise from probable harm.

Risk can be expressed as a *function of hazard x vulnerability.* How one copes depends on capacity.

Risk is the resultant of the interaction of three functions namely hazard, vulnerability and exposure. Beyond expressing a possibility of physical harm, it is crucial to recognise that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people do not necessarily share the same perceptions of risk and their underlying causes (combination of ADPC and UNISDR definitions).

Risk Assessment / Analysis

A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend (UNISDR, 2004).

Stream Flow

The discharge that occurs in a natural channel. It uniquely describes the discharge in a surface stream course. The term "stream flow" is more general than "run-off," as stream flow may be applied to discharge whether or not it is affected by diversion or regulation.

Surface Run-off

The part of the run-off (from precipitation) which travels over the soil surface to the nearest stream channel (USGS Glossary, 2004).

Target / Design Flood

Design floods are hypothetical floods used for planning and floodplain management investigations. A design flood is defined by its probability of occurrence. It represents a flood that has a particular probability of occurring in any one year. For example, the 1% Annual Exceedence Probability (AEP) or 1 in 100 Average Recurrence Interval (ARI) flood is a best estimate of a flood which has 1 chance in 100 of occurring in any one year (Earth Science, 2005).

Vulnerability

The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. Positive factors, which increase the ability of people to cope with hazards, is defined as capacity (UNISDR, 2004).

Watershed

The land area that drains water to a particular stream, river, or lake. It is a land feature that is defined by the topography of the area and can be identified as elevated land between two areas on a map, often a ridge. Large watersheds can contain many smaller watersheds (USGS Glossary, 2004).

Weather

The daily manifestation of atmospheric conditions which is the subject of meteorological forecasting and the cumulative conditions that define the climate of a region.

Overview

A risk assessment forms the basis for risk management programmes and activities, which should be planned according to the results of the assessment. It defines the nature of the problem in terms of the flood hazard and existing conditions that exacerbate its impact. A flood risk assessment considers the flood hazard as well as secondary hazards such as landslides and erosion, and the exposure and vulnerability of people and infrastructure to flooding and the existing capacity of flood risk management institutions and communities to deal with the flood problem. Flood risk assessments can be carried out at any level - national, regional and community - and through participation of stakeholders in the process; they provide an excellent starting point for encouraging risk awareness in a particular area.

Flood hazards tend to be specific in occurrence both temporally and spatially. They can occur due to intense or prolonged rainfall, tidal changes, a sudden release of water from storage reservoirs or breach of embankments, dams and other flood protection structures. There are a number of factors that contribute to the risk of flooding and determine the level of damage it causes. The aim of this chapter is to describe in brief how flood risk information is derived through the following methods:

- **Hazard Assessment** - Determines the nature of flooding based on meteorological and hydrological parameters and river basin conditions. The information can be used to determine relationships between meteorological and hydrological parameters and create flood models. Studies also outline the frequency and general magnitude of floods.

- **Vulnerability and Capacities Assessment (VCA)** - Highlights the people and infrastructure most vulnerable to flooding and the potential damages that may be incurred.

- **Damage Assessment** - Assessment and analysis of potential total loss due to flooding.

Hazard and vulnerability information can be used to analyse risk and produce risk maps and matrices, which define the areas, people and infrastructure most at risk from flooding. This information is then used to steer the flood risk reduction programme.

Information derived in a risk assessment is extremely useful for risk reduction programme planning and serves as valuable reference for evaluating the impact of any risk reduction intervention. National governments, local governments, NGOs, the community itself can use the information to plan programmes, reduce vulnerability and implement development initiatives. It is therefore beneficial to disseminate the information to the mentioned parties and even more useful to plan an integrated programme from the information. It cannot be stressed enough that sustainable development is obsolete without risk reduction.

The whole flood mitigation strategy must be based on risk assessment. Every activity for risk reduction including disaster preparedness and also those that address vulnerability must take into consideration the information derived. Risk assessments should be updated and carried out after changes in the human, physical, political and economic environment that either transforms the flood hazard or people's exposure and vulnerability to it.

Risk should be prioritised and addressed. It may not be possible to improve risk levels, until those institutions and individuals in charge agree upon accepted levels of risk and those that must be prioritised. Action can include:
- Ignoring the risk
- Eliminating the risk
- Reducing the risk
- Transferring the risk

Risk treatment methods are explained in Chapters 5, 6 and 7.

see Chapters 5, 6 & 7

The past decade has brought considerable advances in understanding of the link between physical attributes of flood hazards with the socio-economic conditions that create vulnerability. A wide variety of risk and vulnerability assessment methodologies are available to help decision-makers identify and analyse patterns of risk. Assessment activities often focus on the vulnerability of specific "elements at risk", which should include indirect and intangible impacts as well as direct impacts of flood risk.

Concepts of Assessing Flood Risk

How Flood Risk is Created

From a purely ecological perspective, floods are considered to be a phenomenon associated with an *unusually high stage or flow of water over land or coastal area.* However, from the disaster risk management point of view, *floods are those that exceed the capacity of the main conveyance of the river channel*, resulting in loss of life or injury, property damage, social and economic disruption or environmental degradation (WMO, 1999).

The risk posed by these 'damaging' floods can be described as a function of the frequency and magnitude of flooding (nature of the hazard) and severity of its impact (based on existing vulnerability). Risk assessments should take into account the changing nature of the physical and natural environment, whereby the risk landscape is altered. Risk assessments can be carried out at any level, community to national.

Flood risk is defined as a function of three inter-related elements:

- Flood hazard.
- Vulnerability and capacity of communities living within the impact area.
- Level of exposure of various elements located within the area.

Because of the dynamism of the natural environment, development of built-up areas and expansion of human settlements, the risks faced by people are constantly changing. A risk assessment is necessary to identify how these changes affect exposure to the hazard and forms the basis for any risk reduction programme.

A flood risk assessment is made up of three component parts:

- **Hazard Assessment:** To analyse the nature and mechanisms of flooding including frequency, velocity and magnitude.
- **Vulnerability and Capacities Assessment (VCA):** This highlights the factors or constraints of an economic, social, physical or geographic nature, that reduce the ability to prepare for and cope with the impact of flood hazard and peoples' skills and abilities to make them resilient, resulting in an understanding of the likely impact of flooding in human terms. This includes identifying the exposure of people and infrastructure to potential flooding.

Data for Flood Risk Assessment

- Meteorological data
- Hydrological data
- Topographic data
- Demographic data
- Income profile
- Building typology data
- Property and land-use data
- Infrastructure and lifeline facilities
- Cultural and historical sites
- Soil and geology of the area
- Historical flood data

Sources of water

Riverine floods can be caused by natural and/or human activities, such as:

- Heavy rainfall (precipitation)
- Rapid snowmelt
- Erosion and landslides
- Deforestation
- Structural failure (eg. dams, embankments)
- Excessive water releases or breach of water retention structures in upper catchment areas

Rainfall and snowmelt quantification is important for analysis of flood hazard and obtained through meteorological measurements (rainfall and snow). It is the function of national meteorological agencies and they obtain such measurements as point measurements. Interpolation between isolated point measurements determines the spatial patterns. However, a range of new techniques based on radar and satellite measurements are also available for aerial measurements. The advantages and disadvantages are presented in Box 4.3.

see Box 4.3

Measuring and forecasting spatial and temporal variation of precipitation are fundamental elements of river and floodplain flood analysis and forecasting. The World Meteorological Organisation (WMO) provides a summary on state-of-the-art techniques in precipitation estimation and forecasting (WMO, 2000).

Those carrying out studies should bear in mind that the biggest flood is always yet to come. Historical information is needed to select the design flood on which the mitigation strategy will be based. The floodplain and at risk area for this design flood should be delineated. Rainfall events can be caused by seasonal climates, monsoons, cyclones and storms, and unique and freak weather systems. As precipitation is the main cause of flooding, it is the basis of flood forecasting and preparedness.

see Chapter 8

Flood occurrence is based on the combination of precipitation events and hydrological processes as shown in Box 4.1.

Physical characteristics

The following describes characteristics of floods (WMO, 1999):

- The depth of water and its spatial variability.
- The spatial extent of inundation, and in particular of the area that is not normally covered with water.
- The water velocity and its spatial variability.
- Duration of flooding.
- Suddenness of onset of flooding.
- Capacity for erosion and sedimentation.

Several hydrological processes can contribute to creating more favorable environment for flooding and several factors can affect the flood potential of a flood-prone area (WMO, 1999). There are also meteorological and human factors contributing to flooding as illustrated in Box 4.1.

see Box 4.1

It is necessary to determine the **design flood** (target flood) and discharge (or target flow) that will be used for floodplain delineation and engineering purposes. For example, flood control structures, dams and other hydraulic structures must be built to withstand a particular magnitude of flooding normally described in terms of its return interval (WMO, 1999). It should be remembered that the biggest flood is always yet to come, therefore the selection of the design flood should not be based solely on past flood events.

The **Probable Maximum Flood** is the largest flood that could occur in the area. It is based on the probable maximum precipitation and derived from an assessment carried out using a flood model. Precipitation records over a time can be used to determine normal and average daily precipitation for that location during particular times of the year. A normal rainfall pattern can be assigned to it and all rainfall can be classified as being greater or less than the average rainfall.

Box 4.1
Factors contributing to flooding

Meteorological Factors	Hydrological Factors	Human Factors
• Rainfall • Small-scale storms • Snowfall and snowmelt • Cyclones	• Soil moisture level. • Level of ground water prior to the storm. • Surface infiltration rate affected by vegetation, soil texture, density, structure, soil moisture, etc. • Presence of impervious cover. • Hydraulics of overland sub-surface and open channel flow. • Channel cross-sectional shape and roughness. • Presence or absence of over bank flow. • Channel network. • Duration of run-off production relative to run-off travel time.	• Land-use activities (deforestation, urbanisation) increase the volume and rate of run-off. • Occupation of the flood plain. • Structural flood control measures. • Greenhouse gas emissions which may cause long-term climate change affecting the frequency and magnitude of precipitation events.

(Source: WMO, 1999)

Flood Hazard Assessment

Flood practitioners need to analyse floods qualitatively and quantitatively with the aim of gaining an understanding of the nature of flooding to:

- Identify the probability of a flood occurring.
- Identify the specific future time period.
- Identify the area and intensity of impact.

(UNISDR, 2004)

see Box 4.2

Flood hazard assessment can be conducted in various ways depending on the data availability (as described in Box 4.2). Assessment is based on the '*detailed observation of natural systems*' (WMO, 1999) and considers the impact of the hazard on the physical environment. A flood hazard assessment derives a number of aspects relating to flooding that pose a threat to people and property. The method of carrying out the assessment depends on the information, technology and resources available.

- Identifying the probability of flood occurrence

  The return interval, or return period, places magnitude of floods in terms of their expected frequency giving a probability of a particular flood occurring. There are a vast number of methods that can be used to calculate or determine return intervals based on the data or lack of data available. Box 4.2 presents one method.

  It is necessary to determine the return period for classification and also to determine the design flood and discharge that will be used for engineering purposes. For example mitigation structures, dams and other hydraulic structures must be built to withstand a particular magnitude of flooding normally described in terms of its return interval. The 100-year flood is a common design flood use delineate floodplains and design structures. Often there are not enough records to determine the magnitude of the 100-year flood; this must then be done by empirical extrapolation using frequency distributions (WMO 1999).

Box 4.2

Flood frequency calculations based on the annual maximum flood series

This method is widely used for determining the probability and return period for floods. Ideally there should be records for more than 20 years for it to be more representative.

Data Required:
Peak Flood discharge (Q) every year for a particular gauging station
Date and time peak discharge occurred

Rank the Data set with the largest discharge (Q) volume ranked as 1, second largest as 2, etc.

Q	M (rank)
21	1
19	2
14	3
14	4
13	5
9	6
9	7
8	8

Compute the recurrence interval (or return period) of each flood using the formula:

$$T_r = (N+1) / M$$

M = rank; N = total number of floods; The units of T_r are years.
When Q = $19 m^3/sec$
9 / 2 = **4.5 years**

To determine the probability use the formula: P = $1/ T_r$
1/4.5 = **0.22 probability (22%)** for any year that a flood of that size will be equalled or exceeded.

The probability information (0.22 or 22%) is most useful as it easier for the public to understand. Using the recurrence interval (4.5 years) may confuse people and lead them to believe that the flood will only happen at the given intervals.

Floods are a recurrent event, but magnitude and characteristics of each flood changes to a greater degree. However, depending on the magnitude and characteristics, floods can be explained depending on their frequency and probability of a particular flood occurring, called the return period.

- Identify the specific future time period

  Part of the flood hazard assessment is to identify the specific time period for flood occurrence. It means making the connection between rainfall, run-off and streamflow. Measuring rainfall and river discharge will allow a correlation to be made and models to be adopted. Rainfall and snowmelt quantification can be obtained through measurements. Methods of measurements can range from simple rain-gauges throughout the watershed to radar and satellite systems.

  Radars and satellites can also be used for aerial measurements. However, they have their limitations in accuracy and are more suitable for large areas. Most radar and satellite systems need calibration with ground rain-gauge networks.

Box 4.3
Comparison between radar and satellite systems

Satellite		Radar	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
a. Relatively inexpensive when compared with weather radar. b. Easy to operate & maintain c. Tried & proven - but mainly in tropical zones. d. In convective rainfall, accurate monthly totals can be obtained, daily totals less so and sub-daily totals much less accurat.	a. At night estimation is based on infrared and microwave data which are less accurate. b. Sub-daily totals are very inaccurate, particularly in areas with predominant frontal systems. c. Estimates of snow cover are only possible in cloud free periods. d. Multi-layered cloud decks prevent the reliable monitoring of orographic rainfall enhancemen. e. If satellite sensors fail, they cannot be repaired until another satellite is launched.	a. Temporal resolution very high; updates as frequently as desired at no extra costs. b. Spatial resolution very high. c. High accuracy of sub-catchment rainfall totals. d. Snowfall can be measured in near-real time in all cloud situation. e. Very short-term forecasts can be made. f. Orographic rainfall enhancement can be monitored. g. Equipment faults can be rectified quickly. h. Provides real time data for operational management, e.g., flood forecasting and warning.	a. Total system is expensive. b. Requires maintenance and electronic calibration on a monthly basis. c. Requires a higher level of operator knowledge than the satellite technique. d. Technical training is required.

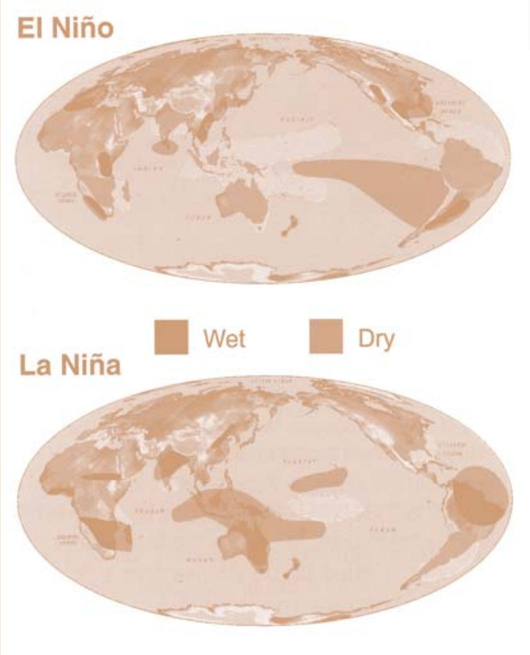
Abnormal atmospheric conditions can affect the intensity of rainfall events. These abnormalities should be considered in the hazard assessment to account for changes in flood occurrence.

Events such as the El Niño Southern Oscillation (ENSO) can cause massive floods, for example in Vietnam in November, 2000, the central provinces received the equivalent of 2 years of rain in just six days (IFRC, 2001).

Box 4.4

El Niño Southern Oscillation (ENSO)

El Niño Southern Oscillation refers to changes in Pacific Ocean temperatures due to abnormal trade winds. Air pressure and trade winds affect the distribution of warm ocean water across the Pacific, and it is the ocean temperatures that greatly determine the climate and weather systems in Asia Pacific and the west coast of the Americas. El Niño can be described as the warm phase of ENSO and La Niña is the cold phase. They have many weather implications for different areas, but there is a tendency for increased wet weather in Asia during a La Niña event as conditions in the Eastern Pacific are cooler than normal and extend further west bringing wet weather to the Asian region.



(Source: Will It Rain? The Effect of the Southern Oscillation and El Niño in Indonesia)

ENSO events follow a distinct pattern and can therefore be forecasted and the impacts known in advance. It should be monitored and its impact considered in rainfall and flood forecasting.

see Chapter 12

Issues such as El Niño and climate change are further discussed in Chapter 12.

- Identify the area and intensity of impact
  The area of impact can be determined based on hydraulic analysis techniques (that models the relationship between discharge, velocity and stage) to determine the water surface elevation from the peak discharge. The water surface elevation will determine the spread of the floodwaters based on the topography of the area. It is important to remember the transboundary nature of flooding and the need to involve countries sharing the watershed in this aspect of risk assessment.

The area of impact can also be roughly defined based on the impact of past floods. Obviously, this can only be done if the historic information is available. Information regarding the extent and intensity of the impact can come from a number of sources and data types as described in Box 4.5 and 4.6.

Box 4.5

Information and data collection and analysis

Data can be quantitative (numeric in nature) or qualitative (cannot be described numerically). The information gained for the hazard assessment will be both qualitative and quantitative, but the qualitative information may have to be arranged and assigned a value in order to apply it, depending on the chosen techniques for displaying and using the information eg, modelling or analysis.

Examples of Data

Quantitative	*Qualitative*
Number of people affected	Types of areas
Hydrological and meteorological data	Damage caused
Economic losses	Severity of flood

- Records from municipality, water authority, environment agency / ministry.
- Media reports.
- Existing documentation for construction and other projects.
- Information or assessment data obtained through PRA techniques.
- Hydrological information from monitoring stations, stream flow and rainfall maps.
- Interviewing the public and experts.
- Site investigations, geophysical tests, vegetation.
- Photos and satellite images of post-flood impact.

Considerations

The conditions under which the data in a series is gathered, for example, if part of the data collected is after the construction of flood structures, it will affect the data. Therefore, data must be analysed to determine its credibility and usefulness for particular studies.

Basic Principles in Flood Hazard Assessment

In most cases assessments are done for determining the design flood level, which gives a fixed probability of occurrence. Several techniques and methods as well as combinations can be used. However, determination of most suitable method will depend on:

- The nature of flood hazard.
- The availability of data, particularly stream flow measurements and topographic data.
- Feasibility of collecting additional data.
- Resources available for analysis.

(WMO, 1999)

Data

Obtaining accurate, consistent and continuous data for a long time period is difficult. Due to the lack of commitment in the region, particularly from governments, to establish databases and inventories, data is not always available. This section presents some scenarios and how best to deal with them. (adapted from WMO, 1999).

Box 4.6

Hazard assessments and data availability

1. Thorough analysis of the quality and consistency of available data.
2. Determine the peak discharge of the design flood (eg. 20-year, 50-year, 100-year, etc.).
3. Use hydraulic analysis techniques (that concern the relationship between discharge, velocity and stage) to determine the water surface elevation from the peak discharge.
4. Plot inundation areas associated with stage of the design flood on a topographic map to see spatial distribution.

There are limitations and difficulties when estimation of infrequent floods has to done using the data obtained through short observation periods. For example it is difficult to gain knowledge on the 100-year flood, as there will be little data because of its rare occurrence. In this case, supplementary information from the following two methods can be useful:

1. **Regionalisation.** This approach is based on the assumption that within a homogenous region flood frequency curves at various sites are similar to hydrological and meteorological characteristics of individual sites. In essence, data from several sites are pooled together to produce a larger sample than is available at single site. Although the advantage may be offset by correlation between sites, however, this is a more robust study than using flood frequency analysis at a single site.

2. **Paleo-flood and historical data.** Paleo-flood data is derived from the geological / geomorphologic and botanical evidence of past floods. Historical data refers to information on floods that occurred before the existence of systematic stream-gauging measurements. It may be in the form of a specific stage, date of occurrence or knowledge that the flood has exceeded a certain level during a certain time.

Alternative data sources and methods

Assessment based on observations of extent of past flooding.
Ground observations, aerial photographs or satellite imagery, as well as geomorphologic or soil studies, all carried out after flooding, can be used to determine the area flooded and delineate the floodplain.

Rainfall run-off models use mathematics to predict the discharge of the river as a function of the rainfall. They tend to be used for return intervals greater than 100 years or for sites where there are less than 25 years of streamflow records. Hypothetical storms can be used to model the run-off. One of these storms could be the **PMP**, the largest amount of rainfall that could occur in the given watershed. The PMP is used to model the **PMF**. Precipitation records over time can be used to determine normal and average daily precipitation for that location during particular times of the year. A normal rainfall pattern can be assigned to it and all rainfall can be classified as being greater or less than the average rainfall.

Watershed with limited topography data
It is difficult to do any hazard assessment in areas without topographic data. It might be possible to carry out community-based flood and risk assessments, but they are only suitable for small areas. These small area maps can be integrated to prepare a bigger area map. It can be made more accurate with the support of GPS measurements. It can also be augmented with spot heights through ground measurements to define topography. At present, there are many remote sensing (RS) and GIS methods available for developing digital elevation models and with adequate resources this problem can be overcome easily. Otherwise simple inundation maps can be prepared using assessments based on observations of extent of past flooding as explained above.

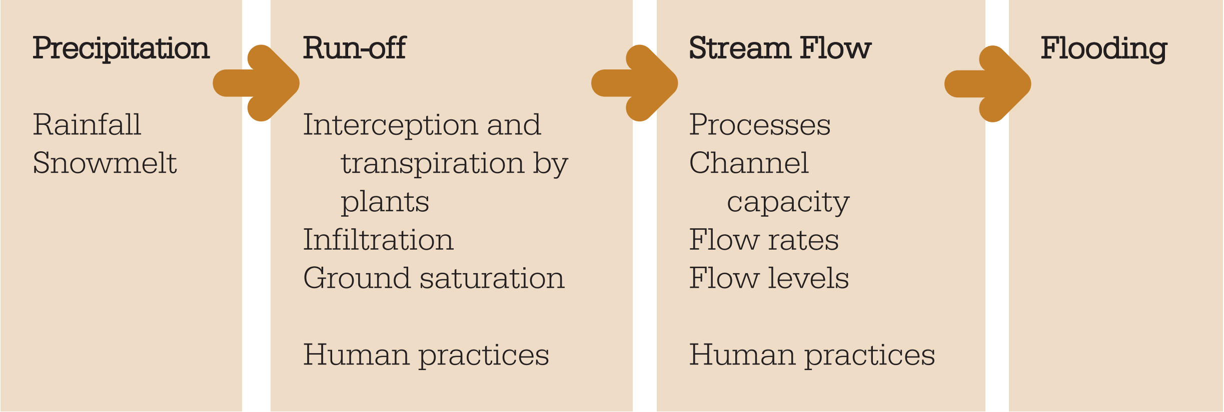
Watersheds with no data
If sufficient regional discharge data is available regional flood frequency curves or regional regression equations can be used for un-gauged watersheds. Regional regression equations relate to peak flow at a specific return period to physiographic characteristics such as area extent, slope, altitude, etc.

(Adapted from WMO, 1999)

Flood modelling and simulation

Models can be used to determine the occurrence of floods based on actual or hypothetical rainfall events. Both meteorological and hydrological data and information is required as shown in Figure 4.1.

Figure 4.1
Flood modelling inputs



Flood models

Lumped models treat the watershed as a single unit for inputting data and calculating run-off. The calculations are statistically based and relate to the underlying hydrological processes as a spatially averaged process. Models based on scaling unit hydrographs would fall into this category.

Semi-distributed models are lumped models in which the watershed is subdivided for some parameters to be physically estimated and modelled.

Distributed models simulate the key hydrological processes that occur in a watershed using distributed data inputs and processes. For forecasting purposes these commonly include precipitation, interception, infiltration, interflow and base flow. Overland flow and channel routing may be incorporated into the model or calculated in a hydraulic model. Distributed models require much more data and knowledge of watershed processes than lumped models. When the model is first established, precipitation and land cover characteristics may be the only distributed features.

Hydraulic models used in channel routing calculate the travel time of the flood wave and its attenuation. These models use the standard equations of unsteady, non-uniform flow with various simplifications depending on the channel characteristics, available data and accuracy requirements. Storage-flow relations are often incorporated into hydrological models. One-dimensional unsteady flow hydraulic models can be used to route flows through multiple channels or in situations where overland flow is a serious concern.

Probabilistic forecasts are typically derived using hydrological process models wherein statistical distributions are used to describe the uncertainty of input data and basin conditions such as precipitation data, soil moisture and snow pack conditions. A large number of model projections are produced that can be statistically analysed to allow for a better understanding of the uncertainty of the forecasted future water conditions. This approach is rapidly gaining popularity, as it provides the decision-maker with the probability of an extreme event to occur, not just that it might occur

Run-off routing approaches: Produces a complete flood hydrograph based on dividing the basin into sub-areas that have different rainfall excess characteristics and routing the run-off from each sub area through downstream sub-areas to the basin outlet. The major advantage is the possibility of modelling changes to the basin surface or channel conditions, such as land-use changes or the construction of a reservoir. This allows for such changes to be analysed in the flood hydrographs. It also allows for the spatial distribution of rainfall, which is important for prediction of floods and for design on large basins.

see Case Study 4.1

A unit **hydrograph** is based on a given unit (depth) of run-off occurring over a given watershed (area) during a given data time interval.

Data Presentation

Maps are the standard format of presenting flood data and disseminating information in an easy to understand format. Areas subjected to flooding can be represented on a topographic base map by shading or colouring areas subjected to inundation of various magnitudes of flood. Different types of maps are mentioned below:

- **Flood inundation maps** show the variation in flood depth over the floodplain. They provide a clear and concise picture of the depth and the extent of inundation.
- **Flood duration maps** are similar to inundation maps, but they also take into account the duration of the flooding. They are useful particularly for the evaluation of potential flood damages including agricultural (crop) damages.
- **Flood comparison maps** show the difference between two flood maps. There are two types of comparison maps illustrating:
  a. Impact of an intervention
  b. Change in flooding over time

Based on an Extreme Value Analysis of the simulation results, flood risk maps showing for example 10, 100, 500 year flood and “Probable Maximum Flood” can also be generated.

Case Study 4.1

Simulating Scenario Floods for Hazard Assessment on the Lower Bicol Floodplain, the Philippines

Floods are the most serious and frequent natural hazard in the lower Bicol river floodplain and cause substantial suffering, loss of life and economic damage, especially for the city of Naga. The Bicol floodplain is located on the island Luzon of the Philippines. Simulating flood events that may occur in this region using a computer model can contribute to minimising the loss of life and damages to property and it is essential for supporting flood risk management.

This research applies a **1D2D flood propagation model** in the Lower Bicol Floodplain to simulate flood events for return period of 2, 5, 10, 25 and 50 years. This 1D2D flood model, SOBEK, requires three input parameters: a Digital Elevation Model (DEM), surface roughness coefficients of the floodplain and input hydrological data. The DEM was generated from interpolation of spot heights and contour lines obtained from different sources and scales. The hydrological data consisted of discharge and water level hydrographs for the return periods of 5, 10, and 25 years. Values for return period of 2 and 50 years are derived from statistical interpolation and extrapolation of the available data.

The modelling resulted in spatial distribution of flood extent, water depths, velocity, and time of flooding. The model results showed an increase in the inundation extent of about 50 % from flood with a return period of 2 years to the largest flood with a return period of 50 years. Positive correlation between the inundation depth, flow velocity and the probability of flood events was found, where the higher the return period, the higher the depth of inundation and the flow velocities. The results of the model were compared with the 2003 results of a study by Nippon Koei for the Bicol River Basin and Watershed Management Programme. For water level calibration, scatter plots of the model results and the reference model showed good agreement with 0.98 correlation coefficient for return period of 5 and 25 years and 0.99 for return period of 10 years. Indicator maps produced from modelling were further processed to create flood hazard maps.

Understanding that the level of flood hazard cannot be measured by a single parameter, this research proposed hazard maps based on single and multiple categorisations. It was found that different parameters, either single or multiple, created different flood hazard maps that are suitable for multiple users with different information requirements.

(Source: Usamah and Alkema, undated)

see Box 4.6

Flood Referencing

Flood referencing is an activity that can be carried out at the community level to forecast flooding by community members. Trained people can predict the flooding in comparison with a flood water level marker (or level gauge) placed in the community watch point based on the information received from a flood forecasting centre. The prior assessments should provide the information required by the community for prediction of flood impacts for which the community can take actions depending on their own predictions. This sort of flood referencing system at community level can be developed as a part of the regional flood forecasting system.

Flood referencing in Cambodia and Hat Yai, Thailand

The success of the activity will depend on people's ability and initiative to record the water levels at a permanent water level marker and relaying the information back to a central body for verification at regular intervals. Information needed to develop a new flood referencing system includes water levels and details of past flood events. At present this is being piloted by MRC in communities on the Mekong Tributaries to record water levels at particular locations and they are referenced to the main Mekong channel levels. When it becomes fully operational, it would be possible to use the whole network to predict flood levels 5 days in advance (MRC, 2003).

Secondary and Complex Hazards

Where flooding occurs, there may be occurrence of other hazards. These may include secondary hazards, which are triggered by the primary hazard (flooding). Landslides, riverbank erosion, building collapse, transport accidents, leak of toxic substances, epidemiological concerns and the failure of flood control structures are all associated with floods. The risk assessment should analyse the likelihood of these secondary hazards occurring and the threat they pose to the community.

Landslides and mudslides may occur where the foot of slopes are eroded by floodwaters in combination with rainfall overloading the top weight causing slope failure (refer to Box 4.7).

Box 4.7

Factors affecting landslide occurrence

- Topography - slopes and hilly areas.
- Characteristics of soil type (parameters such as cohesion, consolidation, etc).
- Soil strength.
- Saturation.
- Vegetative cover.
- Loading on soil (buildings, roads, additional water from rainfall).
- Sub-surface formations (geology, fracture density, etc).

Hazard assessments may also identify that an area may be affected by complex hazards, which is the occurrence of more than one hazard at a given time. For example, flooding at the same time as a tropical cyclone will have implications for risk reduction methods, such as types of hazard-proof housing, preparedness and response efforts. It is important that a hazard assessment identifies the nature and potential of ALL hazards in the given area.

Vulnerability and Capacities Assessment

Vulnerability, as defined by (Blakie et al, 1994) is the capacity of a person or group to anticipate, cope with, resist and recover from the impact of a natural hazard. Vulnerability can be attributed to a number of different factors such as demographic, economic, social and political as well as geographical. Similar to risk, it is dynamic and changing constantly with the human and natural environment. It must be noted that not all groups in a flood area are necessarily disaster victims (Blaikie et al, 1994).

$$\text{Vulnerability} = \frac{\text{Exposure x Sensitivity}}{\text{Capacity and Resilience}}$$

Exposure

Exposure is a component of risk, which refers to the susceptibility of people and infrastructure to flooding in terms of their location and physical defenses. The elements at risk are those that are within the boundaries or on the fringe of the delineated floodplain. This means that they will be affected by the design flood. Poor people are often more exposed to flood risks, as they tend to occupy the marginal lands on the floodplain. They often live on the riverbanks and even in the river channel, in shelters that hardly provides any protection against floodwaters.

Sources of information for exposure inventory

- Site investigations
- Maps
- Photos
- Census data
- Demographic data
- Administration boundaries
- Land-use data
- Soil and geology data
- Property valuation data
- Digital data

Infrastructure such as roads, electricity poles and drainage systems are also often exposed to flooding due to their locations and inadequate protection and maintenance, so they are either destroyed or become non-functional during and after a flood event.

An inventory should be prepared to identify all the infrastructure and lifeline buildings such as hospitals and administration buildings as well as particular communities within the flood-prone area. Generally, hazard maps should be overlaid with maps that show all elements exposed to the risks posed by various magnitudes of floods. If demographic data and valuation data are available then the exposure elements can be given a quantitative cost figure and be used in assessing potential damages and losses. Structures should be assessed for their structural integrity and resistance to the impact of the floods. They should be treated as appropriately determined in the flood risk management strategy.

Vulnerability

A variety of factors contribute towards vulnerability, often in combination. Vulnerability can also change over time - it can increase or decrease according to the position of the community or individual due to the effects of the various causal factors, which may also change over time. Vulnerability is not homogenous within any given area: it varies according to income, exposure, level of preparedness, etc.

Below are some factors that cause vulnerability to flooding:
- Unplanned expansion with poor drainage and sanitation.
- Development of squatter communities on marginal land such as on embankments, river banks and within river channels.
- Poor housing.
- Poverty.
- Inadequate flood defences and preparedness.
- Lack of awareness about the flood hazard.
- Lack of early warning systems.

In many Asian countries it is the urban centres that have been prioritised and protected by flood protection structures. However, by aiming to protect cities, floodwaters can be diverted elsewhere, often inundating rural areas.

Methods of undertaking a VCA depend on:

- Urban / rural area
- Size of the population
- Resources (human and financial)
- Technology (eg. telephone interviews)
- Time
- Information required (eg. perception of risk or census information)

A vulnerability and capacity assessment (VCA) allows the most vulnerable people to be identified and assisted. Identifying the people who are most in need of help allows for the targeting and prioritisation of resources.

A VCA strives to find out who is vulnerable, why they are vulnerable, what are the major factors that trigger their suffering and what their potential capacities are to decide how to help them. Assessing capacities helps choose the right strategy to reduce the risk (IFRC, 1993).

Vulnerabilities and capacities can be analysed according to a number of criteria described in Box 4.8. However, there are many more different indicators of vulnerability and resilience, which may only be evident in particular situations.

see Box 4.8

Identifying strengths and resilience

Vulnerability of communities can be reduced through increasing the **resilience** or **capacity to cope** in the event of flooding. Determining people's ability to withstand disaster can be done using the sustainable livelihoods approach as described in IFRC (2004). It identifies that people have a range of assets referred to as 'capitals' that form insulative layers to protect against disasters. These are:
- Natural capital: land, rivers, vegetation and any natural resources.

see Chapter 11

- Financial capital: savings, income, credit, pension.
- Human capital: knowledge, skills, health, physical ability.
- Social capital: networks, relationships, trust, mutual exchange.
- Physical capital: Infrastructure, shelter, tools, water and sanitation, transport.

(IFRC, 2004)

All of these capitals offer a complex buffer against the impacts of a disaster. Those without such capitals are more vulnerable to flooding disasters.

see Chapter 10

The VCA must also look beyond the flood event to the aftermath. In the case of river flooding, most people tend to die or become ill in the aftermath, often due to spread of contagious water-borne diseases. It should consider people's abilities

Box 4.8
VCA framework

	Vulnerabilities	Capacities
Physical / Material	• Proximity and exposure to flooding - living on a floodplain, poor housing. • Poverty - few options, no financial savings, few assets. • Resources - limited technology, skills or employment.	• Money, assets, land, jobs Savings • Insurance. • Good health • Protected location • Skills and expertise
Social / Organisational	• Marginalisation - people excluded due to politics, religion, ethnicity or social customs and norms. • Organisation - limited community or legal structures. • Discrimination - lack of support, reduced access to resources and services.	• Community support, leadership, institutions. • Political structures, adequate management. • Community cohesiveness.
Motivational / Attitudinal	• Perception of risk - deny the threat, unaware of the threat, misconception of the threat and benefits of living or working in the floodplain. • Attitude - no confidence in their abilities, view themselves as dependent. • Power - no influence in the community.	• People with confidence, with dignity and independence are better able to cope with crisis. • Ability to influence their environment. • Hold a strong belief system and consequently support structure. • Aware of how disasters affect them.

(Adapted from IRFC, 1993 and Anderson and Woodrow, 1998)

to recover from floods. Below is a list of essential information to include in the vulnerability assessment to determine the impact of past flooding events. Understanding the impacts of past events will be useful in identifying vulnerable groups and the specific vulnerability context.

- Mortality and morbidity rates
- Damage caused by floods
- Areas worst affected
- Severity of past floods
- Impact of flood on socio-economic status
- Impact of flood on food security and health

Assessment of Potential Losses and Damage

The most basic risk assessment should include an assessment of the potential damage to infrastructure and the built environment shown in Box 4.9. The analysis evaluates the potential costs of flooding (often based on replacement costs). Normally the analysis is carried out for various magnitudes of floods and an elevation-damage curve is developed.

see Case Study 4.2

Box 4.9
Potential damages

Typical data sets required for assessment	Structures
Location	Buildings
Structural properties	Roads
Financial values	Bridges
Nature of damage	Critical infrastructure, utilities
Magnitude of flood	Flood control structures

Estimating potential loss allows for the prioritisation of expenditure for mitigating the risk. Losses can be tangible (measurable in monetary terms) or intangible (not measurable in monetary terms). Therefore, risk has to be presented as a loss parameter so that decision-makers will be able to understand the implications. For example, a government building and a community house can be located in high-risk zone, but loss parameter will be different.

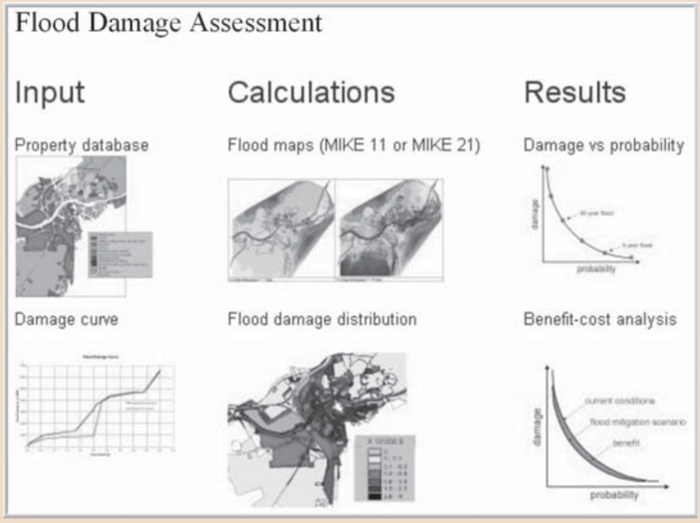
Loss estimation can be considered as a form of risk assessment, whereby potential risks is calculated in terms of measurable losses such as:

- Monetary loss due to physical destruction
- Casualties
- Percent loss of function
- Environmental losses

In Asia vast populations are located in rural areas where agricultural economies are predominant and data on physical structures is generally unavailable. Some assessments quantify lost agricultural production and livestock loss as a means of estimating rural damages. Farm location, type of crop and planting cycles are common data sets.

Case Study 4.2

Model-based Damage Assessment



The following steps are followed in computing flood damage based on modelling technology in GIS.

Inputs: The main input is the property database of the floodplain or area for which damage assessment will be carried out. The property database, includes land type, crop coverage at a given time, infrastructure, eg. roads, buildings, railways, water and sanitation facilities, etc. A damage curve is then prepared for each type of property. For example, damage due to floods depends on the depth and duration of flood affecting the particular property. Such damage curves are prepared by a variety of experts and compiled from past experience and prevailing costs.

Calculations: Two steps are involved in the calculation:

a. Determining the extent, depth and duration of flooding in the particular area. This can be done by using hydraulic models such as MIKE11 or MIKE21 (DHI, 2004). The models can generate the flood characteristics (extent, depth and duration) for different probabilities.
b. Superimposing the flood characteristic onto the property database to generate a flood damage distribution database.

Results: Using the flood damage database obtained in the calculation step, a probability vs. damage curve is obtained for the whole area. Similar exercises are carried out for different scenarios of flood mitigation measures. The difference between the two curves (damage due to current situation - damage with flood mitigation) gives the benefit of a particular flood mitigation scenario. Further analysis of the benefits (reduced damage) in comparison with the cost of flood mitigation can be done. For a given flood mitigation scenario cost is calculated for a flood of given probability, thus generating a probability vs. cost curve. The two curves can then be used for cost benefit analysis.

(Source: DHI, 2004)

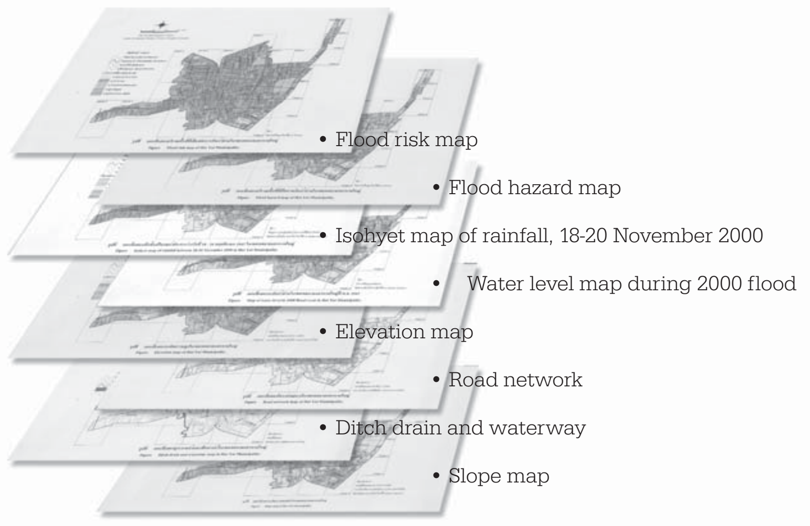
Types of flood losses to estimate can be summarised as:

- Residential losses *(buildings, personal possessions, furniture, food stocks, etc.).*
- Commercial losses *(shops, banks, markets, hotels, food and market products*).
- Industrial losses *(equipment, raw material, stored products, etc.)*
- Utilities *(electricity, gas, water, telephone, irrigation facilities, farm roads, etc.).*
- Transport *(road surface, railway, harbours, airports, bridges, railway stations, vehicles and equipments, etc.).*
- Public losses *(losses to national and provincial local government bodies).*

Determine Risk

The hazard, exposure and VCA information presented can be put together to determine flood risk. This information can be presented in the form of maps showing the areas prone to inundation from a particular flood event and the location of the most vulnerable elements to obtain risk information.

Municipality of Hat Yai, Thailand



(Source: Prince of Songkla University)

Risk can be given a quantitative figure in order to make ranking possible. A risk matrix can convert qualitative information into quantitative data. Risk analysis can be done per community or location with a risk level assigned depending on exposure, vulnerability and potential damage. This is demonstrated in Box 4.10.

Box 4.10
Risk analysis

Exposure, vulnerability level and capacity can be defined in a scale:
1 = low to 5 = high

Community	Exposure to hazard*	Vulnerability of population	Capacities	Total Risk Score (Exposure x Vulnerability)/ capacity
X	2	4	4	2
Y	5	4	3	6.66
Z	5	2	1	10

From this assessment we can see that although communities Y and Z are highly exposed to flooding, community Z is at greater risk. Multipliers can be assigned to the categories to place more value on them. Exposure to floods or zones of exposure can be a significant indicator of risk, and therefore can be given a multiplier of 2 so it has greater weighting in determining total risk*. Risk scores can be assigned colour codes and mapped.

Community-based Risk Assessment

A community-based risk assessment is a simple method used to assess risk for assessing risk to design community-level flood risk management plans. It has a lower level of accuracy because the information collected is subjective and tends to be more qualitative. For example, community members may not remember events accurately, especially those that have happened a long time ago.


Community-based disaster risk mapping

see Chapter 12

Participation is the key to conducting a successful community-based risk assessment. The opinions, knowledge and experience of the community can be tapped into by ensuring that a process for active participation is established.

Box 4.11
Conceptual framework of community participation

(Source: ADPC, 2003)

The community must be part of the risk identification, prioritisation, plan formulation, implementation, monitoring and evaluation (ADPC, 2004) (refer to Box 4.11). They must be involved in all aspects of the risk management process, beginning with assessment.

see Box 4.11

Community-based risk assessments can be carried out using Participatory Rural Appraisal (PRA) tools. These tools can be used to gather the information needed for the risk assessment of the respective community. The benefits of a community risk assessment is that all the community members can participate, they can identify the flood hazard they face and gain understanding of it and it gives them information to enable them to participate in decision-making. Risk mapping can be a community project that encourages participation and awareness. It is an exercise that not only produces a risk map that is understood by the participants, but it also informs them of potential hazards, vulnerability of risk elements and potential exposure.

Box 4.12

Community-based risk assessment

How communities can participate in risk mapping

The method for producing a flood risk map depends on the community and nature of flooding. The community itself should decide how to organise the work and take the first step.

	Objectives	Outputs
Step 1	Describe (flood) hazards in the community.	List and nature of hazards.
Step 2	Conduct (flood) hazard mapping.	Community hazard map. Community resource map.
Step 3	Describe vulnerabilities and capacities of the community (men and women).	Vulnerabilities and capacities analysis.
Step 4	Determine flood risks.	Comprehensive list of risks faced by the communities.
Step 5	Rank flood risks.	Prioritised list of risks .
Step 6	Decide on the acceptable level of risk.	Agreed level of risk for family and community security.
Step 7	Decide whether to prevent, reduce, transfer or live with the risks.	Agreed strategies.

(ADPC, 2004)

Process for Risk Assessment

The following process provides a summary of the chapter:

Step 1. Foundation for risk assessment

- Gain support, establish institutional arrangements and networks for carrying out the flood risk assessment.
- Determine the area to be assessed.
- Involve the relevant stakeholders and required skill-base and expertise.
- Acquire funding.

Step 2. Plan risk assessment

- Assess the availability, suitability, quality and coverage of hydrometric and topographic data.
- Identify additional information required and means of collecting.
- Choose the most appropriate methodology for establishing flood water levels and the method for producing the flood risk.

Step 3. Estimation of the flood hazard

- Gather information on flood location, frequency and severity.
- Carry out hydrological analysis including determination of design flows and flood hydrographs if necessary.
- Carry out hydraulic modelling and determine flood levels for given recurrence intervals of flood events using steady state or transient state models as appropriate.
- Produce flood hazard maps.
- Create a flood information database to serve as part of a multi-hazard information inventory (include observed data and or simulated data such as flood discharges, water levels and flood extent) using GIS.

Step 4. Estimation of vulnerability, capacity and exposure

- Develop an exposure inventory with all elements at risk.
- Carry out a vulnerability and capacities assessment, determine why people are vulnerable and what makes them resilient.

Step 5. Assess potential damages and losses

- Consider the potential damages in terms of cost.
- Use potential loss information to prioritise risk treatment.

Step 6. Determine risk

- Use all the information derived to determine areas and elements at risk from flooding.
- Develop a risk map showing the varying levels of risk as well as loss and damage values.

Step 7. Disseminate flood risk information

- The information should be disseminated as baseline information to guide:
    - Policy development.
    - Flood mitigation strategies.
    - Preparedness activities.
    - Assessments conducted in the recovery process.
    - Allocation of finances.
    - Development planning.
- The information should identify sectors and key stakeholders involved in risk management that risk assessment information must be disseminated to. These include:
    - NDMO.
    - Government ministries and departments.
    - Regional / transboundary organisations.
    - Urban and land-use planners.
    - Various economic sectors, eg. construction, agriculture, etc.
    - NGOs and community-based organisations.

Limitations

- The accuracy and details required as outputs for some risk assessments are dependent on the ability to access specific high end technologies (eg. computer software and hardware).
- Specific technical skills are required for most aspects of sophisticated risk assessments. Expertise in hydrology, engineering and analysis are beneficial. Not all countries in Asia have the skills-base to carry out detailed risk assessments.
- The equipment required to measure and collect data is also expensive to generate and maintain. The initial outlay of funds is difficult for many agencies / government departments to arrange for and justify.
- Although community-based assessments are low cost and easy to conduct, they fail to accurately depict the total flood risk environment. They serve their purpose at a local level and help in raising awareness of flood risk, but their limitations must be accepted.
- Risk assessments should be regularly carried out due to changing flood and human environment. It may be costly and time consuming to continue monitoring and collecting data, but inventories of databases need to be upgraded to ensure complete and relevant data sets.

Checklist

☑ Do you have a national policy which demands the integration of risk assessment recommendations in decision making for development projects?

☑ Do you have a standardised set of common terminologies, notions, symbols and abbreviations for texts and maps pertaining to spatial data presentation in general and in particular in reference to hazard data?

☑ Do you have a national policy on established formats, scales pertinent to spatial data production and usage in national / regional / provincial and local authority level development projects? What mechanism do you have to retain the compatibility of map scales / formats produced by different institutions?

☑ Do you have an authority / coordinating body to act as a national depositary for hazard information, maps responsible for dissemination of data pertinent to various kinds of hazards and associated subjects such as land-use, population, infrastructure etc?

☑ Who is authorised to develop databases for natural systems, resources and hazards? Do you have a mechanism to share such information with the public?

☑ What mechanisms do you have to establish acceptable levels of risk and design floods for various development initiatives, infrastructure projects and design of lifeline facilities? Who will authorise to make decision, and what mechanism is available to retain the compatibility of such decisions?

☑ Do you have a mechanism to produce land-use zonation regulations based on risk assessment data at local government level?

☑ Do you have a system to ensure participation of public in hazard risk and vulnerability assessment and dissemination of assessment data?

Future Challenges

- *Special skills are needed for conducting risk assessment to a reasonable accuracy.* In Asia there is a shortage of expertise for conducting risk assessment. Government departments have difficulty keeping trained staff since they have transferable skills. This problem is mostly seen at the local government. It will take time to develop the skills and human capital necessary and create a conducive environment that attracts expertise for the long-term.

- *Extent to which assessment methodologies are able to identify and accurately represent the actual situation.* Most methodologies used are capable of producing accurate flood hazard data. However, it remains a challenge to extract accurate vulnerability information. The vulnerability assessment tools / methods should be capable of assessing vulnerability in quantitative and qualitative terms. Currently, there is a weakness in representing and evaluating intangible indicators of vulnerability. For example, the social dimension of vulnerability is difficult to measure and therefore the assessments are somewhat vague. When results are not available, these parameters are not taken into consideration when estimating the risk treatment interventions. Methodology for accurate vulnerability assessments needs further research with the aim to extract and represent both tangible and intangible aspects of vulnerability.

- *Risk assessment has to be a prerequisite for decision-making in development work in flood-prone areas*. Development efforts are often set back by the occurrence of damaging floods. Risk assessments are not only applicable to the disaster sector. They should be used as a basis for all development planning so that risk reduction measures can be applied.

- *Financial resources need to be allocated for risk assessment.* There is a shortage of human resources due to inadequate funding allocation for capacity building of personnel. Similarly, funds are not allocated for the procurement of equipment necessary for undertaking high quality assessments. The impact of resource constraints can have cascading negative effects in flood-prone areas. In most cases, arbitrary decisions are taken, resulting in project failure. The importance of risk assessment must be advocated to governments to direct budget allocations to this area on a regular basis.

- *Political will is essential for making major policy decisions.* In most cases land-use decisions, structural interventions, etc. have to be based on risk assessment. Sometimes, when flood risk maps are available, politicians are reluctant to make potentially unpopular choices fearing that such decisions may not be accepted. Participatory dialogue legitimises policies, making implementation less disruptive. Any risk assessment result if properly presented to stakeholders can be used as an awareness-building tool. However, when decisions are taken by authorities and forced upon the people without adequate consultation during implementation, it is difficult to justify the advantages.

Resources

Technical Paper

ADPC (2001) *Disaster Risk Management and Vulnerability Reduction: Protecting the Poor.* Presented by Yodmadi, S. at the Asia and Pacific Forum on Poverty organised by ADB.
This document is a useful resource for further research on:

- Concept of Risk Reduction
- Poverty and Vulnerability
- Community-based Risk Assessment

WMO (1999) *Comprehensive Risk Assessment for Natural Hazards.* WMO/TD No. 955. Geneva, WMO.

PAHO (undated) *Guidelines for Preparing a Community Risk Map.*
http://www.eird.org/ing/varios/folletocomunidades/mapascomunidades.htm
Accessed March 2005

UNISDR (2004) *Guidelines for Reducing Flood Losses.* Geneva, UNISDR.

References

ADPC

- (2003) *Project Completion Report of the Bangladesh Urban Disaster Mitigation Project.* Project Report 5. Implemented by CARE-Bangladesh under AUDMP.
- (2004) *Field Practioners' Handbook: Community-based Disaster Risk Assessment*. By Abarquez, I. and Murshed, Z. Bangkok, ADPC.

Anderson, M.B. and Woodrow, P.J. (1998) *Rising from the Ashes, Development Strategies in Times of Disaster.* London, IT Publications.

Blaikie, P. et al (1994) *At Risk: Natural Hazards, People's Vulnerability and Disasters.* London, Routledge.

Department of Primary Industries Queensland (2002) *Will it Rain?* The Effect of the southern Oscillation and el Niño in Indonesia. Partridge, I. and Ma'shum, M. (eds.). Brisbane, Publishing Services.

DHI (2004) *Scientific Reference and User Guides to MIKE11 and MIKE21 Models.* Denmark, Horsholm.
http://www.dhi.dk
Accessed October 2004

Earth Science, *When Good Rivers Turn Bad.* Australia.
http://earthsci.org/Flooding/unit4/u4-03-01.html
Accessed April 2005

IFRC (1993) *Vulnerability and Capacity Assessment, A Federation Guide.* Geneva, IFRC.

IFRC (2001) *World Disasters Report.* Ed. Walter, L., Geneva, IFRC.

IFRC (2004) *World Disasters Report.* Ed. Walter L., Geneva, IFRC.

Humboldt State University (undated) *Methods of Streamflow Data Analysis.* Prepared by Lehre A.
http://www.humboldt.edu/ geodept/geology531/531_handouts/streamflow_ data_analysis.pdf
Accessed April 2005

MRC (2003) *Annual Report.*
http://www.mrcmekong.org/annual_report/ar9.htm
Accessed March 2005

Montana University (2001) *Flood Frequency Concepts.*
http://www.homepage.montana.edu/ uessc/esci432/FloodFreqConcepts.html
Accessed March 2005

Usamah, M.B. and Alkema, D. (undated) *International Institute for Geo-Information Science and Earth Observation.* Netherlands.
http://www.itc.nl

UNECLAC (2003) *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters.* UNECLAC, International Bank for Reconstruction and Development and the World Bank Group.
http://www.proventionconsortium.org/toolkit.htm
Accessed March 2005

UNISDR (2004) *Living with Risk.* Volume 1. Geneva, UNISDR.

WMO (1999) *Comprehensive Risk Assessment for Natural Hazards.* Technical Document 955, Geneva, World Meteorological Organisation.

WMO (2000) *Operational Hydrology.* Report. No. 40. Geneva, WMO.

5

integrated watershed management

This chapter must be based on Policy (Chapter 3) and Risk Assessment (Chapter 4). The concepts in this chapter are also applicable to Chapters 6, 7 and 10.

Chapter Brief

- Integrated watershed and floodplain management are essential for effective flood risk management.
- Activities in the watershed should be managed to ensure that they do not increase the risk of floods.
- Legal devices such as land-use planning and zoning can be adopted to keep people away from floods. Mechanisms for enforcement are needed to ensure compliance.
- Good governance is necessary for effective management. Public and private sectors need to be accountable and transparent.
- Watersheds often spread across national borders, therefore there must be open dialogue between countries sharing the river system. Transboundary issues are complex because key stakeholders have different and dynamic uses of the watershed.
- Any land-use planning and development should consider flood risk reduction.
- Urbanisation within the floodplain increases people's vulnerability to flooding. Focus should be placed on urban planning and land development issues in order to reduce flood risks.

Key Words

Encroachment

The advance or infringement of uses, plant growth, fill, excavation, building, permanent structures or developments into a floodplain which may impede or alter the flow capacity of a floodplain (UNESCO, 2001).

Environmental Degradation

The reduction of the capacity of the environment to meet social and ecological objectives and needs, for example, deforestation, climate change and water pollution (UNISDR, 2004).

Flood Fringe

Either side of the floodway is the flood fringe area. During a flood it has shallower stiller water stored until levels in the floodway drop and water drains away. During this period of storage, sediment usually settles and is deposited on the flood fringe (UNDMTP, 1994).

Flood Zoning

Definition of areas, based on flood risk, within floodplain appropriate for different land-uses (UNESCO, 2001).

Floodplain

A strip of relatively flat land alongside a stream, river, or lake that is covered by water during a flood (USGS Glossary, 2004).

Floodplain Management

The operation of an overall programme of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations. Floodplain Management Regulations: Zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (covering, for example, floodplains, grading and erosion control), and other regulations to control future development in floodplains and to correct inappropriate development already in floodplains (Floodplain Management Association, 2005).

Floodway

The floodway is the central section of the total flood area, the enlarged main channel that evacuates the flood discharge and has characteristically deep-water high velocities and much entrained debris (UNDMTP, 1994).

Integrated Watershed Management

Integrated Watershed Management (IWM) planning is a multi-resource management planning process, involving all stakeholders within the watershed, who together as a group, cooperatively work toward identifying the watershed's resource issues and concerns as well as develop and implement a watershed plan with solutions that are environmentally, socially and economically sustainable (Alberta Watersheds, 2002).

Natural Resources

Material sources of wealth, such as timber, fresh water, or mineral deposits, that occur in a natural state and have economic value (USGS, 2004).

Stormwater

Also referred to as run-off. It is the portion of water that does not infiltrate or percolate into the ground and remains as surface water.

Watershed

The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds can contain thousands of smaller watersheds (USGS Glossary, 2004).

Overview

Integrated watershed management in terms of flood risk reduction places emphasis on the concept of *coping with floods* as opposed to preventing floods. There are a variety of techniques and options that can be used to reduce the likelihood of a damaging flood occurring and to reduce the impact it would have on a vulnerable community. The concept of living with floods acknowledges that flooding in Asian countries offers many benefits and is vital for agricultural production and livelihoods. It is the damaging aspects of flooding such as human and economic destruction that must be mitigated against.

Flood risk is increasing for two main reasons:

- **Increasing frequency and magnitude of floods**
  Human land-use practices and activities in the watershed such as slash and burn methods and deforestation can contribute to the frequency and magnitude of flooding downstream.

- **Vulnerability to the impacts of floods**
  As well as activities in the watershed, unplanned development in the floodplain and poor water resource management are observed to be two of the main reasons of increased vulnerability to flooding and thus increased risk.

In many areas throughout Asia land-use planning has never been practiced or integrated into watershed or floodplain management. Land-use planning aims to protect people and their assets by keeping them away from high-risk areas. It can also be used to manage human activities that may contribute to flooding (for example, forestry and agriculture). It has to be carried out with the purpose of meeting the socio-economic needs of communities living in the floodplain and reducing the flood vulnerability of the built environment.

This chapter addresses such topics and provides information on how integrated watershed management and all of its components as well as low-tech methods can significantly reduce the risk posed by flooding.

Concepts of Integrated Watershed Management

Integrated Watershed Management

Integrated watershed management (IWM) (also referred to as integrated river basin management), is an umbrella term that covers the planning and management of all the activities carried out in the geographic area of the watershed including the floodplain. It is a tool or strategy that can be used to address issues in the watershed such as water resource management and flood risk. It can be effective in managing both the contributing factors and impacts of flooding. It is a multi-sectoral and often transboundary approach that ensures that activities and land-use in the watershed benefit all and do not endanger people or exacerbate flood risk.

see Box 5.1

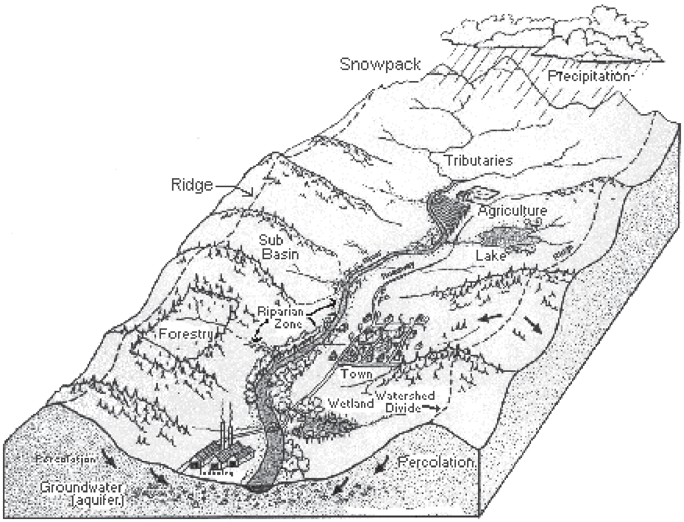
In this chapter IWM is considered as the overall strategy used to address flood risk. It covers:

- Watershed management, dealing specifically with the effect of human activities on natural resources and the subsequent effect on flood intensity and frequency.
- Floodplain management and the tools that can be used to reduce human vulnerability and exposure to flooding such as land-use and urban planning.

Watershed management

The watershed is a vast geographical feature characterised by river systems and defined by topography as shown in the diagram below.

Figure 5.1
Watershed



Produced by Lane Council of Governments

Watershed Information Network, (2004)

Box 5.1

Stakeholders involved in integrated watershed management

Government Ministries / Departments

- Ministry of Agriculture and Fisheries
- Department of Meteorology and Hydrology
- Ministry of Public Works
- Department of Water Resources
- Ministry of Communications and Transport
- Ministry of Environment and Natural Resources
- Ministry of Home Affairs and Foreign Affairs
- Department of Sanitation Works and Drainage
- Ministry of Urban Development - Land Management

Public

- Landowners
- Producers (farmers, fishermen, subsistence households)
- Rural and urban residents
- Human and environmental interest groups

Transboundary

Other jurisdictions and their stakeholders in the watershed:

- Countries
- Provinces / states
- Towns / villages

Private sector

Companies that utilise particular resources or areas of land including:

- Logging companies
- Agriculture and aquaculture farmers
- Water transport / shipping
- Private developers
- Waste management and utilities
- Industries using the river for effluent waste
- Real estate agencies

Goals of integrated watershed management in terms of flood mitigation.

(Adapted from Burby, 2000)

Goals related to the hazard:

- Reduction of private property losses
- Protection of population safety
- Reduction of damage to public property
- Minimisation of fiscal impacts of disasters
- Equitable distribution of hazard programme costs
- Promotion of hazard awareness

Goals related to environmental protection:

- Preservation of natural areas and resources as part of reduction of flood occurrence
- Preservation of open space and recreation as part of management of flood occurrence
- Maintenance of good water quality as part of reduction of hazard losses

Watersheds are rich in natural resources and are often exploited for subsistence farming, economic interests and tourism. Some activities, when unmanaged, have impacts that degrade the environment in the long-term. These factors intensify the flood hazard by increasing the quantity and velocity of run-off, increasing flood risk downstream. The resulting intensified flood can be devastating to settlements occupying the floodplain.

Planners need to understand how these human activities contribute to flooding in order to be able to implement appropriate management strategies. These issues must be addressed as part of IWM. Box 5.2 gives a simple explanation of the effects of particular actions.

Box 5.2

Summary of primary and secondary effects of natural hazards

Human activities that may exacerbate flooding:

- **Deforestation** - increases run-off and subsequent storm flow, also causes erosion and siltation, reduces infiltration capacity of soil.
- **Removing vegetation -** reduces water loss through transpiration and interception.
- **Mining and industry -** pollutes water channels and affects ecosystems, can alter water courses.
- **Agriculture** - compacts soil, reducing infiltration. Some agricultural crops transpire less than natural green vegetation.
- **Urbanisation** - increases the amount and rate of run-off due to extensive impermeable surfaces. Drainage systems either do not have storage capacity and overflow causing urban flooding or rapidly discharge rainfall into rivers reducing the lag time and increasing storm flow.
- **Dumping rubbish and build-up of debris in rivers** - reduces conveyance and causes blockage.

Planners also need to acknowledge the dynamic environment of the watershed. GIS/Remote Sensing, photography and maps can all be used to determine the changes that have taken place over time, in the watershed. This is useful for understanding how the watercourse has changed, what contributed to the changes, and how land-use may potentially impact in the future. In some cases watercourses have been deliberately altered to reduce flood problems, but increased the flooding instead. The problem was then addressed by changing the watercourse back to its original state.

see Case Study 6.4

Conservation

The conservation of natural resources and proper environmental management is an effective flood risk reduction measure. Natural systems such as mangroves, forests and floodplain areas reduce the impact of floods. When altered or removed they start to lose their effectiveness of natural flood protection.

A strategy for flood risk reduction must include the protection and re-establishment of natural resources, specifically conservation of the upper watershed area, which most countries now practice. Not only is this beneficial for risk reduction but it will have long-term development benefits as communities depend on natural resources to support them. The government must have the capacity to enforce policy and educate people about the benefits of conservation.

> *Environmental management can prevent the loss of biodiversity, protect ground and surface water sources, prevent desertification and land and soil degradation and enable the land and communities it supports to withstand shocks to it, such as floods (UNISDR, 2004).*

see Case Study 5.1

Conservation can be a difficult issue to address because many countries in Asia are economically dependent on utilising natural resources for primary industries. It must be addressed by striking a balance between economic rationale and conservation to better manage the natural resources to promote long-term sustainability.

Strategies for proper watershed management

Good watershed management should manage activities in order to reverse the processes that aggravate flooding, it should aim to recreate the ideal characteristics of the river basin - to store water and encourage infiltration. It is essential that there is involvement and cooperation of all the countries and provinces sharing the watershed in order to maximise the benefits. The measures that can be taken are:

- Monitor ecosystems and natural resources.
- Carry out environment impact assessments to consider the impact of all activities on the environment.
- Stop or reduce deforestation and logging and begin a tree replanting scheme.
- Create retention ponds that can be used at playing fields or parks when dry or kept as shallow lakes.
- Prevent rubbish dumping in rivers or clear debris regularly (especially around bridge abutments).
- Apply land-use planning for development and activities and the creation of protected areas that cannot be used for agriculture or development.
- Prevent the reclamation of wetlands and floodplain areas.
- Create policies and legislation (for example, to prevent mining and land burning or restrict these activities to particular areas).
- Ensure national commitment to Agenda 21 and other such strategies for natural resource protection.

see Case Study 5.2 & 5.3

Case Study 5.1

China Land Management

The Loess Plateau in the upper and middle reaches of the Yellow River in China, is one of the most severely soil-eroded areas in the world. Sediment from the yellow river contributes to more than 80% of the total sediment carried downstream. Soil and water loss in the Loess Plateau is a consequence of a number of different factors, natural and related to human activities. The former comprises climate, land forms, soil, vegetation cover, etc. Rainstorms during the flood season are the main soil-eroding factor. The average annual precipitation ranges from 400 to 600mm in most regions of the Loess Plateau.

Conservation

Since the founding of the Peoples Republic of China in 1949, the Loess Plateau was given a high priority for soil and water conservation, and techniques for large-scale soil loss control were developed. Systematic data have been accumulated and much research carried out. Soil conservation in the Loess Plateau has gone from demonstration projects to comprehensive development; from simplistic and dispersed control to integrated control.

Soil conservation measures in the Loess Plateau mainly comprise engineering measures, biological measures and conservation farming. Engineering measures are applied to the following:

- Slopes: terraces, ponds and land leveling for afforestation.
- Gullies: interception banks to protect gully heads, check dams, silt trap dams and small reservoirs.
- Farmland: terracing and silt trap dams (to increase agricultural output).
- Formerly cultivated sloping land: restoration of forest and grass cover.

Using biological measures, vegetation cover may be improved or restored by introducing suitable species of trees, grass and bushes in appropriate combinations. The development of grass and forest areas functions to conserve soil and water, and to promote the development of animal husbandry, forestry and orchards.

Conserving farming for the retention of moisture and earth includes fallow fields, limited tillage, cultivating along contours, contour furrow-and-ridge planting, etc to detain water and soil, to reduce effects of droughts and to have better harvests.

(Source: Extracted and adapted from ADB, 2000)

Case Study 5.2

Malaysian Conservation Act 1960

Purpose
To consolidate the law relating to the conservation of hill and the protection of soil from erosion and inroad of silt.

Main Provisions
The main provisions are contained in Part II and Part III of the Act. In general the Act contains the following:

- The provision relating to the declaration of areas as hill land by the State Authority and the provision prohibiting the use of hill land for any purpose other than for limited agricultural purpose and for mining;
- The provision enabling the Land Administrator to take action against any landowner whose land has caused or is likely to cause damage to other land, water course or has interfered or is likely to interfere with the due cultivation of other land by earth, mud, silt, gravel or stone from his land;
- The provisions enabling the Land Administrator to take action against any landowner whose land has been damaged or is likely to be damaged as a result of erosion or displacement of earth, mud, silt, gravel or stone upon or from such land.

Penalty
Any person who without reasonable excuse fails to comply with any order made under, or any provision of this Act, requiring him to do or prohibiting him from doing any act or thing shall be liable to a fine of not exceeding five thousand ringgit and in default of payment thereof to imprisonment for a term which may, subject to section 283 of the Criminal Procedure Code, as the circumstances may require, extend to six months.

(Extracted from Department of Director General of Lands and Mines, 2003)

Floodplain Management

Effective floodplain management requires a sound understanding of the physical, biological, geological and chemical processes that impact flood hazards. It is equally important to understand the social processes involved in human interaction with the floodplain (Dunbar et al, 1995).

Floodplains are rich and fertile lands located downstream in the watershed. They attract human settlements as they are flat and spacious for cities, have rich fertile soil for agriculture and provide good access to the river for waste disposal and transport methods.

Many major cities are located on floodplains for these 'ideal' conditions. The past few decades have seen an increase in human migration to cities. This has resulted in overcrowding, placing stresses on services, resources and natural resources resulting in increasing vulnerability and flood risk.

Why Floodplain Management is necessary:

- Development on floodplains throughout Asia is taking place faster than protective structures can be built.
- Asian countries are experiencing larger floods that can exceed the ability of defensive structures to protect.
- The high cost of flood protection structures.
- The high economic and human costs of disaster relief and reconstruction.
- Land usage and development upstream affecting downstream areas.
- Adverse environmental impacts caused by structural flood protection.
- It preserves the natural floodplain which manages flooding.
- Advancement in understanding flood risk, from preventing floods to coping with floods.

Floodplain management is aimed at reducing vulnerability to flooding and the losses that occur. It does so by enabling the best use of the floodplain to minimise risk while considering the need for economic development, agriculture and human recreation. It is essential for planning new developments, treating existing risk and also residual risk (risk that remains after mitigation strategies have been applied).

Floodplain management:

- Decides the appropriate use of the floodplain by considering the benefits of development and potential flood losses.
- Considers the effect of floodplain usage on up and downstream areas.
- Identifies and selects the most environmentally suitable decisions for the use of the floodplain.
- Ensures coordinating efforts as well as cost and responsibility sharing.
- Aims at reducing flood damages.
- Preserves and enhances natural floodplain values.

(WRC, 1981)

Floodplain management includes most of the stakeholders previously mentioned in Box 5.1. It is a multi-sectoral and multi-stakeholder process that must be based on planning. The national government plays a role in promoting the concept of floodplain management as part of an IWM approach. It should support provincial governments and committees in implementation. There should be suitable legal backing to uphold the law and stand up to large private companies, agricultural workers, tourist companies and anyone who may be opposed to management activities because of their personal interests in the area.

see Chapter 3

The way in which the floodplain is managed depends on its characteristics and the nature of the human settlements. Ideally, the solution would be to keep people away from the floodplain, but in most occasions, development has already occurred and a suitable risk reduction strategy must be employed. As well as addressing flood risk in terms of location, floodplain management also includes addressing other related risks such as health risks associated with the discharge of industrial, agricultural and untreated sewage waste into waterways.

The tools that are applied to implement floodplain management include land-use planning, zoning, building codes, and urban and rural planning, which are described in the rest of this chapter. Policy and legislations are also tools.

see Chapter 3

The supporting mechanisms include:

- Pilot programmes.
- Institutional arrangements and capacity to enforce and uphold the legislation.
- Developing the capacities if local staff are to be able to enforce the law.
- Training staff to use appropriate tools such as GIS.
- Monitoring and evaluating the effectiveness and feeding back to the management process.

Box 5.3 illustrates guidelines for settlement planning in flood-prone areas in Sri Lanka.

see Box 5.3

Land-use Planning

Land-use planning determines the location and design of development activities in a defined geographic area. The aim is to guide settlement expansion and redevelopment away from flood-prone areas. Land-use planning programmes in most places are standalone programmes usually initiated by local governments covering a local geographic jurisdiction (Burby, 2000). Land-use planning can be used to control human development on the floodplain, which in turn, aims to reduce the vulnerability of its inhabitants to flooding. It has two objectives:

- To bring about the most effective use of the floodplain, consistent with overall community development.
- To promote the health and safety of the present occupants of land subjected to flooding.

(Ansari, 2004)

see Box 5.4

Land-use planning can use a number of methods such as zoning, urban development planning, building codes and conservation to achieve its goals. Regulating land-use within the floodway can also be used to ensure that development does not exacerbate flooding. For example, land-use planning can specify that certain activities and infrastructure are not located or implemented to encourage local flooding. This will ensure that the flood flow is not modified by obstructing elements, and that damages to property will be minimised.

Land-use planning should also complement decision-making regarding the construction of infrastructure such as roads, bridges, housing, as well as structural interventions for flood control. These interventions have the potential to exacerbate risk by altering the river flow, or reducing risk by the use of small storage off-stream reservoirs (polders or flood retention ponds) to provide storage for excess water. During dry-season the area can be used for other purposes with the assurance, that when necessary, it can be used as storage for excess water.

see Chapter 5

Box 5.3

Guidelines for settlement planning in flood-prone areas

SLUMDMP, Ministry of Housing and Plantation Infrastructure (2003)

- Settlements should be strictly avoided in the prohibited zone.
- Regular observation and monitoring should be done in the prohibited zone to prevent illegal settlements.
- New settlements should not be promoted and encouraged in the prohibited zone. Voluntary settlers should be sufficiently warned and advised.
- Floodwater detention facilities should be ensured in unoccupied floodplain areas such as marshes and estuaries for storing peak discharges of floods.
- Reclamation of land in flood-prone areas should be strictly controlled and monitored.
- Construction of dikes along rivers or raising the levels of existing riverbanks should be done to prevent inundation of dense settlements in urban areas after assessing their vulnerability.
- Proper drainage systems and escape routes should be designed in urban areas and housing settlements prone to floods.
- At least the emergency routes should be kept free of floodwaters by means of proper drainage systems, embankments, etc.
- People should be educated about the importance of keeping the drainage systems unblocked and the responsibility of keeping them in good condition should be shared by the community and the local authority.
- Natural drainage areas should not be used for new house settlements.
- Reservation areas of rivers and other water bodies should not be used for new development.
- Those who are already in the restricted zone should be relocated to a safe area.
- Growing of sturdy trees in reservations along riverbanks and coastlines should be promoted in order to reduce the velocity of floodwaters.
- Similarly housing settlements should be surrounded by green belts with sturdy trees in order to reduce the velocity of floodwaters.

Box 5.4

How to make land-use planning effective in reducing vulnerability to natural disasters:

- Be subject to stakeholder participation and scrutiny to ensure that its role and purpose is understood.
- Mobilise adequate resources in terms of finance and people, skills and equipment.
- Enact legal status and power to enforce plans, codes and legislation.
- Co-ordinate with other mitigation methods.
- Raise awareness of measures, its benefits and limitations.
- Monitor and evaluate the success of the plans.
- Be aware of transboundary issues and participation.

(Gunne-Jones, 2003)

Legal devices for land-use control

Control and compliance to land-use planning regulations is difficult. There are few, if any, national level mechanisms because land-use is generally the responsibility and jurisdiction of local government. National governments can provide financial incentives and disincentives for land-use regulations, but even at local government level, it is difficult to introduce land-use planning to areas with existing infrastructures and established socio-economic activities. Landowners are reluctant to change their land-use and make amendments to their buildings, which usually come at a high financial cost. The issue is also often politically contentious (Burby, 2001). Land-use control measures are executed by local and provincial government institutions and units with special powers for land management. However, policy should be driven at national level. Such institutions will have powers to develop land-use regulations, implement and execute policies for efficient management of land within the flood-prone areas.

see Case Study 5.3

Zoning

Zoning directs the development of obstructing features away from the main river flow as well as keeping people away from the high-risk flood fringe areas. Zoning is the legislative side of land-use planning as long as it can be enforced. Zoning can prevent the use of high-risk floodplain areas for residential development, but allow it for more suitable activities such as parks, agriculture or nature reserves. It must be done through the government where authority is given to a body to discern suitable use of the floodplain. Zoning should take into account socio-economic activities, for example industries such as fishing or tourism. If people are prevented from carrying out their normal work, appropriate compensation and agreements should take place. For example, if fishermen cannot live by the river, they must be allowed access and provided with security for their boats. Where landownership is concerned it may be difficult to introduce zoning. People may be unwilling to move, change practices or accept land elsewhere. The situation must be handled carefully and other risk reduction methods applied. Use of the floodplain should be in conjunction with flood early warning systems.

see Chapter 8

Case Study 5.3

Japan's Integrated Approach to the Planning and Management of Land Resources

Japan's Implementation of Agenda 21

As a part of a comprehensive and basic national plan for the management of land resources, Japan has established successively the Comprehensive National Development Plan, which determines the use of land, water and other natural resources and the proper locations for industry, as well as the National Land Use Plan, which determines the basic framework for national land use. In addition to regulations concerning the prevention of pollution, conservation of the natural environment, protection of the historical environment, environmental impact assessment, and the relocation of industries, the Plan also addresses prevention of traffic pollution, the quality of water in lakes and marshes, and the creation of comfortable urban environments.

The Land-use Master Plans are established by prefectural governors and cover matters dealing with the designation of five areas (urban, agricultural, forest, natural park and nature conservation areas), and the coordination of competitive land uses. These plans function as a means of comprehensive intra-administration coordination.

In addition to these and the Pollution Control Plan, Japan has also established land use plans for specific sectors, such as forests and water.

Remote sensing data on land use are regularly collected by satellite, and this information is maintained, in graphic form, and updated through a Project to Construct National Land Information System. In addition, a geographical information system called "ISLAND" manages related numerical information.

(Extracted from UNESD, 1997)

Encroachment lines

Encroachment lines are defined by fencing or on a map that determines restricted areas at a designated distance away from the centerline of the river channel. This is probably the simplest form of land control, applicable even in areas where other aspects of land-use planning are rather rudimentary. They can be applied to ensure that the floodway is free from obstructions and settlement laying setback lines on either side of the river channel between which no construction is permitted. They may also be used in coastal areas, to prevent building close to the shoreline where occasional high tides will have damaging effect on settlements.

Building codes

Building codes complement zoning in that they take steps to decrease people's vulnerability and exposure to floods. They can ensure the construction of safe homes, roads, bridges, and public works by setting design standards for methods and materials used. For example, building standards can be applied to limit flood damages through encouraging measures such as flood-proofing. Link to having standards, national, provincial or local, can work to decrease the vulnerability of whole communities and it generally raises the quality of housing in the area. Governments who are actively seeking to reduce flood risks will encourage and enforce building codes and thereby become more accountable in flood disasters. It is a proactive step along with other tools in treating flood risks. Box 7.2 (see Chapter 7) provides some examples of building guidelines for flood-prone areas which can serve to develop building codes.

see Chapter 7

Measuring material standards and specifications

Public acquisition or purchase

Land zoning and building codes are easier to encourage, monitor and manage on government owned land. It can be more difficult to enforce such practices on privately owned land as it limits landowners' rights to develop on their own property. If a landowner cannot develop their land, they may be deprived of any profitable private use and the land value will depreciate further reducing the likelihood of private sale. In such cases the government may offer to purchase the land to use for flood reduction, such as retention areas like nature parks, playground and recreation area, etc. that can be inundated during flooding. The government may decide to pay compensation, or pay a value defined by insurance or market value. Although a logical solution, this is rarely practiced due to potentially high purchase cost and lack of economic gain for the buying party.

Relocation and resettlement

Permanent relocation and resettlement of people to a safer area is sometimes an option. However, it is normally the last option as it has massive social impacts for the community (UN-Habitat, 1995). Some communities relocate temporarily each year during the flood season as a way of coping with floods. However, in some cases they may be required to move permanently. The settlement in the new location should be carried out in conjunction with zoning regulations or building codes to prevent repetition of the same problem. However, it is sometimes difficult to relocate agriculturally based people due to lack of availability of suitable space.

In this case, land-use regulations can be used to limit activities in the high-risk area, such as determining the location of homes. Restrictions can prevent homes being built in high-risk areas, but allow farming. If there is a problem with people honouring the zones or codes, the government may have to buy the development rights of the land before resettlement so that people will be limited in the use of the land.

Relocation and resettlement of people away from flood-prone areas is a contentious issue. It is costly, complex and disruptive to the community. Generally initiated at national government level and implemented at grassroots community level, little is known about the long-term impacts on these communities.

see Chapter 7

Case Study 5.4

Relocation and Resettlement

In the case of Vietnam the national government has a policy to reduce the losses of people, properties and to contribute toward stable living conditions. Therefore, to mitigate against further loss, death and damage due to flooding, the government supports relocation and resettlement of local communities. Three communes - Trieu Giang, Trieu Long and Trieu Thuong located 15 km from the Thach Han River experienced yearly floods that recently claimed 10 lives, swept away homes, cattle and crops at an estimated cost of ten billion VND. With the assistance of external funding, the local District of Trieu Phong and Province of Quang Tri decided to relocate these three communes away from high flood risk areas. The 1 year project proposed to build transport roads, water supply and irrigation systems, electricity systems, schools, medical centers, and cultural areas. As the primary economic activity was agriculture, the exploitation of the new resettlement site was also encouraged.

In total 425 households (1608 people) were involved in this government resettlement project. The project stated that employment and income of the 3 communes increased as a result of the resettlement (Socialist Republic of Vietnam, 2001).

However, sometimes the results are not so successful. People have complex reasons for living at risk. Kinship ties, community relationships, employment, land scarcity, and history can contribute to reasons why people are reluctant to relocate. Floodplains are a source of livelihood for many, and communities live on disaster-prone land to earn a living.

Relocation schemes were once popular with the Malaysian Government. Residents in the State of Kelantan were permanently shifted from flood-prone agricultural land to nearby urban towns. However, the traditional 'Kampong' way of life valued and preferred by these rural people became the government's main obstacle to achieving a successful relocation programme. To attract people to the scheme, the government promoted a 'Traditional Kampungs Development Programme' with the objective to resettle people away from flood-prone areas with promises of higher incomes and better living conditions. However, the land acquired was in a hilly area, and could not replicate the original Kampung arrangement desired by the people.

Aside from the social disruption to the way of life of the Malays, the schemes were also costly and without guarantee of a better life. Resettlement also had the potential to fuel conflict and tension in political and ethnic sensitivities prevalent in Malaysian society (Chan, 1995).

In the US, the case of Boone, North Carolina shows that although costly, sometimes state policies favouring government land acquisition and community relocation can be successful. However, in Boone, only 30 households and a nursing home were resettled at a cost of US$ 2.3 million in a government sponsored, voluntary 'buyout scheme'. People were given the option to relocate with substantial compensation in this 'buyout scheme' (DEM, 2004).

Relocation and resettlement can be favourable in certain conditions where financial instruments and resources are available. Yet, in most parts of Asia, this mitigation measure has proven to be less successful, costly, and economically, politically and socially sensitive.

Urban Development Planning

Cities in Asia are expanding rapidly due to increasing migration of people from rural to urban areas in search of employment and improved access to services. This has resulted in the overcrowding of cities causing expansion into high-risk areas and an increase in vulnerability as listed in Box 5.6. Most Asian megacities are situated on floodplains, for example, Bangkok, Dhaka, Vientienne, Ho Chi Minh. The poorest people tend to occupy the marginal land closest to the river channel as it is often the only available space and they can usually live on it for free or at low cost.

The development and expansion of towns and cities must be planned in accordance with hazard and risk maps. Planners must consider designs suitable for construction of buildings, roads, drainage and sanitation. These should be in accordance with zoning regulations as well as building codes adopted. During planning and improvements, planners need to consider the effect of bridges on the flow of water. They need to be high enough so they do not constrict or obstruct the flow. It is essential that they are well-designed and operational during a flood as they provide key access routes. Sometimes roads may be elevated on embankments to provide safe access. However, the embankments may have the undesirable effect of detaining floodwaters, raising the level upstream. Situations like these need to be well-planned with all potential effects considered. Codes and design standards should also address other vulnerable structures such as water distribution systems and treatment plants, power and telephone lines.

see Chapter 5

Box 5.6

Increased Vulnerability

Unplanned urban development can increase the vulnerability of people to flood risks due to the following factors:

- Increased population and settlement growth on marginal land prone to floods.
- Poverty (lack of access to education, health, employment, etc.).
- Interruption of natural drainage processes.
- Pavement of open areas, increasing the surface run-off and volume.
- Pollution of rivers and water bodies.
- Water supply schemes, roads and other infrastructure development projects blocking the natural drainage path.
- Excessive sedimentation in drainage channels.
- Reclamation of low-lying areas without additional drainage.
- Reduction of natural retention ponds.
- Reduction of trees and vegetation which help in retaining water.

> *It is important to locate particular 'lifelines' services and or vulnerable groups away from the flood risk. These include hospitals, residential homes for the elderly and disabled, orphanages, government administrative buildings Red Cross centers and utility plants.*

When zoning regulations for settlements on floodplains are designed, they should consider the likelihood of expansion. Zones should maintain high-risk areas free from settlement, but there should be defined areas that can be built upon in the case of expanding the city limits. It is always difficult to impose such new regulations on existing land. The development of the areas should be planned according to regulations.

Urban drainage systems

Drainage in urban areas increases floods risk due to:
- Poor drainage systems in urban areas can increase the rate of flow of run-off into rivers as stormwater discharges directly into waterways.
- Drainage systems without adequate storage capacity will result in overflow. This increases localised or downstream flooding.
- Stormwater discharges directly into waterways carrying residues and litter from roads (oil, heavy metals, excreta, polythene bags, cigarette butts, etc.) and polluting the waterways.

Sustainable urban drainage systems and "Best Management Practices" are being adopted in a number of Asian cities. They consist of creating more natural drainage areas such as retention and retardation areas, and swales and wetlands that retain and attenuate water encouraging infiltration and filtration. It also promotes the use of permeable hard surfaces in urban areas such as stones and gravel car parks. These measures reduce stormwater run-off and pollution to rivers as well as improving the amenity value and environment for public enjoyment (Environment Agency, 2003). Sustainable urban drainage should be incorporated into the planning and development of new urban areas and improvements to existing drainage systems.

Urban drainage and flood mitigation works in built-up areas is becoming increasingly costly and difficult. Engineering options are limited by space, infrastructure, private utilities and services, and the cost of acquiring land for drainage construction. There is reluctance by private developers and local authorities to deliberately set aside land for land retention areas as it reduces the amount of highly valued urban land available for building. This is a case where financial and legal incentives and disincentives should be employed to encourage better storm water management, especially in Asian megacities.

Box 5.7

Infrastructure design and development

Infrastructure
- Roads and alternative access routes for during floods
- Buildings and services
- Bridges
- Flood protection structures
- River channels and canals
- Utilities

Considerations

- Survey and identify Infrastructure systems and units at risk.
- Identify the character of vulnerability.
- Upgrade vulnerable elements and systems.
- Raise design standards for structures that require to be in vulnerable locations.
- Produce good practice guidelines related to buildings and operation.
- Establish flood reference levels.
- Protect sensitive plants and infrastructure:
    - Locate above flood levels.
    - Special foundation designs for earthquake-prone areas.
    - Protect the foundation from floodwater flow.
- Design urban systems based on zoned regulations.
- Avoid siting in high-risk areas.
- Organise special assistance for low-income communities:
    - Technical advice.
    - Maintenance.
    - Risk avoidance.
- Announce the policy for risk reduction (zonation for risk avoidance, controls / building codes, advisory services.
    - Zonation for risk avoidance.
    - Controls / building codes.
    - Advisory services.

Checklist for urban planning

- Keep up to date through making flood risk maps available to public and making public aware about the urban flood risk.
- Purchase land and designate its use by different land-user categories (housing, commerce, recreation, open air, etc. in accordance with the vulnerability categories).
- Exchange highly flood-prone land with less vulnerable land-uses (settlement areas with play grounds, parks, etc.).
- Consider permanent release of areas prone to floods for other land-uses such as conservation.
- Maintain buffer zones such as urban forests, tree plantations, wetlands adjacent to settlements (these can also act as fire breakers).
- Safeguard water bodies (designate them for public access for recreation and maintain them as urban wetlands. Regulate such land development by private parties).

see Case Study 5.5

Retention areas

Retention areas and swales are allocated in urban areas to collect stormwater run-off. They are naturally grassed areas that collect the run-off from surrounding impermeable surfaces like roads and buildings. These areas can be used as recreational areas during non-flood times (eg. sports fields, playgrounds and nature reserves).

left. *recreation areas,* right. *swale*

The benefits are:

- Reduced run-off to drainage systems and therefore the discharge into rivers.
- Natural filtration to reduce pollution of waterways.
- Controlled localised flooding by guiding the waters to an allocated area that provides water storage.
- Encouraged evaporation and reduced amount of stormwater.
- Areas can be multi-purpose for example, recreation and flood control.
- It encourages natural processes and minimises the need for radical change (for example, enlargement of existing drainage systems).

Rural Development

Rural areas are not free from flood risk, but most initiatives for flood mitigation are generally reserved for urban areas. Low population density and less built-up areas helps to maintain much of the natural drainage processes. However, nearby structural interventions constructed to protect urban areas can sometimes have adverse effects on rural neighbours. For example, embankments can divert floodwater unintentionally to surrounding outskirts whilst protecting urban centres.

Case Study 5.5

Diyawanna Uyana Golf links - Sri Lanka

Many parts of the city of Colombo experience frequent floods. The floods of June 1992 inundated a considerable portion of the capital city due to the absence of proper rainwater drainage facilities leading out to the sea. The government had earlier launched the Greater Colombo Flood Control and Environmental Improvement Project to improve the drainage facilities, and to clean up and de-sediment the channel network in and around Colombo. The Diyawanna Uyana Golf Course project was a follow-up project undertaken by the Urban Development Authority (UDA) to ensure the minimising of flood risk to parts of the city.

The total project area comprises approximately 85 hectares of low-lying lands, most of which was designated as a Flood Detention Area by the Sri Lanka Land Reclamation and Development Corporation. The area was not developed for two decades because of its flood retention capacity to prevent flooding in the surrounding area. Due to land scarcity for development and housing projects, the area is now in high demand because of its strategic location and scenic beauty.

The project comprises:
a. "Shrine of the Innocents", a landscaped monument dedicated to the memory of innocent youth who lost their lives in recent years, in an area of 0.2 hectares.
b. Golf Course in an area of 56 hectares with a Golf Club and Leisure Centre, a Rowing Lake and the Rowing Club.
c. Public Athletics ground cum football pitch and cricket pitch.
d. Additional nature park areas (including both marsh and ponds) and ancillary facilities such as parking, toilets and a boat terminal.

The land was acquired by the UDA and compensation was paid according to the valuation. The UDA arranged for the project to undergo an EIA process for the overall site where recommendations were made to ensure the retention of minicatchments in the context of there being more than one potential developer for various components of the project.

Controversy has since arisen as developers are planning to build access roads, approximately 70 housing apartments in 2 building blocks of 6 and 8 stories and 100 bungalows in the area adjoining the golf course. This land use is not in line with the flood risk reduction strategies and could render the potential residents vulnerable to future flooding.

(Source: adapted from Kasturisinghe, 2003)

Flood-proofing measures are more appropriate options available for rural communities who both benefit from the rich alluvial deposits along the floodplain, and are confronted with the need to reduce potential losses.

Development of agricultural areas

Damage to crops and livelihood is highly significant in terms of cost to the government as well as the farmers themselves. Although the floodplain is ideal for agriculture, measures should be taken to prevent losses. These can include a shift in timing for the planting and harvesting of crops. This can be adopted to avoid the seasonal floods and subsequent crop losses. Farmers can also build bordering embankments or folders to protect the crops (Tinh and Hang, 2003).

Incentives and disincentives

In order to prevent occupation or new development in flood-prone areas, disincentives such as special taxes and tariffs can be introduced. Primarily the government must acknowledge that it is economically worse to pay for infrastructure repairs and emergency relief and recovery. It is beneficial to introduce incentives to reduce the exposure of people and infrastructure to floods and thereby reduce future expenditure due to damages. Incentives such as tax windows, special low tariff systems and material subsidies can be offered when people are reluctant to move into newly developed flood-safe areas. Incentives must be issued in conjunction with other factors such as NGO activities, facilities and services in the area. People cannot be expected to move to areas lacking in essential services, nor will it be beneficial to leave if they are benefits in living in these areas.

Yet, this strategy does not target the marginalised groups who settle or squat illegally in areas such as remote shoals, slums, and abandoned buildings. There should be more appropriate incentives and measures taken to target these groups, who are not always recognised by either government or society.

Process

Process for addressing flood risk through an IWM approach.

1. **Identify key stakeholders and form a planning team**
    - Determine stakeholders of the watershed.
    - Form an IWM flood risk committee.
    - Discuss visions for the watershed that addresses flood risk reduction based on the needs and concerns of the different stakeholders. The communities involved should be included in the initial planning.
    - Launch a public awareness campaign to keep the public informed. Ensure citizen participation in decision-making, implementation and review.
    - Decide on the information required and methodology for collection.

2. **Risk assessment**
    - Create a database inventory determining:
        - Current land-use practices.
        - Patterns of human settlement.
        - Location of resources (natural and artificial).
        - Map the natural course of the river.
    - Conduct a hazard assessment, include watershed hydrological and meteorological data.
    - Conduct VCA to determine the people and areas at risk.
    - Determine the human factors that contribute to flooding.
    - Identify areas on the floodplain in terms of their level of risk to different magnitudes of floods.
    - Identify the boundaries of the floodplain in terms of a particular design flood. For example, the high-risk area for a 20-year flood will differ from that of a 100-year flood.
    - This information can be presented visually such as in maps, tables and graphs. Tools such as GIS and modeling may be used.

3. **Action planning**
    - Determine objectives based on risk assessment results and vision.
    - Decide the scope of your plan (geographic area, economic resources, affected population, political boundaries).
    - Financial resources determine the scope for implementing monitoring and evaluating the plan. The private sector should be tapped as a source of financing.
    - Decide the most effective techniques to address flood risk within the given scope. These include land-use planning, building codes, zoning, conservation, drainage improvement.

- Create an action plan listing specific activities, delegate roles and responsibilities to key stakeholders and set a target date for achievement. The action plan should also include a detailed monitoring and evaluation process.
- Conduct EIA and SIA to determine the impact of the proposed plan.

4. Implementation

- Execute the action plan.
- Establish and maintain good communication between all stakeholders involved.
- Maintain open communication channels with public.
- Ensure that transparent monitoring and evaluation (M&E) takes place and the results feed back into the action plan periodically. Changes should be made in accordance with findings and recommendations of the M&E.

5. Regulation and enforcement

- Develop the mechanisms for compliance to all zoning, building and conservation regulations that have been issued as part of the action plan.
- In some cases compliance may be difficult to enforce, incentives can be provided as encouragement.

6. Monitoring and evaluation

- Revisit the vision of the watershed and consider the changes.
- Evaluate the effectiveness of the plan in achieving objectives.
- Devise indicators to monitor the impact of the plan on flood risk reduction.
- Adapt plan as required and incorporate feedback.

Limitations

Activities that are worsening flooding downstream may be occurring upstream, which could well be in another district, province of even country. This is the case in many large watersheds in Asia, where the flooding problems in one country originate and are exacerbated by another country's activities. In such cases, water and resource issues can become politically sensitive issues and dialogue and cooperation between the countries is limited. Addressing transboundary issues are integral to integrated watershed management.

see Chapter 12

It can be extremely difficult to meet the needs of various stakeholders because water is an essential element for human survival. The use of water has caused conflict between countries for centuries. It is a challenge for government departments, private companies, subsistence farmers, etc. to get together to discuss the management of the watershed. They are often reluctant to stop particular activities even though they may be contributing to flood risk, making it difficult to even gain a compromise.

Lack of political will at national level to address floods through an integrated watershed management (IWM) approach means that policy and legislative tools may be limited and there may not be adequate national representation for transboundary watershed issues. The support of national government as well as provincial and local governments is essential. They should be a driving force for IWM.

Policies, legislation, agreements and cooperation can only be effective through good governance. Good governance ensures that the law is being upheld, it ensures equity, protecting the rights of all stakeholders. It is often the case that corruption, bribery, favouritism and apathy prevent laws from being upheld and therefore prevent plans from being effective. IWM cannot and will not be effective without good governance throughout the government, private companies, transboundary organisations and stakeholders involved. There needs to be a high level of accountability and transparency.

see Chapter 12

Checklist

☑ Does your IWM plan complement development goals?

☑ Is the IWM plan integrated into development planning for the area?

☑ Have you conducted a comprehensive EIA and SIA?

☑ Is your IWM plan realistic?

☑ Does your plan consider transboundary issues?

☑ Have you ensured fair, equal and open participation with the community?

☑ Have you considered all minority groups, such as refugees, hill tribes, marginalised ethnic and religious groups?

☑ Is there adequate capacity within the IWM flood risk committee? This includes technical policy, social, engineering and environmental experts.

☑ Does your plan advocate corporate responsibility and provide incentives where necessary for private sector compliance?

☑ Have you looked at alternative financing means such as:
- Private sector contributions (levies, taxes, leases).
- International funding (bilateral and multilateral).
- Forming partnership and collaborations with other countries, institutions, etc. in the watershed.
- Creating national parks and encouraging tourism to generate income.

Future Challenges

- *IWM should consider development plans for the area.* A proactive approach to IWM should consider issues related to the socio-economic contexts of communities living in the flood-prone area and land-use management. Development plans for the area, concerning economic and social development, are often the main management challenges for government. People must be involved in discussions about the changing land-use, they need to know their rights and their options. Similarly, authorities need to understand the potential socio-economic issues related to these changes. There must be a participatory planning approach that promotes consensus on the options available. It ensures that people are not displaced or made even more vulnerable and that the authorities compensate them appropriately. IWM should consider how flood risk management strategies such as zoning, conservation, regulations, etc. affect the achievement of these development plans.

- *An integrated approach is the only way to effectively manage flood risk in the watershed.* Flood risk management has to be the joint responsibility of key stakeholders within a multi-sector environment, both within countries and across national borders. A management body (such as the NDMO), as well as relevant stakeholders, should be given institutional powers to apply and execute land management regulations. This should be part of or linked to the body dealing with early warning systems. Partnership, cooperation and collaboration needs to be formed to ensure that policies follow an integrated approach.

- *Compliance to laws and agreements is essential to ensure their effectiveness.* It is common for developers in many parts of Asia to ignore existing building by-laws, land-use and zoning regulations due to lack of awareness, lack of consequences and "corner cutting". The construction industry is lucrative, powerful and lacks enforcement of existing regulations, and because of this, many unofficial transactions take place unnoticed. These practices have unsustainable results and therefore contribute to increasing flood risks. Governments need to take the lead in enforcing compliance.

- *Decisions regarding the development of the floodplain must consider long-term effects.* Most decisions regarding floodplain development are made due to political pressure and often only short-term impacts are taken into consideration. The developing countries of Asia can learn from the long-term ill effects of major flood management interventions undertaken in developed countries. However, it is a major challenge to develop mechanisms for considering long-term effects and sustainability into the planning process as a total paradigm shift is required. The watershed has to be considered as a system which is responsive to all changes. The current trend is to have over-emphasis on non-structural flood mitigation measures. It is a challenge to convince decision-makers that the overall flood management strategy could involve a mixture of structural and non-structural measures designed to work in an integrated manner.

Resources

Urban Drainage Systems

Environment Agency (2003) *Sustainable Urban Drainage Systems, A Guide For Developers*. UK, Environment Agency.
http://www.environment-agency.gov.uk/commondata/acrobat/a5_suds_v3.pdf

International Stormwater Best Management Practices (BMP) Database.
http://www.bmpdatabase.org

Land-use Planning

UN-Habitat (1995) *Guidelines for Settlement Planning in Areas Prone to Flood Disasters.* Nairobi, UN-Habitat.

UNESCAP (2003) *Guidelines on Participatory Planning and Management for Flood Mitigation and Preparedness.* Water Resources Series No. 82. New York, United Nations.

References

ADB (2000) *Yellow River Flood Management Sector Project.* TA no 3259-prc, mid-term report. Manila, ADB.

Alberta Watershed (2002) *Integrated Watershed Management.*
www.albertawatersheds.org
Accessed March 2005

Ansari, J.H. (2004) *Land-use Planning for (Risk) Reduction in Urban Areas.* National Institute of Disaster Management, Government of India.
http://www.nidm.net/Chap9.htm
Accessed February 2005

Burby, R.J. (2000) *Land-use Planning for Flood Hazard Reduction.* Floods Volume 2. Ed. Parker, D.J. London, Routledge.

Chan, N.W. (1995) *Flood Disaster Management in Malaysia: An Evaluation of the Effectiveness of Government Resettlement Schemes.* Disaster Prevention and Management. Volume 4, Number 4.

Dang Quang Tinh and Pham Thanh Hang, (2003) *Living with floods in the Mekong River Delta of Vietnam,* Paper for the World Water forum poverty and Flood Theme.

Department of Director General of Lands and Mines (2003).
http://www.kptg.gov.my/undang-undang.htm
Accessed April 2005

DEM (2004) *Boone's Acquisition and Relocation Initiative - An Example of Pursuing Multiple Objectives.*
http://www.dem.dcc.state.nc.us/mitigation/case_boone.htm
Accessed October 2004

Dunbar et al (1995) *Natural Hazards Data and Information in the United States.* Geological Survey of Japan Report, No 281, p.57-84

Environment Agency (2003) *Sustainable Urban Drainage Systems, A Guide For Developers*. UK, Environment Agency.
http://www.environment-agency.gov.uk/commondata/acrobat/a5_suds_v3.pdf
Accessed April 2005

EPA (2004) *Watershed Information Network.* USA, EPA.
http://www.epa.gov/win/what.html
Accessed 20 March 2005

Floodplain Management Association (2005) *www.floodplain.org*
Accessed March 2005

Golam, R. and Tariquzzaman, S.M. *Squatter Settlement on the Flood Protection Embankment in Dhaka City.*
www.commonwealth-planners.org/papers/ssdc.pdf
Accessed March 2005

Gunne-Jones, A. (2003) *Land-use Planning - How Effective is it in Reducing Vulnerability to Natural Hazards?*
http://www.icdds.org/downloads/HAZARDS%20PAPER%20v.2.pdf
Accessed April 2005

Hirsch, P. and Phanvilay, K. (1998*) Community-based Natural Resource Management and Watershed Resource Conflicts*: A Case Study from Nam Ngum, Lao PDR. Paper presented at International Workshop on Community-based Natural Resources Management. Washington D.C.

Kasturisinghe, N. (2003) *Diyawanna Double Dealing?* Sunday Times, 6 July, Sri Lanka.

SLUMDMP (2003) *Guidelines for Settlements Planning and Construction in Flood-prone Areas*. Sri Lanka Urban Multi-hazard Disaster Mitigation Project. Sri Lanka, Centre for Housing Planning and Building.

Socialist Republic of Vietnam (2001) *Project: Relocation of People from Heavily Flooded Areas in Three Communes in Trieu Phong District Quang Tri Province*. People's Committee of Quang Tri Province.

UN-Habitat (1995) *Guidelines for Settlement Planning in Areas Prone to Flood Disasters.* Nairobi, UN-Habitat.

UNDMTP (1994) *Land Use Aspects, Volume 5.* Disaster Prevention and Mitigation. New York. Geneva, UNDP / DHA.
http://www.undmtp.org/modules_e.htm

UNESCAP (1999) *Regional Cooperation in the 21st Century on Flood Control and Management in Asia and the Pacific*. New York, UN.

UNESCO (2001) *Guidelines on Non-structural Measures in Urban Flood Management*. By Andjelkovic, I. IHP-V, Technical Documents in Hydrology No. 50. Paris,UNESCO.

UNESD (1997) *National Implementation of Agenda 21, Japan.* Information Provided by the Government of Japan to the United Nations Commission on Sustainable Development, Fifth Session. New York, UNESD.
http://www.un.org/esa/earthsummit/japan-cp.htm
Accessed April 2005

UNISDR (2004) *Living with Risk*. Volume 1, Chapter 5.1, Environmental Management. Geneva, UNISDR.

USGS (2004) *Water Glossary of Terms.* United States Geological Survey.
http://ga.water.usgs.gov/edu/dictionary.html
Accessed March 2005

WRC (1981) *Floodplain Management Handbook*. USA, United States Water Resources Council.

6

structural interventions

This chapter must be based on Policy (Chapter 3) Risk Assessment (Chapter 4) and Integrated Watershed Management (Chapter 5). When reading this chapter you should refer to Early Warning Systems and Emergency Planning (Chapter 8).

Chapter Brief

- There are different types of structural flood control measures that can be undertaken to suit different situations and contexts.
- Large-scale and expensive structural flood mitigation projects can encounter problems if an open, transparent, accountable and participatory process is not adopted.
- There needs to be stringent EIA, SIA and risk assessments conducted to investigate all probable effects of structural flood mitigation measures on social, economic, political and environmental systems in both the surrounding and neighbouring geographic area.
- Structural measures can be highly effective, but the possibility of future flooding should never be an oversight.
- It is important to extensively explore and analyse through a multi-disciplinary and multi-stakeholder approach, future ramifications of structural interventions and pre-empt possible scenarios.

Key Words

Structural Flood Control

All measures that are aimed at reducing the harmful effect of floods by structurally modifying the stream flow.

Flood Protection

Protection against the damaging effects of floods (UNESCO, 2001).

Flood Control

The use of techniques to change the physical characteristics of floods (UNESCO, 2001).

Flood Peak

The highest magnitude of the stage of discharge attained by a flood. It can also be called Peak Stage or Peak Discharge.

Flood Stage

The level of a river where overflow onto surrounding areas can occur.

Siltation

The filling-in of lakes and stream channels with soil particles, usually as a result of erosion on adjacent land. Also called “sedimentation.”

See Chapter 4 for the following definitions:

see Chapter 4

Discharge

Design Flood

Flood Magnitude

Overview

In the past, structural interventions have been the preferred method of mitigation against floods. There are a variety of structures designed to keep floods away from people. They have been successful on occasions when the characteristics of water discharge in a catchment do not exceed the design parameters of the particular mitigation structure. They can regulate the impact and reduce the eventual damages and losses due to floods, but it is impossible to achieve absolute protection. Structural measures are undertaken with the purpose of altering the streamflow by providing safety from floods, thus allowing the continuity of normal social and economic activities. Streamflow alteration, however, often has many negative impacts, which must be considered for future planning.

Structures must be built according to a calculated design flood, which governs the maximum magnitude flood that the structure can withstand. Capital investment for structural interventions is usually high. Structures have the potential to be well-designed and constructed, and serve their purpose during their designed lifespan. However, this is not always the case. Effective operation and maintenance is an essential factor for their continued performance. Supporting mechanisms such as institutional arrangements, operation and maintenance procedures and continuing assessment of performance are needed for effective functioning.

Some flood control structures and facilities such as dams form part of multi-purpose schemes making them more cost-effective. Projects should be implemented in conformity with the integrated watershed management plans of national and provincial governments as well as transboundary initiatives.

Flood control structures can be responsible for large-scale resettlement and forced migration or displacement of people, causing considerable social and environmental consequences. In such cases, these projects become politically sensitive because there is often much opposition to their potentially wide-ranging consequences.

Although structural interventions have been commonly used throughout Asia, their limitations are becoming increasingly apparent. Land scarcity and demands created by urbanisation have made it difficult to restrict development in areas protected by structures. This has led to an increase in the number of people at risk. When projects are undertaken in the future, it is important to take into consideration their effectiveness, long-term consequences, environmental and social impacts, including the risk of structural failure.

This chapter outlines the different structural interventions that can be applied including their benefits and limitations. Case studies throughout the chapter from Asia and other parts of the world provide examples of how structural measures have been applied within a given context.

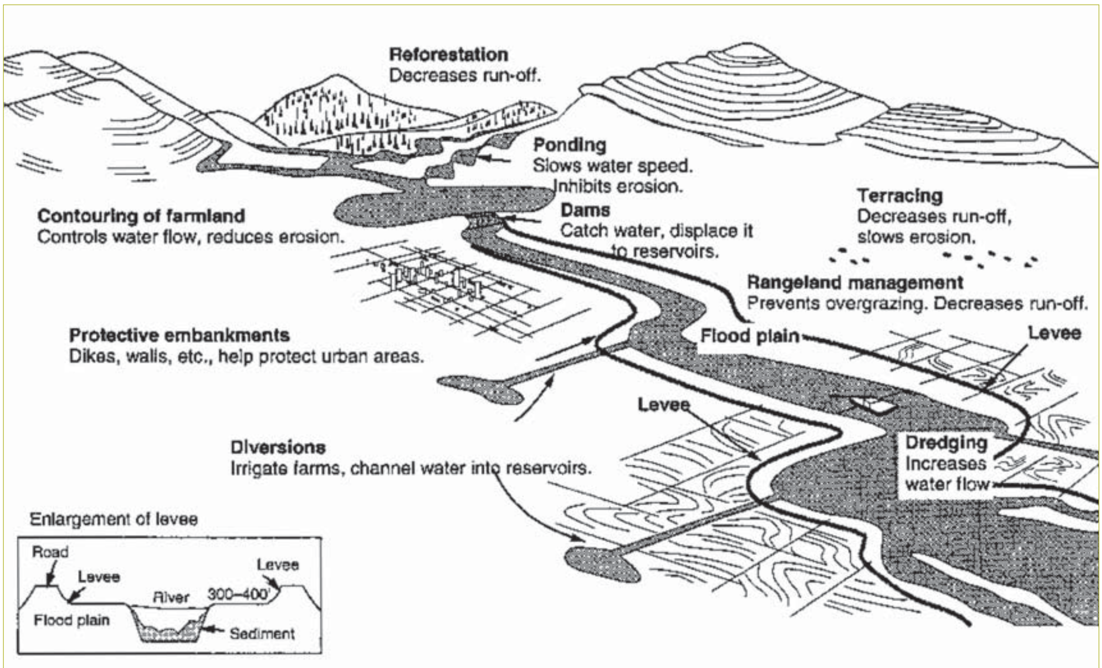
Concepts of Structural Interventions

The emphasis of structural interventions is placed on flood risk management instead of flood prevention as the flood hazard can never be totally eliminated. The focus is on controlling the floodwaters and reducing the risks associated with the structures.

The methods available differ in cost, materials, level of engineering required and suitability to particular river systems and basins. All offer a degree of protection, but similarly have their drawbacks.

Common flood control structures can be classified as those that:
- Reduce flood peak by providing storage.
- Confine the flow within a predetermined area.
- Increase the flow velocity to reduce peak stage.
- Divert flood waters to another area.
- Improve discharge through external means such as pumping.
- Are appropriate for use by communities.

Figure 6.1
Flood plain management



UDMT, 1997

As well as simply controlling floodwaters, other important related functions can include the regulation of streamflow. Human settlements and activities in the watershed as described in Chapter 5, have changed the natural runoff and streamflow resulting in the reduction of the flow of water. Some structures such as regulated dams can be used to reproduce a natural style flow. It must be noted however, that structural interventions can be the cause of the river changes in the first place.

see Chapter 5

As illustrated by Case Study 6.1 and 6.3, there are many risks associated with structural interventions which are often overlooked. These need to be placed as essential factors for consideration when planning for structural interventions.

see Case Study 6.1 & 6.3

Case Study 6.1

Mozambique Floods

Background

Many major rivers in Southern Africa meet in Mozambique, the largest of which is the Zambezi, which has a river basin of 1,200,000 square kilometres (km^2). Situated in the upstream area of the Zambezi river are two dams, the Kariba in Zimbabwe and Cahora Basso in Mozambique. These are multi-purpose dams servicing several neighbouring countries.

Map provided by ReliefWeb
http://www.reliefweb.int/
Source: USAID/OFDA

Downstream effects:

Prior to construction of the dams, flooding occurred naturally in the Mozambique river basins depositing rich alluvial materials and emptying into the Indian Ocean. However, since the dams were built, the natural occurrence of flooding has been reduced, and sometimes non-existent. Flooding needs to be simulated through the release of the dam gates. Over 25 years, reduced flooding has, dramatically changed the eco-system in the area.

People in the river basin had become accustomed to reduced flooding after the dam construction. This contributed to a reduction in awareness of potential risks. In early 2001, heavy rains in Zambia deposited huge volumes of water into the Zambezi River, causing it to overflow. As the Kariba Dam reached capacity, the dam gates were released. This contributed to the filling of the downstream Cahora Basso Dam. The gates of the Cahora Basso were also released, causing flooding to populated areas downstream.

Dam issues

There are many issues surrounding the construction of dams globally. In this case:

- The disruption to the natural flow of the River caused dire changes to the eco-systems, social structures and economic systems downstream.
- The capacity of the Kariba Dam was revised from 68km^2 to 74km^2 to 91km^2 due to the increasing annual flood levels during construction. There will be a point when the dam will not be able to store the flood waters.
- Lack of data collection and dissemination regarding monitoring of sources of water flow, precipitation, coordination of gate release times and volumes contributed to excess flooding downstream.
- There was lack of clear communication mechanisms between the two dams housed in different countries, bodies responsible for releasing water, and warning the people downstream. There is still no flood warning system in place for the Zambezi River.
- There was lack of awareness of the potential of severe flooding of people living in the river basin.

Careful dam management and vigilant floodplain monitoring and intervention are essential for flood management.

(Sources: Alvaro, 2000; UNRCO, 2001; and WCD, 2000)

There are many risks associated with structural interventions which are often overlooked. They need to be placed as essential factors for consideration when planning for structural interventions.

see Case Study 6.2

Flood Storage Reservoirs

As mentioned previously, many flood control structures are part of multipurpose projects. This is the case especially with reservoirs to justify their cost and scale. As well as providing floodwater storage capacity, functions can include hydroelectric power generation, irrigation, public water supply and recreational activities, which adds value to the project and contributes to cost-effectiveness.

Reservoirs (including those that are unregulated) control floods by detaining and storing a portion of floodwater, thus reducing the destructive flood peak. Dams hold back a portion of the floodwater as the wave passes through the reservoir during the peak discharge. Temporary storage for a given amount of water is dependent on the capacity of the reservoir. Some types of dams, such as check

Case Study 6.2

Pakistan Kalabagh Dam

To date, the proposed Kalabagh Dam is still attracting considerable debate and opposition from people living in the Indus River Region. The dam site is located in the Punjab province and aims to provide electricity to people in the surrounding area. The US$ 42 billion dam is projected to generate 3600 mega watts of electricity.

Arguments for the Dam

- Collects and holds surplus water during flood times and reduces the incidence of flooding.
- Provides much needed water for irrigation of agricultural and grazing areas.
- Hydropower will provide electricity for both domestic and commercial uses, and reduce the country's dependence on finite fossil fuels.
- Create employment during construction and upkeep of the dam.
- Provides additional storage of water to meet water shortage needs from April to June.

Arguments against the Dam

- Land acquisition will displace approximately 78,000 of the 120,000 people living in the area. There will be a scheme executed under the Land Acquisition Act that will compensate people for the cost of their land, but this might be difficult to monitor.
- Fertile and arable land in the riparian areas will be inundated.
- Historical and archaeological sites will be submerged and lost (Makhad).
- Sea water intrusion in the Indus estuary will be accentuated.
- Mangrove forests are potentially under threat.
- Fish production and drinking water supply may be affected.
- People dependent on the Indus River for their livelihood security may be affected.
- Reduction of water flow downstream.

(Sources: Pakistan Water Gateway and Islamic Republic of Pakistan Official Websites)

Hat Yai, Thailand: reservoir (right. *wet season,* left. *dry season)*

dams (sabo dams) control the discharge of debris and sediments, allowing water to be released and solid particles be retained behind the dam. This prevents erosion and sediment deposition further downstream. However, this can disrupt natural processes resulting in a changed environment.

An effective flood mitigation is obtained from an adequately sized reservoir located immediately upstream from the area (or reach) to be protected. The more effective reservoirs for flood control are located in a broad floodplain where a very long dam would be necessary, however a large area of valuable agricultural land would have to be flooded. Here the reservoir would 'catch' most of the run-off water that would cause flooding to the nearby area. Sites further upstream require smaller dams and less valuable land, but they are less effective in reducing flood peaks. The loss in effectiveness results from the lack of control over the local inflow of run-off between the reservoir and the area to be protected. Economic analysis often favours the upstream site despite its lesser effectiveness.

see Case Study 6.1

A significant, although largely quantitative criterion for evaluating a flood control reservoir or a system of reservoirs is the percentage of the total drainage area controlled by the reservoirs. In general, at least one third of the total drainage area should be controlled through a storage reservoir for effective flood reduction (ADPC, 2001).

At community level, several small reservoirs are often preferred to a single large reservoir. Communities adopt them based on the areas they need to service and for other uses such as irrigation and rainwater harvesting.

Flood detention and retardation basins work in a similar way to reservoirs. They provide temporary or long-term storage for excess floodwaters causing a reduction in downstream discharges. Diversion methods are often required to channel the flow from the main river to the basin area. They require different levels of engineering depending on topography, location and capacity.

see Chapter 5

Limitations

Cost: Large reservoirs involve heavy construction and high capital costs. Funding for such large projects often comes from loans from international donors. This can lead to significant national debt. Donor countries may fund the project, but this has the potential to lead to loss of control over the workings of the reservoir and priorities may differ between stakeholders.

see Case Study 5.4

Level of Protection: A single reservoir cannot give equal protection to number of areas located at differing distances downstream. Overtopping may occur where floodwaters exceed reservoir capacity, or water with momentum spills over the dam.

Social Impacts: Creating reservoirs requires extensive areas to be inundated. Populations in the inundation zone must be relocated, disrupting lives and livelihoods. This is one of the main reasons why dams and reservoirs face opposition. Relocating people increases their vulnerability.

Maintenance: Large storage reservoirs will accumulate debris and sediment requiring maintenance to de-silt it in order to maintain storage capacity. High costs are involved in such routine maintenance and difficulties in removing accumulated sediment have created problems.

Capacity: Reservoirs can only be effective when they have adequate storage capacity at all times. A flood mitigation reservoir has maximum potential for flood reduction when it is empty. After a flood has occurred, storage is occupied by the collected floodwaters, which must either be released for continuing effectiveness or the reservoir should have enough capacity to hold water from a second storm or flow. A large catchment may produce a flood over which the reservoir would have little or no control.

Multipurpose Projects: Reservoir operators may be reluctant to release water in advance when the main purpose of the storage is other than flood control. This is one of the disadvantages of multi-purpose projects. Often in such situations a large quantity of water is released from the reservoirs within a short period causing flash flooding downstream. Therefore, having a storage reservoir in the upstream area does not offer a permanent solution to the flood problem downstream and may even aggravate it.

see Case Study 6.3

Confinement of Flow by Dykes, Levees and Embankments

The method of protecting an entire area by building a dyke is a traditional method applied by communities of flood-prone countries such as Vietnam and Bangladesh. It has been in use for thousands of years and is still being applied.

see Case Study 6.1 & 6.4

Embankments, dykes, levees and floodwalls are all designed to protect areas from flooding by confining the water to a channel, thus protecting the areas immediately behind them. They increase the flood level in the confined area up to their height and so increase the discharge of the water.

Embankments can be multipurpose as they not only confine floodwaters, but also provide transportation routes. Roads are often built along the top. However, they require regular maintenance as the weight of the traffic can compress the embankment, eventually reducing the height. Embankments specifically as roads can act as flood barriers when they are not intended to. This can cause the backing up of floodwaters behind them. Culverts need to be built into them to allow the free flow of water where necessary.

Building dykes is one of the most economical means of flood control. Dykes built by communities traditionally involve low technology and traditional knowledge. Usually material used is from the local area and excavated from pits located not far from the structure. Cross-sections (in relation to the height of the structure and angle of the sides) are adjusted to suit the material and also the location. Most dykes are homogeneous earthen embankments constructed through placement and compaction of layers of material to achieve a high degree of stability and strength. Controlling discharge through the embankment itself or seepage through the foundation is very essential to achieve high efficiency of such structures.

Traditional practice was to have a system of dykes built to protect villages or farmland from floodwaters. They are normally built according to the highest known flood level. The common practice was to evaluate the performance after every flood and take remedial measures if needed to protect the area from subsequent flooding.

left. *Embankment,* right. *Stabilised embankment and culvert to prevent gullying*

Case Study 6.3

Flood Control and Restoration of Former Flood Plains in the Upper Rhine

Structural measures that took place to control floods from the River Rhine, Germany, during the past 150 years did not totally help in protecting people and infrastructure. When a flood event with a return period of 200 years occurred, considerable damage was caused by the submersion of the areas behind the dykes. This case study demonstrates the negative impacts of engineering structures and the solutions that can be applied.

Over a course of 150 years the following events took place:
- The natural, wild river Rhine posed a threat to nearby settlements. The numerous branches of the river were changing course constantly and stretched over a vast floodplain area.
- Engineering works combined the branches of the river and cut off the meanders. The floodplain area was greatly reduced.
- Further engineering works included the construction of stone heaps, groins, dykes and barrages.

By the construction of ten barrages, the risk of downstream flooding was increased due to the loss of floodplains and also because the flood wave was meeting with those of the Rhine's tributaries.

The loss of floodplains meant that natural habitats for rare animals and ecosystems were disrupted. Ninety-five towns and inhabitants were in danger from flooding on the Upper Rhine.

Major floods in 1988 saw the need for a new approach to managing the river. The Integrated Rhine Programme was adopted for flood control and restoration of the former floodplains on the upper Rhine, which include retention by way of polders, dyke relocations and weirs. Dyke relocation enables the river Rhine to freely flood former floodplains in the event of severe discharges. Previous wetland areas of the river Rhine basin are reconverted into marshy lands. In order to maintain smooth unhindered flow of water, the dead arms of the Rhine will be reconnected to the Rhine. By implementing the integrated Rhine programme, it is expected to restore lost habitats of flora and fauna in the region.

(Source: Integrated Rhine Programme, 1997)

Limitations

Height: These structures only protect from inundation up to their height. There is always a significant possibility of a flood occurring that is much greater than previously experienced. Therefore, the embankments should be built according to a greater design flood. It must be taken into account that sedimentation in the river channel can mean that the flood level will be higher than expected.

Space: Embankments take up a lot of space as the width depends on the height. Higher, safer embankments must be extremely wide in order for their slopes to be stable.

see Case Study 6.5

False Safety: Dykes are never built to provide protection from the possible maximum flood. The unwarranted feeling of safety is the greatest danger connected with the construction of dykes or embankments because it actually increases the potential of flood hazard becoming a disaster. Failure of a dyke can release water rapidly thus reducing the evacuation and preparedness time. It is essential to maintain dykes and have an early warning system in place to provide advance notice of a potential failure.

Erosion: Structures that are built of earth are highly susceptible to erosion. Erosion on the wet side of the structure can lead to siltation of the channel and reduce water conveyance. Erosion on the dry side of the structure can lead to slope instability and failure. It can also reduce the height of the structure making it less effective. Slopes can be stabilised by various methods, including turfing by planting vegetation.

Catkin grass used to stabilise slopes in Bangladesh

Settlement: Embankments are often used to protect human settlements on the floodplain. Squatters often occupy the embankments, building large slum settlements such as in Bangladesh (Rahman and Tariquazzaman, 2001). They are attractive because they provide spacious, often, free land. The settlements on the side of the embankment located behind the river erode the slopes and are also highly vulnerable as they are immediately adjacent to the river. People living behind the embankment tend to have the misleading perception that it provides total flood protection.

Case Study 6.4

Bangladesh Embankments

Flood control measures in Bangladesh are mainly limited to building earthen embankments, polders and drainage. The lack of good building material and strong ground surface, as well as the flat topography of the country, make these the best structural options. A total of 5,695 km of embankments, including 3,433 km in the coastal areas, 1,695 flood control / regulating structures, and 4,310 km of drainage canals have been constructed by the Bangladesh Water Development Board during the last several decades. Embankments and polders have reduced floodplain storage capacity during floods, leading to increased water levels and discharges in many rivers. Earthen embankments can easily breach and can be damaged by riverbank erosion. Most of the embankments in Bangladesh have experienced breaching and erosion more than once since their completion. Breaching of the Gumti embankment at Etbarpur during the 1999 flood caused substantial damage to the environment and property. Embankments have created a false sense of security among residents living within embanked areas.

(Source: Khalequzzaman, 1999)

Channel Improvements

Rivers and natural streams have been subjected to changes over a long period. Development and urbanisation have led to various infrastructure projects that affect rivers and streamflow. Infrastructure, such as bridges and piers, create obstructions to streamflow and reduce the flow velocity, which can cause flooding upstream. Bridges can also create bottlenecks and cause the ‘backing up’ of water. Significant improvements in river flow conveyance and discharge at a specific point on a stream can often be achieved by merely improving the hydraulic capacity of the channel or stream. The different forms of channel improvement are:

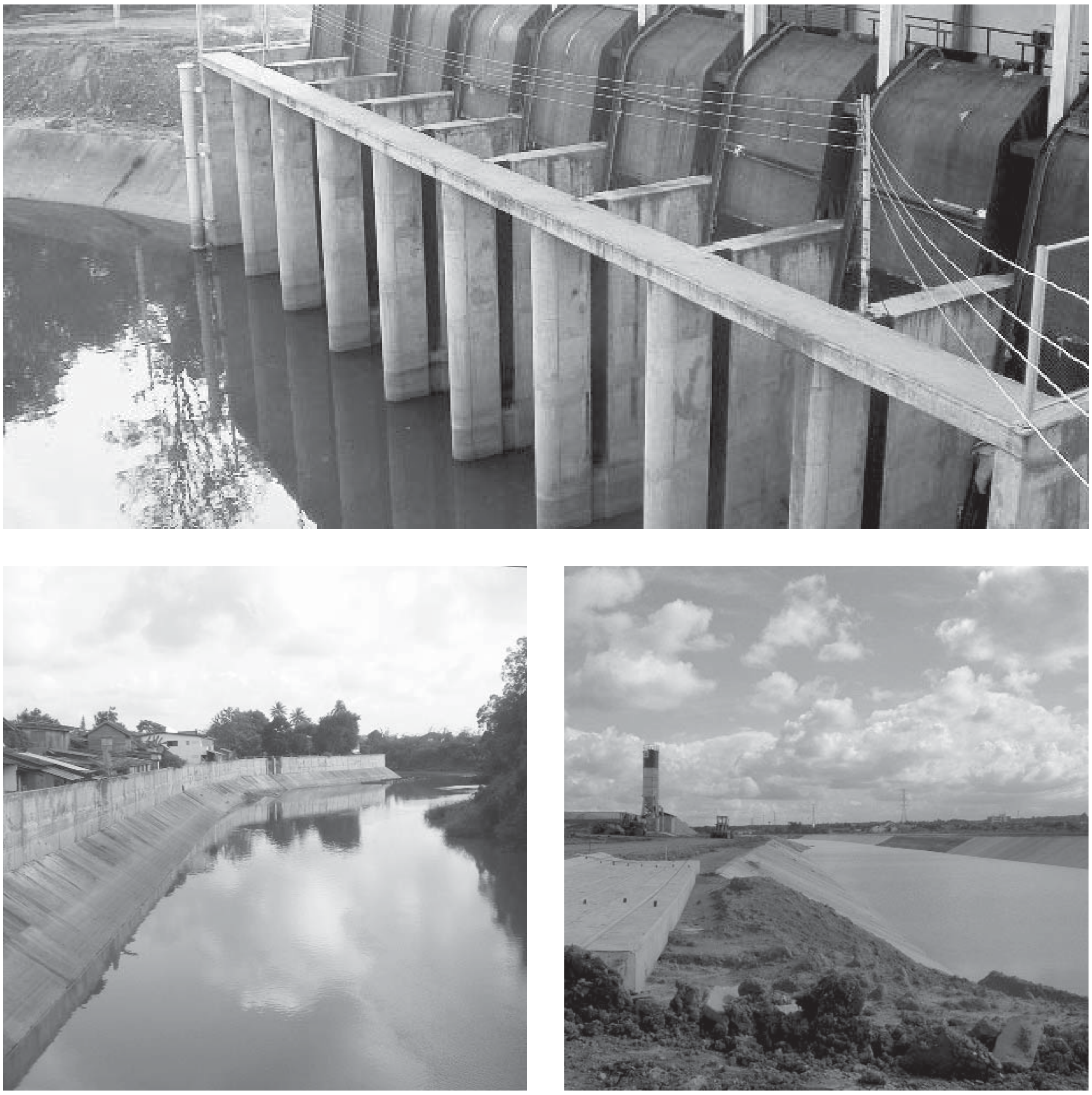
- Widening and deepening the channel.
- Removing of debris and vegetation restricting the flow.
- Straightening the channel.
- Removing or altering obstructions.
- Deepening (dredging) the channel.
- Lining the channel.
- Widening the channel mouths.
- Raising and/or widening of bridges, culverts and barriers that prevent free flow.

Limitations

Straightening the channel and cutting off the meander increases the slope of water surface, thus increasing the velocity of the water, and reducing the flood stages. The increased velocities may have the undesirable effect of producing uncontrolled erosion, thereby developing new meanders and consequently bringing about severe damage to riparian land, adjacent roads and property.

Straightening of a meandering alluvial river may not be specially successful unless the channel is lined or the banks reinforced. Without protection against bank erosion, the stream will probably begin to meander again (ADPC, 2001).

Dredging the channel will only decrease the flood height as much as the channel is deepened. It may be most effective at particular points such as bridges. Dredging must be an ongoing intervention because silt and sediment will continue to settle as deposition is an ongoing natural process.



top. *Sluice gate,* bottom left. *Floodwall,* bottom right. *Building bypass channel*

Bypass Channels and Floodways

Excess floodwaters can be controlled by using bypass systems such as tunnels or open channels which divert water elsewhere. This intervention can be multipurpose to provide water for irrigation and industry. Diversion systems serve two functions in flood mitigation:

- They provide storage through large, shallow reservoirs, which decreases the flow in the main channel below the diversion.
- They provide an additional outlet for water discharge from upstream.

Methods of Diversion

- Spillway allows the water to naturally flow over into a channel when it reaches the height of the spillway.
- Sluice gates in control structures.
- Purposely breaching a dyke to divert water in an emergency. This is generally used to protect critical areas from inundation.

This method of flood diversion can be very effective and inexpensive when planned in advance and appropriate measures are taken. The diversion channel should be:

- Free from human settlement.
- Bordered by secondary dykes to confine the floodwaters.
- Have reasonably effective drainage facilities.

Limitations

- Construction of floodways are limited by topography.
- Diversion channels are only used during major floods so the land can be used for agriculture during non-flood times. In urban areas where land is scarce, this may not be a viable option because the land cannot be developed.
- Squatters may also occupy the land which exposes them to great danger when the diversion channel is in use.

People living behind the floodwall are vulnerable as these structures only protect up to a particular flood level.

Discharging Drainage Water by Pumping

Water due to run-off or breaches in structures can accumulate in areas where there is inadequate drainage capacity. This water can be removed by pumping. Pumping is not an effective solution by itself. Considerations and improvements need to be made to the drainage system so there is optimum use of storage areas, channels, pipe systems and gravity outlets (ADPC, 2001). This reduces the amount of water that needs to be pumped and therefore minimising pump capacity, size and period of operation required. The planning and design of efficient pumping plants should be based on:

- Determining the required rate of water removal.
- Existing drainage facilities.
- Location to ensure a suitable outlet area for the water.

The pump systems should be designed based on the following parameters:
- Size of area served.
- Maximum amount of water (run-off) expected in the area.
- Timing of run-off.
- Location of accumulated water.
- Pump type (consider the head and discharge required).
- Pump arrangement (parallel and series for water height and volume).
- Pump cost and efficiency.
- Pump maintenance and running parts.
- Electricity or generator to power the pump.

There should be two or more pumps to cope with the varying amounts of water and also to provide back-up in the case one pump breaks down.

Limitations

- Pumps rely on electricity or generators which have the potential to fail during floods. There needs to be a system and contingency plan to ensure that pumps are always in operation when required.
- Pumps have working parts that are susceptible to failure and clogging. Repair and maintenance are essential, as well as keeping supplies of running parts available.

Infrastructure for Community Flood Protection

Structural interventions can also be implemented at community level. Historical evidence shows the use of ingenious methods of flood control that are being applied throughout Asia. These methods vary according to cultural practices as well as the flood environment. Some examples are listed below:
- Polders.
- Embankments along tributaries which are subjected to flash flooding and backwater effect of the main stream.
- Minor drainage works.
- Irrigation canals diverting water to agricultural land.
- Culverts.
- Floodways.
- Submersible embankments in deeply flooded wetlands, designed to protect winter paddy from early floods and then to be overtopped by floodwaters.
- Coastal folders protecting against tidal flooding and saline water intrusion.
- Houses, villages and roads built on raised land or embankments.
- House design adapted to flooding.

see Chapter 7

- Raised walkways on stilts or supported by trees.
- Folders enclosing houses, fields, food supplies or animal fodder.

(Adapted from Thompson and Sultana, 2000)

Community level structural interventions can also be multipurpose, serving as transportation, transition and evacuation routes, storage, stay points for farm animals during floods as well as normal time and camping sites during evacuation.

Communities have the resource capacity to implement these structural interventions through the support of local government and NGOs, using local labour, community contributions, past experiences, traditional wisdom and know-how. There are also community-based micro credit schemes to assist with the implementation of these minor structural works.

see Chapter 11

top left. *Walkway,* top right. *Road raising,* bottom left. *Minor drainage works,* bottomright. *Complete drainage*

Limitations

see Chapter 8

- Community structures are usually well-adapted to normal flooding events and they have a tolerance for flooding up to a certain magnitude. However, they are extremely vulnerable to larger than normal floods. Communities can be assisted by including them in flood early warning systems and helping them to develop their strategies for coping with larger floods.

Environmental and Social Concerns

Many types of flood control interventions such as large-scale dams and embankments have been criticised for introducing greater problems. Although they can have short-term benefits, they tend to cause major environmental and social problems over the long-term. The use of large-scale interventions is controversial as their impact on sustainable development is questionable.

- *Resettlement issues*. Placement of human and animal habitats due to construction of large storage reservoirs is the most common impact of structural flood mitigation measures. It disrupts natural cycles and can result in loss of livelihood, unemployment and increased vulnerability.
- *False sense of security*. People living in settlements protected by structural interventions can develop a false sense of security. It is necessary to assess the risks and keep the community informed of potential disaster. The residual risk (remaining risk of flooding) must be also addressed through other methods such as awareness and preparedness so there is an understanding of the limitations of the structure.
- *Loss of natural and environmental value.* Flood control projects are often criticised for their adverse environmental impacts, including loss of biodiversity, disruption to eco-systems, depletion of natural resources and changing natural processes.
- *Lack of discussion with local communities.* It is the community who are most knowledgeable about the environment in which they live. When deciding and planning for structural interventions, the community must be consulted, and encouraged to participate in decision-making. Stakeholder participation is an integral part of all stages of the project.
- *Transboundary issues*. Some of the structural interventions needed to mitigate floods have cross-border implications. They may result in conflicts among countries sharing a watershed. The transboundary issue highlights the need for decision-making processes that go beyond the borders of individual countries.
- *Human resilience:* Relying solely on infrastructure does not promote resilience in the community. People may become dependent on flood control structures for protection and take no further action to improve the resilience of their households and families to flooding.

Risk Minimisation

People have a tendency to move to areas ‘protected’ by structural interventions as the assumption is made that it is now safe for development. It is necessary to consider that high income-generating enterprises will be attracted to the floodplain following the implementation of structural measures, moreover increasing the expected value of flood losses.

Population pressures and increasing severity of floods due to natural and man-made factors have significantly increased the damage risk. These wide-ranging issues often perceived as unassociated with flood disasters must be addressed.

The adoption of structural measures alone can lead to sub-optimal development of the floodplain. The need to regulate floodplain development is imperative. Regulations may be achieved through non-structural measures such as land use planning and awareness. This is demonstrated in Case Study 6.5

see Chapter 5

Case Study 6.5

Appropriate Mitigation Mix, Hat Yai, Thailand

The devastating flood of November 2000 brought to public attention the need to minimise future social and economic losses. An integrated network of bypass channels, drainage systems, floodwalls, water-pump stations and retention ponds were constructed to manage large volumes of water. ADPC targeted government officials to participate in capacity building training to motivate the development of building codes, environmental management, early warning systems, land-use planning and zonation, legislation and policy. The case of Hat Yai highlights the gradual shift from response and relief to an integrated flood risk management approach. It also highlights that structural interventions alone are not sustainable enough to reduce flood risks.

(Source: ADPC, 2005)

Although, in general, a shift in paradigm from "structural flood control" to "non-structural flood management" is being noticed in Asia, it is unavoidable that many flood control structures will be constructed in the future. Hence, attention should be focused on minimising risks of structural failures and keeping the public informed of the consequences. Refer to Case Study 6.6.

> *The overriding objective should be a reduced vulnerability of society, and a reduced risk of flood disasters caused by structural failure or inappropriate interventions.*

Case Study 6.6

Flood Control: Does it Work?

Analysis carried out in Bangladesh comparing the benefits of flood mitigation structures against losses shows interesting lessons to be taken up by the flood risk management community. Structural control can be effective if it is part of an integrated flood risk management approach.

Assessment of the Effectiveness of Structural Flood Control in Bangladesh

"Reports quoting statistics of June 1990 of Bangladesh Water Development Board (BWDB), lists the completion of 437 projects comprising of 7,550 km of embankments and about 7900 hydraulic structures. In total 3.37 million ha of land was reported to have benefited from flood protection (23% of Bangladesh). Despite such flood protection projects, over 39% of the country had been flooded. A total of 1,279 km of flood control embankments were damaged and total losses were estimated at US$ 0.5 Billion (WB, 1989). In 1988, a 1 in 100 year flood inundated 42-57% of the country, 1,990 km of embankment was damaged and total losses including infrastructure and crop damage were estimated to be US$ 1.3 Billion (WB, 1989)."

(Extracted from Thompson and Sultana, 2000)

Process

The process for determining the most appropriate structural interventions requires stringent research, assessment and analysis, involving a multi-disciplinary team, and a participatory stakeholder approach. This process is only one part of the overall flood management plan or strategy, therefore, the impacts of the structural intervention needs to be extensively investigated, and consensus met through multi-stakeholder participation.

Decisions need to strike a balance between the costs and benefits of the proposed structure. Before reaching this decision, feasibility studies need to be conducted to focus on the nature of the area, (eg. physical geography, hydrology, geomorphology, weather patterns, climate, human activities, human settlement, etc.). Some structural interventions serving multiple purposes, can be spurred by demands for water and electricity.

- Analysis needs to address links between people, the environment, their activities (economic and consumption) and floods to fully understand the impact of structural interventions.

- Large structural interventions are costly and lengthy operations. They generally require financial and technical assistance from multiple donor agencies, institutions, and neighbouring countries. It is essential to directly involve all the potentially impacted surrounding countries in the process from the initial research study to the implementation and future management of the structure.

Planning concerns

- All structural interventions should be considered as items in an overall plan for flood management. They should be planned and implemented so that their benefits should not offset increased damages elsewhere. Inappropriate placement of flood control structures can exacerbate flooding problems.
- Costs to protect existing vulnerable infrastructure are far less than those related to damages and losses due to flooding.
- Structural measures do not provide complete protection. Long-term climate change factors or activities in the watershed may increase the magnitude of flooding. Probability of a larger flood exceeding their design characteristics needs to be taken into consideration.
- The planning and design of structural measures is a lengthy and complex process.
- Costs associated with their construction, operation and maintenance can be extremely high.

Step 1. Feasibility study

see Chapters 3 & 5

Conduct comprehensive feasibility studies including:

- Ensure structural interventions are planned in conjunction with an integrated flood management approach.
- Consider the potential impacts of the structural interventions on neighbouring countries and provinces (those sharing the watershed).
- Determine budget for the implementation and maintenance of the structure. Budgets need to be carefully broken down to account for all processes and activities.
- Budgets must be allocated to extensive risk assessments (Steps 2 & 3).

Step 2. Risk assessment

- Hazard and vulnerability assessments.
- Compilation of inventory of existing and planned flood related infrastructure such as reservoirs, embankments, waterways, etc.
- Reviews of the national practices for planning, for example, the inclusion of impact assessment (EIA and SIA) and monitoring of structural interventions.
- Hydrological and environmental impact assessment: to study the impact both upstream and downstream including discharge rates, modifications of flood peaks and volumes, cumulative effects of erosion and sedimentation.
- Social Impact Assessment (SIA) to investigate the potential changes and the environmental impacts on socio-economic activities, such as fishing, agriculture and industry.

Step 3. Assessing the risk of structural failure

Conduct comprehensive risk assessments and analysis:

- Conduct failure analysis for potential structures, for example dam break analysis for dams.
- Simulate different scenarios using GIS modeling.
- Simulate past flooding events if the relevant data is available.
- Map potential damages for normal floods and worst possible scenarios. Keep information updated in a database for future review.
- Make information available and accessible to stakeholders.

Step 4. Recommendations for structural flood control initiatives

Using the information from the feasibility studies, assessments and analysis:

- Analyse types of structures suitable for flood mitigation in different areas.
- Recommend options of structure(s), remembering that there may be a sequence or range of various structure types that work best for different scenarios.
- Obtain legal permission and consensus among key stakeholders.
- Provide a public platform for dialogue and discussion.
- Ensure mechanisms for conflict resolution.

Step 5. Capacity building for the management of structural flood control

- Conduct needs assessment at various levels to identify gaps in required competencies to carry out initiatives. For example, training in disaster risk management concepts, legal processes and financial management.
- Conduct capacity building programmes for the management of structural interventions, impact assessment and impact monitoring of structural interventions.
- Develop guidelines for communications between all involved in the management and operation of the structure(s).
- Obtain feedback for continuous improvement of training efforts.

Step 6. Recommendations on operating rules of flood control structures

- Identify gaps in technical expertise available. It may be necessary to contract technical advisors to assist in training local staff. For example, structure specific maintenance and repair.
- Prepare guidelines for operating rules and regulations of flood control structures.
- Provide training according to operating rules and regulations. Promote the use of guidelines, activities and operating functions, such as monitoring of peak-flows, capacity volume, mechanical operations including operation of dam gates and release times, spill ways, water pumps (eg. water release, hydro electric power supply).
- Develop protocol for communication between management, operations, early warning systems and preparedness planning.
- Set standards of operation including upgrading, regular maintenance and service, and repairs.
- Practice simulations for structural failure.

Step 7. Public awareness and risk communication

- Schedule periodic meetings before flood season to discuss the issues with key stakeholder groups. For example, involve policy makers, operations managers, technical advisors, social scientists, economists, fisheries, agricultural extension workers, health and sanitation, utilities, etc.
- Raise awareness on threshold limits of structures, operation and warning procedures (using radio, TV, volunteer networks, etc.). Ensure people are aware that there are still risks and they should never become complacent to the prospect of flooding in the future.
- Erect level gauges, reference markers of flood levels, early warning communications systems and conduct public awareness campaigns to ensure that people are conscious of these warning signs during flood times.
- Create awareness of emergency evacuation plans in case of structural failure or excessive release of water from structures.

see Chapter 8

Checklist

☑ Have you carried out a cost benefit analysis?

☑ Does the project consider an integrated flood management approach, for example, the impact on all activities in the watershed?

☑ Have you adequately researched and considered all the options available?

☑ Have you carried out an environmental impact assessment that considers the immediate, long-term and compounded impacts of implementing structural measures?

☑ Have you considered the impact of other natural hazards on the structure, such as earthquakes and landslides?

☑ Have you made assessments on the social, economic and political impacts, both immediate and long-term?

☑ Have you included all stakeholders in planning and therefore have taken into consideration the views presented and various likely impacts?

☑ Have you considered the funds required for maintenance? How will they be generated?

☑ Have you considered the project in terms of its implications for disaster preparedness and response? Are special requirements in place to deal with warning of, or actual structural failure?

☑ Have you considered the effect in other areas out of your jurisdiction and written responsibility?

☑ Have you consulted surrounding regions and countries that will be impacted?

Future Challenges

- *Ensure maximum safety in the design and use of structural flood control methods.* They should be used only in conjunction with non-structural measures such as land-use planning, zonation, watershed management and disaster preparedness. Integrated flood management requires consultation of all stakeholders.

- *Structural measures must prioritise maximum public welfare and safety.* Social implications should not be sidelined for the sake of economic gains for constructing large-scale structural intervention. They should be based on socio-economic considerations together with risk assessment results. Rational thinking for mitigation action planning must be based on risk reduction principles and aim for high safety standards.

- *Minimise the risk of structural failure.* Flood control structures and risk management professionals will have to focus more attention on reducing the risk of structural failure. This can be done by improving design codes and criteria, good management practices, effective communication mechanisms, stringent operational guidelines and strict maintenance regimes.

- *Maintenance procedures have to be adopted and vigorously followed to ensure safety.* This is an important future challenge as many structures fail due to lack of repair and maintenance. Functional capacity is reduced over time and performance should be monitored and evaluated. Financial institutions and donors need to be more forthcoming with providing funding for repair and maintenance. Regular maintenance and structural assessments by external bodies can also be written into agreements or be made terms of loans.

- *Minimise the impact of structural failure.* Disaster preparedness is essential in reducing losses and damages. Structures do not provide total flood protection and a culture of safety must be upheld. Funding for disaster preparedness must be allocated as part of project budgeting.

- *Addressing transboundary issues.* Effort should be made to reduce the negative effects on downstream and upstream settlements. Transboundary agreements or neutral mediation may be required to address these issues. There needs to be a mechanism for information sharing, open dialogue, ensuring transparency and accountability within the watershed.

Resources

General

Modalities for Environmental Assessment: Flood Loss Reduction in Bangladesh
Covers the following topics:

- Environment and Assessment of Flood Impacts.
- Flood Loss Reduction and Review of Past Experiences.
- Includes Structural Measures and Flood Control Projects.
- Integration of Environmental Concerns into Decision-making.

Accessible online at: *http://www.unescap.org/drpad/publication/integra/modalities/bangladesh/*

UNESCAP (2003) *Guidelines on Participatory Planning and Management for Flood Mitigation and Preparedness.* New York, UN.

English Nature (2003) *Wetlands, Land-use Change and Flood Management.* UK, Environment Agency, DEFRA.
www.defra.gov.uk/environ/fod/policy/wetlands/wetlands3.pdf
Accessed February 2005

Community-based initiatives

ADPC
Asian Urban Disaster Mitigation Programme, Safer Cities Series:
  Safer Cities 2 (2002) *Coping with Flood in Cambodian Communities*
  Safer Cities 3 (2002) *Mitigation of Flood Risk in Cambodian Communities*
  Safer Cities 7 (2004) *Can Small be Beautiful?*
Hard Copies are available on request or can be accessed at *www.adpc.net*

Transboundary conflict resolution

UNESCAP (2003) *Guidelines on Participatory Planning and Management for Flood Mitigation and Preparedness.* Water Resources Series No. 82. New York, UN.

References

ADPC (2001) *Urban Flood Management Regional Course*. Bangkok, ADPC.

ADPC (2005) Safer Cities 13 *What is the Appropriate Mitigation Mix?* Bangkok, AUDMP, ADPC.

Carmo Vas, A. (2000) *Coping with Floods - The Experience of Mozambique*. 1st WARFSA/WaterNet Symposium of Water Resources, Maputo, Mozambique.

Islamic Republic of Pakistan Official Website *http://www.infopak.gov.pk/public/Kalabagh_Dam.htm*
Accessed March 2005

Integrated Rhine Programme (1997) *Flood Control and Restoration of Former Flood Plains in the Upper Rhine*. Lahr, Germany.

Khalequzzaman (1999) *Flood Control in Bangladesh through Best Management Practices*. Department of Geology & Physics.
http://www.eb2000.org/short_note_17.htm
Accessed March 2005

MRC (2001) *MRC Strategy on Flood Management and Mitigation in the Lower Mekong Basin.* Draft, Phnom Penh, MRC.

MRC (2002) *Flood Management and Mitigation Programme*. Phnom Penh, MRC.

Pakistan Water Gateway
http://www.waterinfo.net.pk/fskbd.htm
Accessed March 2005

Rahman and Tariquzzaman (2001) *Squatter Settlements on the Flood Protection Embankment in Dhaka City*. World Planning Schools Congress. July, Shanghai.
http://www.commonwealth-planners.org/papers/ssdc.pdf
Accessed February 2005

Thompson, P.M. and Sultana P. (2000) *Shortcomings of Flood Embankment Strategies in Bangladesh.* Floods (vol. 1). Ed. Parker, D.J. London, Routledge.

UDMT (1997) *Introduction to Hazards.* Third edition.
http://www.undmtp.org/english/hazards/hazards.pdf
Accessed March 2005

UNESCO (2001) *Guidelines on Non-structural Measures in Urban Flood Management.* By Andjelkovic, I. IHP-V, Technical Documents in Hydrology No. 50, Paris, UNESCO.

UNRCO (2001) *Final Report Mozambique Floods*. Maputo, Mozambique, UNRCO.

USAID / OFDA.
http://www.reliefweb.int/
Accessed March 2005

WCD (2000) *Kariba Dam Zambia and Zimbabwe, Final Report 2000*. Prepared for the World Commission on Dams by Soils Incorporated (Pvt) Ltd, Harare, Zimbabwe in association with Chalo Environmental & Sustainable Development Consultants, Lusaka, Zambia.

7

coping with floods

This chapter must be based on Risk Assessment (Chapter 4), Land Zoning and Floodplain Management (Chapter 5). This chapter is useful for Recovery and Rehabilitation (Chapter 10).

Chapter Overview

- Flood-proofing has become a viable mitigation solution adapted by communities living with floods.
- There are different types of flood-proofing measures that can be applied to minimise flood losses suitable to different situations and contexts.
- Flood-proofing programmes should be community driven, but external agencies can provide support and expertise to mobilise them for the development of flood-proofing infrastructure.
- There is a general process surrounding the adoption of flood-proofing projects.
- There are some limitations and critical issues concerning flood-proofing.
- There are a number of challenges ahead for all stakeholders involved with flood-proofing.

Key Words

Flood-proofing
Adjustments or modifications made to structures and contents which are designed or adapted primarily to reduce flood damages (ADPC, 2001).

Relocation
Consists of a number of measures such as moving people and house contents to safe areas, or having a second place to live during times of flooding. Extreme measures can involve physically moving the house if it is so designed.

Elevation
Raising a building or the ground level so that the plinth (base floor) is higher than the high flood level.

Dry Flood-proofing
Ensuring water does not enter the building or specific area by making the walls, doors, windows and other openings of the building watertight.

Wet Flood-proofing
A design that allows floodwaters to freely enter the house, but minimises impact by reducing structural damage due to the force of the water. House contents can be stored on elevated levels or removed.

Overview

People have coped with floods for a long time and have adopted and adapted their livelihoods to suit flood conditions. Shelter is essential for protecting people from the elements, and provides security and a sense of belonging both to a family or extended unit. It is important to protect the home by employing flood-proofing methods that are reliable, cost-effective and suitable for the functioning of the dwelling for shelter and security. Although the term flood-proofing is commonly used, it raises some objection amongst contemporary disaster risk management circles, who argue that nothing can ever be completely proofed against floods. Rather, dwellings and shelters can be made resistant to floods to an acceptable level. For the purpose of this chapter, the term flood-proofing will be defined as:

> *Adjustments or modifications made to structures and contents which are designed or adapted primarily to reduce flood damages (ADPC, 2001).*

There are methods that can permanently or temporarily be applied to reduce the impact of flooding on a house or any building, giving a considerable degree of protection against losses and damages. The importance of housing in reducing vulnerability and flood risk can be summed up in a statement from Nguyen Thanh, director of VNRC's international department: "*You will find deeply entrenched the notion that without a safe haven, it is impossible to start up a successful life again*" *(IRFC, 2001)*. Many people lose their homes in floods and it becomes a cycle of increasing vulnerability.

Flood-proofing is viewed by communities living in flood-prone areas as a viable alternative solution to long-term, large-scale structural flood mitigation interventions. It provides an alternative when large-scale structural flood control methods cannot be applied, because of its significantly low capital investment, high cost efficiency and negligible ecological and environmental impacts. As it is not always possible and financially viable to entirely rebuild houses and structures to protect against and withstand floods, people were compelled to adopt mitigation measures to reduce flooding and damage to agricultural land, homesteads and living areas of animals.

In Asia most of the dwellings in rural and urban areas are owner-built and incorporate adaptations of various flood-proofing methods adopted by different communities in the region. They reflect traditional wisdom, cultural practices and indigenous technology applications. However, the influence of modern engineering technology and urban architecture, loss of natural resources, loss of traditional knowledge and skills, and population increase have caused some of the urban communities to reject traditional flood-proofing practices. Efforts are now being made to revive locally-based initiatives and reap the benefits of increased resilience through flood-proofed communities.

As with other structural interventions, flood-proofing can only be effective against floods up to a particular magnitude and must be used in conjunction with other measures such as early warning and preparedness. It should not be a replacement to land control or other non-structural methods, but is an option for homes already located in areas at risk. It must be part of integrated flood management.

This chapter describes various modifications that can be used to protect homes.

Concepts of Flood-proofing

Flood-proofing is the provision of long-term, non-structural or minor structural measures to mitigate the effects of floods. It is the use of permanent, contingent or emergency techniques to either prevent floodwater reaching buildings and infrastructure facilities, or to minimise the damage from waters that do enter. Flood-proofing would be an initial step in reducing vulnerability to flooding in unprotected floodplains. The flood-proofing measures which can be taken are:

- **Permanent measures** are ideal as it means that risk reduction has been incorporated into lifestyles. Structural adjustments such as elevation tend to be permanent. Concrete walls at base level can be coated with bituminous impervious material or waterproof paint in order to prevent seepage and damage. Automatic valves can be installed on sewer lines in such a manner it gets closed due to back-pressure.
- **Contingent measures** refer to those that are applied for the whole flood season when permanent measures are not cost-effective, together with sufficient flood warnings. In some communities, for example in Bangladesh, tube wells and toilet pits are raised above flood level before the flood season starts. Spare pipes and accessories are often held in stock in case they are needed.
- **Emergency measures** are undertaken when flood warnings have been issued. There may be little time to carry them out. They include the use of sand bags to construct temporary barriers against floodwater as well as evacuation of the house members to safety and temporary removal of household or other items to protect them from floodwater.

Flood-proofing of Dwellings and Homesteads

Flood-proofing also can provide homes with more space for living and to cultivate essential food items. This makes them more self-sufficient during the flood season when food may be scarce and prices are high. It is becoming more popular as a community-based risk management initiative advocated and implemented by many organisations. Communities can apply the same techniques for cluster housing schemes and with little external support. More flood-prone communities can be motivated to practice this method.

see case study 7.1

Another reason for the acceptance of this flood risk management option is the attachment of individuals or communities to a particular place. Even if the area is prone to damaging floods, people are often reluctant to relocate. It encourages them to undertake risk management actions such as flood-proofing to create safe living conditions. The experience in Asia shows that people do not wish to be resettled elsewhere even when a disaster brings heavy losses and damages to property. They mostly show interest to continue life in the same location perhaps for the following reasons: They own land or property, they are part of

Case Study 7.1

Building on Indigenous Practices

In Bangladesh, macro-scale flood mitigation measures such as embankment and polder construction have been implemented over the last few decades. However, they do not always address the impact of flood at the household level. In the Bangladesh Urban Disaster Mitigation Programme (BUDMP), implemented by CARE-Bangladesh in partnership with ADPC in the municipalities of Tongi and Gaibandha, indigenous coping strategies have been promoted. For example, earth has been used to raise the narrow unpaved roads and streets. Deep ditches also run alongside the most frequently used roads, such as ones leading to schools used as multi-purpose community and evacuation centres. Some homesteads have also been raised. The BUDMP aimed to target structural mitigation interventions of infrastructures with multi-purpose functions such as schools and roads. The strategy was to use existing indigenous coping techniques and integrate their practice at the local level. The community contributed their labor, time and small financial resources to pilot this project. It is now being replicated in five different municipalities.

Key features of the programme include:
- Roads leading to selected schools were raised and protected to become multi-purpose flood evacuation shelters.
- Communal facilities were raised to ensure safe evacuation.
- Drains were built to remove excess water in raised areas.
- Culverts were placed where relevant to allow excess water to drain away.
- Public latrines were built on raised demonstration homesteads to improve sanitation facilities during flood season.
- Public tube wells were built on raised homesteads to reduce contamination of drinking water.
- Traditional homestead community clusters were raised to demonstrate the effectiveness of indigenous earth raising techniques for flood-proofing.

This programme clearly demonstrated that existing community-initiated practices are sometimes the most effective. Community-based flood mitigation strategies should adopt, build upon and strengthen local knowledge and promote integration at the household level.

(Source: ADPC (2004) Safer Cities 7)

established communities with important social networks, it is their traditional homeland or there are economical benefits.

A survey conducted by Sri Lanka Urban Multi-Hazard Disaster Mitigation Project (SLUMDMP) of a community living in a landslide-prone area showed that their main income generation depended on the vegetable and food market and railway station and they needed a location from where they could make their services available throughout the day. People tend to continue living in the same location despite the recurrent nature of hazard occurrence and high probability of damage. For such communities, available cost-effective option is flood-proofing or structural modification of the location, building and access road so as to ensure flood safety.

Flood-proofing Practices

A number of flood-proofing methods are listed below (Adapted from FEMA, 1995 and MRC, 2002):

Relocation

Relocation in terms of flood-proofing refers to the relocation of people and communities during flooding times. This is not to be confused with resettlement, which implies a permanent move. Relocation refers to the temporary migration of the occupants of an area during the flood season; they require another place to live for a certain period. This is a traditional practice for coping with floods and when managed and planned it can be very effective and allow tolerant and beneficial existence with flooding. It often works in combination with creating safe elevated areas where people can be evacuated during floods. Relocation can also refer to completely moving the house or infrastructure to another area. This is possible if it is designed for that purpose and easy to move.

Relocation, can also include entire communities living on elevated earthen mounds. Whole villages can live on embankments built to serve as elevated roads (Tinh andHang, 2003). Raised residential areas move people away from the flooding hazard and eliminate the need for permanent evacuation.

Relocation schemes should be planned and ideally be integrated with total planned development, taking into consideration the practicalities of living in particular places and the need for basic resources, facilities and services.

Elevation

Raising the building plinth above flood level is also an effective solution and is practiced by many communities living in flood-prone areas. The use of piles, and bamboo or timber stilts to elevate is traditional, but still widely used in communities living with floods. Most structurally sound buildings can be modified by raising them. A simple one-storey frame building is easier to elevate than a more complex building. The foundations must be protected against erosion by floodwater and debris. Buildings can be raised on piers, posts or piles. Open foundations allow the floodwater to flow underneath; this reduces the impact damage of the flood. The type of elevation is dependent on expected flood depths and available materials.

Piers

- Constructed of a masonry block of poured-in concrete.
- Supported by concrete footings.
- Primarily used for vertical loading, not suitable for horizontal loading, so must be reinforced to withstand flood forces.
- Need suitable connections with the superstructure to withstand wind and buoyancy forces.
- Generally used in shallow depth flooding conditions with low velocity flow.

Posts/Columns

- Made of steel, wood (or bamboo) or pre-cast reinforced concrete.
- Their ends are set into pre-dug holes and backfilled, sometimes anchored in concrete at the bottom of the hole.
- Posts must be braced by either wood knee and cross-bracing, steel rods and guy wires.
- Generally used in moderate depths and velocities.

Piles

- Made of wood, steel and pre-cast concrete.
- Piles are mechanically driven into the ground and provide the best type of foundation.
- They are less affected by high water velocities and scouring.

- Piles must rest on a support layer of bedrock or held in place by friction of the earth and the pile to carry the load.
- Require bracing.
- Large machinery is required to drive the piles into the ground and hence relatively expensive.

(Adapted from USACE, 1993)

As mentioned previously, earthen mounds or embankments are a viable way to elevate houses. It is common practice to elevate homes and community infrastructure this way. Earthen mounds can be protected from erosion by planting trees and vegetation around the base and on the sides.

Construction methods and building materials

The main aspect of construction methods for flood-proofing is to strengthen the lower part of the building, including the foundation, plinth and floor. These are built of durable materials, such as concrete and brick, even if the rest of the building is not. Suitable depth and design of foundations are necessary to avoid damage due to settlement, prolonged inundation and scouring from below. The lower part of walls are also given attention in areas with high flood level. These are made with durable or replaceable materials. In some areas use of nails is replacing traditional lashing with rope or wire, which is not practical where floodwater has a high velocity and can break apart a building with nailed joints. Often the roof serves as a refuge during floods, therefore it is built of durable materials such that it can carry load.

In many flood-prone areas the most widely practiced construction is to build raised houses on stilts. Traditionally stilts were made of bamboo or timber, but nowadays concrete stilts are also used. This is the most logical form of construction for flood-prone areas, but often due to cultural reasons it is not practiced. In such cases, the land on which the building stands is raised instead of raising the building.

Another common form of construction in flood-prone areas is to have raised areas within the building where people can take refuge during floods. During normal times, these areas are used for alternative purposes - storage, cooking, etc. This part of the building is made of durable materials, or materials that can be easily replaced after the flood season.

Dry flood-proofing

Dry flood-proofing involves completely sealing a building against water using waterproof sheeting, shields, sandbags and other material that prevent water from entering doors and windows. It is only suitable in shallow water with a low velocity, otherwise the pressure against the structure would be too great. Not all structures are suitable for this due to the building type and design. Sewers and latrines can be protected to prevent water from either entering the buildings through them or filling them. Generally dry flood-proofing should only be applied to buildings made of brick, concrete blocks or brick veneer on a wood frame. Weaker materials would fail under the force of even shallow water (USACE, 1993).

Wet flood-proofing

Wet flood-proofing allows floodwaters inside the building, but ensures that there is minimal damage to the structure and contents. Contents can be kept in elevated areas, suspended from the ceiling, kept in watertight storage or temporarily removed from the building. The walls can be of a suitable material that can be removed leaving only the structure exposed to flooding while the items remain protected from water. Wet flood-proofing means either removing the walls or leaving doors and windows open. As long as the water can flow through, it reduces force on the structure (depending on the surface area obstructing the flow). This means that some structures can withstand faster flowing water, or at least, not get completely washed away by moving water (USACE, 1993; MRC, 2002).

Box 7.1

Flood-proofing techniques (adapted from ADPC, 2001)

Floating arrangement: In some countries buildings are constructed on a floating arrangement so that when floodwater comes the building can get elevated above flood level. In Central Vietnam, Cambodia (Tonle Sap lake) and Thailand (urban Klong areas) some communities live in boat houses and this technique is applied for poultry and piggeries. Also used in the Philippines, this enables people to continue rearing animals during the flood season.

Temporary walls: In areas where floodwater is very shallow, temporary walls, sandbag walls or small dykes can be used to prevent water from entering buildings or protect the area they surround.

Protection of openings: Some openings must be maintained for effective functioning of structures and for such structures removable bulkheads or floodgates can temporarily seal openings against floodwater. These devices can be bolted against frame containing a gasket, which provides watertight seal.

Seepage control: The most common protection for walls is to seal them with either asphalt or quick setting hydraulic compounds. Seepage also can be controlled by having a permanent pumping facility to draw down the water level.

Limitation in interruptions to services and fire protection: Floodwaters can badly damage electrical installations. It is advisable to elevate installations and ducts both in the home and local infrastructure. During floods there is a strong possibility of fire caused by electrical short circuits. If possible power should be cut off from the main or grid station or every home should be responsible for turning off their main electricity point.

Temporary removal: Emergency removal of goods, equipment, office records and computer equipment is another practice to reduce substantial reduction of damage.

Water tightness of storage facilities: Storage tanks in flood hazard areas could be fitted with watertight caps containing rubber gaskets if outlets are exposed to floodwaters.

Underpinning the structures: Structures constructed on poor quality supporting material are undermined during a flood with resulting subsidence and heavy loss. Proper underpinning of such structures could reduce the chances of it occurring.

Timber/bamboo treatment: Preservative treatment is an effective way of preventing timber/bamboo foundations from rotting due to long-term exposure to water. Treatment using chemical preservatives before flooding, or providing water-proof or concrete cover will prevent exposure and increase the lifetime of the structures.

Anchorage: Some structures have buoyant qualities during flooding and can be carried away by the waters. Proper anchorage will provide a solution to this.

Box 7.2

Suggestions for building design (adapted from SLUMPDMP, 2003)

Siting

- Avoid natural drainage paths, water courses and water detention areas and restricted and reservation areas.
- Site the building with the short side along the contours.
- Construct the buildings on the best bearing soil on ground higher than the probable maximum flood level.
- When siting on high ground is not possible, construct the building on individual high mounds with thoroughly compacted soil and surrounded by trees to maintain stability.

Foundations and Plinths

- Foundations should be at least 2 metres deep to prevent undermining and the plinth should be above the level for the HFL or PMF.
- Buildings may be raised on strong columns (stilts or piles).
- When it is not possible to raise the whole building, raise the floor of at least one room to use as a flood shelter.

Configuration (building shape)

- The building shape that will be reducing the impact of the water is circular.
- The V shape facing the oncoming water is advisable. It is best to have as little surface as possible facing the oncoming water.

Structure

- Use strong corner posts fixed into deep foundations (reinforced concrete where possible).
- If using timber pillars, the free height should not be more than 2250mm and they should be anchored in the ground at least 600mm deep.
- Houses raised on stilts should have a rigid frame and be braced against overturning.
- All joints should be tied with metal or wire strips. They should be braced diagonally using fixed wires or wooden strips.

Walls and openings

- If thatch is used as wall cladding, they should be in two parts, upper and lower, so the bottom part can be removed to allow the free flow of water through the building.
- If fixed materials are used such as bricks or mud blocks, then doors and windows should be positioned to allow the water to flow through.

Roof

- The height of the roof should be well above the height of the flood.
- The roof should have a flat section and should be strong enough to hold the weight of the occupants of the house in a flood emergency.

Flood-proofing of Community Infrastructure

Flood-proofing of community infrastructure projects are undertaken to:
- Create areas for evacuation centres above flood level (community buildings, schools, religious buildings).
- Provide evacuation routes (construction of bridges, elevated roads, elevation of existing roads).
- Ensure proper sanitation and hygiene during floods (elevate toilets above flood level, access to clinics and first-aid centres).
- Ensure supply of water and electricity during floods (locate tube wells on mounds, location of community water / electricity supply structures above flood level).
- Prevent unnecessary water accumulation within settlements (provision of culverts, bridges, canals to divert water and to ensure proper drainage).
- Provide access to areas protected through flood-proofing measures (elevated link roads to settlements).
- Provide safe areas for animals and the storage of agricultural products and fodder.
- Provide parking areas for farm machinery and other necessary vehicles.
- Provide areas for disposal of animal carcasses and other delicate waste.
- Provide an area for use as a mortuary and cemetery.

Farmers living in rural areas can take measures to reduce flood vulnerability, such as through flood adaptation. They can change the crop patterns and start the season early and also plant short duration crops so that they can avoid the harvesting season coinciding with the flood season.

Flood-proofing of existing structures is not as cost-effective as flood-proofing new structures. However, flood-proofing existing structures is more acceptable if there is little effort involved, such as constructing roads on existing embankments when there is enough space for widening the foundation width (ADPC, 2001).

Mobilisation of community support

Most community infrastructure projects are undertaken with the community's support. Such projects should easily be able to mobilise the support of the communities living in flood-prone areas. Also, these projects should be aimed at developing community solidarity and to bring them together as the intended actions are prepared for and to protect themselves from floods. Projects should be aimed at building capacity so that communities themselves can become experts and pass on knowledge to future generations.

see Case Study 7.2

People living in flood-prone areas are the ultimate stakeholders and recipients of the benefits of flood-proofing efforts. External agencies such as civil organisations and NGOs can provide technical guidance to ensure the success of such initiatives. Guidelines and manuals developed for flood-proofing measures should be in accordance with the overall floodplain management strategy. Therefore, information should be tailored to local needs and priorities, and implementation mechanisms should be through the approval of the responsible water management institution or local authority.

Case Study 7.2

Flood-proofing in Fiji

Nabouciwa is situated in a low lying area on the Rewa plains on the main island of Viti Levu, Fiji. In the early 1900's Nabouciwa village frequently experienced flooding due to both floodwater (from rain events) and high tide. It caused serious health threats and disruption to the villagers.

After 10 years of deliberation and much convincing, a community decision was made to implement mitigation measures, including the raising of houses and minor drainage work. From the initial stage the entire community participated fully in this project. The community members carried out activities such as clearing areas, and once they had learnt skills from experts, were able to lay footpaths and drainage.

The funding for this project was initiated by community fundraising in 1977 with CA$1 contribution from each individual. In 1995, the village received a grant of CA$ 49000 from the Canadian government for major drainage work and earth moving machines. The minor drainage works within the village continues to date. Due to the internalising process of adopting the project, the villagers are highly committed to the project and carry out the work at their own pace.

The outcome of the project is improved village conditions with complete control of flooding. The improved village condition has prompted villagers to build durable houses. The project is still in progress with the government committing CA$ 50,000 in 2005.

The engineered mitigation activity at Nabouciwa illustrates how structural mitigation measures adopted by communities resulted in acquiring better living standards. It demonstrates how community internalisation is a key factor in gaining commitment and which, as well as participation, is vital for the success of such projects. It also demonstrates how structural works provided a solution to the flooding problem, prompting the community to take further action for risk reduction.

(Source: Eliki, M. R., 2005)

Flood-proofing in recovery and rehabilitation programmes

Flood-proofing should be encouraged during reconstruction. It makes the community less vulnerable to future floods. An opening created by flooding in a road can be a good location for building a sluice gate or an extra culvert. If such strategy is undertaken it will be easier to mobilise additional funding needed for community level infrastructure improvements. Flood-proofing of existing structures can include raising structures to prevent damage, relocation of utilities, changing building use and installation of protective walls and water-proof closures. Relocation of existing buildings and structures to an area that is not flood-prone is also an option.

see Chapter 10

Policy can be used to promote flood-proofing and create standards for modifications. The design floods to mitigate against should be decided based on risk assessment and it should be larger than the highest known level in the area. For example in Bangladesh, rural infrastructure projects implemented by CARE have to undergo an environmental screening process.

Assessing Flood-proofing Options

There are a number of factors that determine whether flood-proofing is feasible and also which methods are most appropriate. Cost is often the main concern of people. It is highly dependent on the type of materials required and whether they are available locally. Ideally, flood-proofing should be done by the community with the support of external bodies such as the government or NGOs.

Decisions will be based on the nature of floodwater, the type of building, the level of exposure to flooding, the design flood, the cost and resources available and the location of the community, urban or rural. Box 7.3 summarises the factors that should be considered in deciding what flood-proofing method to apply.

Box 7.3
Factors to consider (adapted from ADPC, 2001)

Flooding Characteristics	Site Characteristics	Building Characteristics	Other
•Flood depth •Flood velocity •Flash flooding •Ice and debris flow	•Site location •Soil type •Resources available	•Building foundation •Construction materials •Building type and condition	•Cultural acceptability and significance of location •Cost

Traditional flood-proofing methodology often reflects local wisdom, cultural practices and indigenous technology applications. Also, it is more effective when the techniques are based on local resources and needs. Therefore, guidelines should propose various options to suit various localities.

In South-east Asian countries such as Cambodia, Lao PDR and Thailand, building on stilts is the traditional practice and it is used even in areas without any flood hazard. In Vietnam both methods of flood-proofing are applied; construction on reclaimed land and mounds as well as building on stilts. In the same way, in Bangladesh the common practice is to have houses on elevated mounds, whereas in Sri Lanka people living in floodplains prefer to have multi-storey buildings (at least one room above the flood level), since only short duration floods occur.

Technocrats are trying to introduce innovative, cost-effective and multi-purpose designs in urban housing projects for flood-prone areas. Elevated areas are used effectively for recreation, family leisure, storage, parking and even as elevated rainwater-harvesting ponds in urban areas of some countries such as Thailand, Malaysia, and Vietnam. The idea is to let the area get flooded during flood season (which is usually 2-3 months or even less) and have the opportunity to use the area during non-flood period.

Also, there are initiatives to design furniture and other household items using concrete and steel, which can withstand flooding without getting damaged. These include water-proofing fittings or installing them so they are located above the flood level. People have the tendency to evacuate in a horizontal direction during floods, but multi-storey architectural designs provide opportunity for vertical evacuation which can often be more practical. These features are also being included in new urban housing designs in flood-prone areas.

Financing Flood-proofing Projects

Flood-proofing and structural improvements are risk reduction methods that need to be planned and implemented from the bottom up as they largely depend on local practices, exposure and economic viability and as they are on a personal household level, it is essential that the household decides to implement them in the first place. Communities should decide which method to apply and create a plan to benefit and address every household. The government, NGOs and private sector can assist in providing resources, managerial and planning support and expertise.

Pilot schemes should be carried out first to test how effective and suitable the modifications are. Projects as a whole should be monitored and evaluated, revised as appropriate, information should be shared and the initiatives promoted in other flood-prone areas.

Financing for flood-proofing measures can come from a variety of sources, such as government and private low-cost loans, microcredit programmes and NGO projects, as well as directly from the government's budget line for risk reduction or from international aid organisations.

The Flood Management and Mitigation Programme (FMMP) adopted by the Mekong River Commission provides an overview of issues and concerns related to financing aspects of flood-proofing activities, as shown in Box 7.4.

Box 7.4

Financing flood-proofing projects (adapted from MRC, 2002)

Microfinancing schemes: Microfinancing schemes would help some poor households, while community-based flood-proofing would be more feasible from a financing point of view. Such schemes should be combined with savings programmes, serving as insurance during floods.

Financing of flood-proofing at household level: Poor families may not be able to adopt flood-proofing measures on their own. Possibilities for microcredit and other financing schemes should be explored and recommended.

Financing of flood-proofing at community level: Community-based flood-proofing may be more attractive and feasible from the financing point of view. Existing and new socio-economic instruments like group loans or community subsidy or cross-subsidy schemes would be applicable to most rural areas.

Financing of nationwide flood-proofing: Based on the evaluation of pilot projects, bilateral and international donor/lending agencies may be interested in financing large-scale flood-proofing measures.

Estimation of benefits of flood-proofing measures: Two important concepts underlying the estimation of benefits from flood-proofing measures are avoidable versus potential loss. Flood-proofing can be used to avoid losses from specific floods, but it may not prevent all potential losses from all future floods. For example, flood shelters may prevent loss of human and animal lives and enable household items to be saved, but they would not prevent damage to the houses left by those seeking shelter. In terms of public policy, this activity would introduce the public at risk to the issue of flood mitigation in general and advocate for flood-proofing measures.

Poverty Alleviation: Adoption of flood-proofing measures can have specific targets of poverty alleviation, for example by considering the scope for microfinancing of poor communities. It can break the cycle of increasing vulnerability. Providing shelter is one of the keys to reducing vulnerability and eventually poverty.

Flood-proofing in the Multi-hazard Environment

Most people in Asia are used to living in areas prone to more than one type of hazard. Flood-proofing and structural interventions can be designed to mitigate other hazards such as cyclones and earthquakes.

The basic physical forces the building will be subjected to are different for different types of hazards. It is worthwhile to have a comparison between the physical forces generated by earthquakes, cyclones and floods.

Such differences in the effect and nature of physical forces create some complexities when proofing measures are applied to a building located in an area prone to multiple hazard impacts. Seismic forces created in earthquakes and wind forces created in cyclones share a number of similar characteristics and those predominantly consist of lateral forces. Floods have different kinds of characteristics and the major difference is that the physical force is applied for a longer duration. In case of earthquakes, the duration of seismic ground acceleration is a few seconds and the effect is often lethal in case of high intensity events.

For all hazards, a strong simply configured building is the best option. In addition, flood-proof design requires strong connection to the ground and it must be allied to elevation to be more effective. When constructing in multi-hazard areas, it is necessary to successfully avoid any damages resulting from all possible hazards.

Process

see Chapter 4

Step 1. Risk assessment

Risk assessment should be carried out to assess the hazard and vulnerability of people and infrastructure. Refer to Chapter 4 for details.

- **Establish the hazard context:** Determine the nature of flooding, frequency and magnitude. Use the most current data and use engineering survey to establish the permissible proofing levels. Provide knowledge on the potential of extreme events, as community knowledge may be limited to the experience of a few historical events. The main characteristics of floodwater are associated with depth of water, duration of inundation, velocity of flow, rate of rise / fall of water level, frequency of occurrence and critical time of rainfall. Include environmental impact assessments.

- **Assess the vulnerability of people and infrastructure**: Consider the impacts of the flood waters on structures. Consider potential damages and losses. The level of physical vulnerability of a structure depends on the capacity to withstand the forces of water. Vulnerability analyses have to integrate assessment of the components of the building (such as foundation, walls, openings, roof to a lesser extent) against the flood flow characteristics and the exposure potential of a particular location. The analysis should be carried out for different building types. Include social impact assessments.

Step 2. Obtain the acceptance by the community

Together with the community discuss the results of the risk assessment. Help the community understand the benefits of flood-proofing measures and how they will address the risks. Gain consensus to address the risk through flood-proofing.

Step 3. Develop guidelines for assessing flood-proofing options

It is useful to develop construction guidelines for assessing flood-proofing options. It should be presented in a simplified way. It should include construction standards, methodology, construction materials and workmanship requirements for each option. The minimum requirement of the flood-proofing exercise should be to have the essential living area of the house above the expected flood level as against the agreed flood frequency. Unless the community agreement is reached, it is not advisable to have the houses raised only above the very frequent floods. It is better if guidelines can provide costs associated with different flood-proofing measures and tips to achieve cost-effectiveness. Full regard should be given to factors such as the income, gender, age and level of education of different regions, and the ethnic, religious and cultural background of the users as these will influence the design characteristics.

Flood-proofing can be done by construction of buildings on natural or artificial high grounds, by placing the building on columns or by providing access from outside via staircase to the upper floors. In areas where floodwaters are shallow and slow moving, temporary barriers composed of sand bags may be used to protect individual buildings.

Step 4. Help to select the best option

Select the best option based on assessments, keeping in mind the role of cultural practice.

Step 5. Prepare design manuals

Practical design manuals should be prepared as the second step of construction guidelines explaining the various steps. The purpose should be to present 'how to do' methodology. For example, in homestead raising, estimation of safe height considering flood levels, and required freeboard considering wind setup, fetch, and wave run-up can be illustrated in simple language with graphics in the manual (see for example, Ahmed, 2005). The safe height will be determined by the risk assessment.

Step 6. Identify traditional best practices and promote them

Communities have been affected by flood hazard in many flood-prone countries and they have developed traditional coping mechanisms and indigenous practices. For example, communities living in cyclone-prone areas submerge boats during cyclones to avoid damage by wind. It is necessary to carry out research to document such practices on application of indigenous techniques of flood-proofing and also to make them popular through experience-sharing mechanisms.

Step 7. Build capacity

Community members should be taught flood-proofing techniques. Seminars, classes and implementation would ensure that they can pass on skills. Capacity building can be done by NGOs, members from surrounding communities and other skilled professionals. Provide knowledge enhancement in correct applications of methodologies, construction materials and methods for improvement of workmanship. For example, bamboo as construction material can be improved by applying simple preservative chemical treatment.

Step 8. Raise awareness

Awareness campaigns are needed to provide knowledge and also to market the benefits of flood-proofing. Community level meetings, media campaigns, brochures and education material in local language with graphics and posters can be prepared and distributed at household and community levels. Due consideration should be given so that the materials are responsive to literacy levels. Awareness of the limitations of flood-proofing should also be raised. These can be included as a subject in universities and technical colleges as well as in training for builders and contractors.

Step 9. Carry out demonstration projects

The theoretical knowledge and awareness creation can be made more effective through demonstration projects and programmes.

Box 7.5

Institutional initiatives in Sri Lanka and India

Sri Lanka Urban Multi-hazard Disaster Mitigation project (SLUMDMP) has undertaken an activity to promote flood-proofing technology and cost-effective construction practices in one of the resettlement sites of communities affected by the floods of 2003. In India, BMTPC and HUDCO established "Nirman Kendra" to promote construction in disaster-prone areas and they serve as centers for community training and dissemination of research outputs on new innovative solutions.

Box 7.6

Post-flood family shelter recovery programme in Bangladesh

Following the unprecedented floods of 2004 in Bangladesh, UNDP embarked on an extensive recovery programme including a cash-for-work component for economic recovery and a component for reconstruction of family shelters. This is somewhat unique because it is among the largest recovery programmes undertaken by UNDP. It is being implemented in partnership with community-based NGOs over a period of 6-9 months and through the shelter programme more than 16,000 houses are expected to be built in various flood-affected locations throughout Bangladesh. The basic idea is to assist very poor and vulnerable households in the most severely flood-affected areas by building new houses that would be more resilient to floods, hence incorporating future risk reduction within the post-flood recovery programme.

A set of guidelines for shelter design was developed by UNDP based on previous action research. The implementing NGOs were trained and advised to follow these guidelines, modifying or incorporating design elements according to their judgment, experience, local context and owner participation. Although some innovative techniques are proposed, they are actually simple improvements to indigenous know-how, not alien or completely new techniques that would supplant existing house building methods. Special attention is given to the lower part of the house, which is most susceptible to damage during floods. This is done by stabilising typical earthen plinths with a cover of mud-cement mixture, using concrete base blocks to protect the lower ends of bamboo posts and simple preservative treatment of bamboo.

Some of the crucial aspects of the shelter programme are:
- Cost-effective, that is, cost is rationalised without compromising quality.
- Built out of locally available materials.
- Can be built in a rural context without the need for highly skilled workers who are typically male, hence providing scope for women's involvement.
- Can be replicated with very little training.
- Flood-resistant and risk reduction measures are incorporated.

Building a flood-proofed house: 1. Cement stablised earthen plinth, 2. Concrete stumps to hold bamboo posts off the ground, 3 and 4. Treating bamboo against insect infestation, 5. Walls and floor of house, 6. Raised house. (UNDP Flood Recovery Programme in Bangladesh)

Limitations

Like any other mitigation option, flood-proofing has its limitations. Flood-proofing can be applied in places where a certain level of flood risk is accepted. However, the nature of the flood risk determines whether flood-proofing will provide enough protection. Locations that are subjected to fast moving water or violent wave action during flooding are not suitable for flood-proofing measures alone. Zoning may determine the areas suitable for flood-proofed housing.

Additional cost involvement in land filling or reclamation, or applying other flood-proofing techniques is one of the greatest disadvantages of flood-proofing. Other disadvantages of flood-proofing are that there may be a short supply of earth as a fill material, perceived poor aesthetics of flood-proofed houses, and restricted usage in areas where people tend to migrate during floods.

Flood-proofing sometimes has the potential to cause further flooding problems. Earth mounds and dykes may reduce the infiltration and retention capacity of the given area, or may divert floodwaters creating flood elsewhere. Sometimes people choose to build flood-proofed homes on land which should primarily be for water retention. Flood-proofing homes does not justify using them in such a way. Flood storage and retention areas are extremely important and measures should be taken to restrict people from living in such areas.

There is always a high risk that a larger than normal flood event will occur. People living in flood-proofed houses need to be aware that their house is only safe up to a particular flood level.

Most of the developing countries in Asia do have building codes, but enforcing them is very difficult. Even the municipal authorities permit new constructions without considering hazard-resistant construction techniques. Usually for existing houses when they are subjected to flood-proofing, no special approval is needed and therefore regular controls also do not exist. So homeowners may resort to a practice or option based on their own judgement.

Checklist

☑ Have you engaged the community in discussion and determined the need for flood-proofing?

☑ Have you considered cultural practices?

☑ Have you considered all the criteria for the selection of the most appropriate flood-proofing option?

☑ Does your flood-proofing process ensure technical capacity building so that future generations can be taught? (For example, training of local builders and construction workers.)

☑ Have you involved community resources - human labour and financial capital?

☑ Are flood-proofing initiatives supported at the government level?

☑ Is flood-proofing part of the integrated watershed management approach? For example, ensuring that activities do not exacerbate flooding.

☑ Is the community aware of the limitations of flood-proofing? (That no dwelling is completely resistant to floods of very high magnitude.)

☑ Are permits required to modify or adjust dwellings (particularly in urban environments)?

☑ How will flood-proofing programmes be funded (government, NGOs or community)?

☑ Have you considered the impact of multiple hazards on the dwelling? (For example - earthquakes, cyclones, landslides, etc.)

☑ Do community projects include marginalised and minority groups who tend to be the most vulnerable? (For example, slum dwellers, people living in remote areas, etc.)

☑ Have you considered how flood-proofing measures can be maintained over time? (For example, planting trees around raised homesteads, bracing stilts, etc.)

Future challenges

- *Long-term considerations.* Flood events are frequent and despite all mitigation actions floods continue to be responsible for creating major property damages in every flood-prone country. One reason might be that flood mitigation programmes are being implemented as simple loss reduction initiatives. People tend to apply measures for short-term gain rather than long-term implications. This is apparent when different people and communities undertake flood-proofing measures only as a result of flood events. Since they are not included in a larger floodplain management framework, the impact has mixed success. In certain programmes the loss potential in the locality has been reduced through flood-proofing actions, but overall flood problem has been aggravated. It is necessary to consider that any volume addition into the floodplain reduces the overall retention capacity of floodwater and each flood-proofing project should estimate the influence of the particular action in overall flood management capacity in the larger context. This has to be done not merely as a technical exercise to share the results among professionals. Such information if circulated widely and analysed by all stakeholders including affected communities, should generate a collective responsibility to increase flood safety.

- *Flood-proofing initiatives are largely a reaction of affected communities to make an effort to reduce vulnerability.* This, however, is not receiving sufficient encouragement from governments, donor agencies and funding institutions. Mostly government initiatives are not supportive enough and are a reactive action, but not as a proactive approach to address the problem. This situation can be changed if more resources through micro-credit programmes and other funding mechanisms can be made available to homeowners for retrofitting or flood-proofing initiatives. In that way, flood affected people can be mobilised into a resource that will contribute positively to the efforts of flood safety and in the process governments will have a lesser burden of relief and response efforts in future flood events.

- *Flood-proofing practices which are currently in use are a result of traditional wisdom and indigenous practices.* They are products of trial and error and have evolved through time. It is slowly becoming a source of ideas for technocrats, but still generally there is little input from engineering and architecture professionals for innovative solutions developed from indigenous knowledge. Large-scale engineering works have been the remit of the engineering community and large-scale land-use planning practices are experimented by planners in urban as well as rural contexts. In the future, professionals from engineering, planning and architecture have to invest more time and energy to produce research outputs targeted at enhancing the effectiveness of current flood-proofing practices.

Resources

ADPC
Asian Urban Disaster Mitigation Programme, Safer Cities Series
    Safer Cities 2 (2002) *Coping with Flood in Cambodian Communities*
    Safer Cities 3 (2002) *Mitigation Flood Risk in Cambodian Communities*
    Safer Cities 7 (2004) *Can Small be Beautiful?*

Ahmed, K. Iftekhar (2005) *Handbook on Design and Construction in Flood-Prone Rural Areas of Bangladesh*. Bangkok, ADPC.

FEMA (1982) *Design Guidelines for Flood Damage Reduction.* FEMA-15, December. New York, FEMA.

SLUMDMP (2003) *Guidelines for Settlements Planning and Construction in Flood-prone Areas.* Sri Lanka Urban Multi-hazard Disaster Mitigation Project. Sri Lanka, Centre for Housing Planning and Building.

UNDRO (1982) *Shelter after Disaster.* Office of the United Nations Disaster Relief Co-ordinator. New York, UN.

References

ADPC (2001) *Urban Flood Management Regional Course*. Bangkok, ADPC.

Eliki, M.R. (2005) *Case Study of Disaster Risk Mitigation.* CBDRM Pilot Course. Fiji, SOPAC.

Tinh, D.Q. and Hang, P.T. (2003) *Living with Floods in the Mekong River Delta of Vietnam.* Paper for the World Water Forum Poverty and Flood Theme.

Walter, J. (ed) (2001) *World Disasters Report, 2001*. Geneva, IFRC.

UNESCO (2001) *Guidelines on Non-structural Measures in Urban Flood Management*. Ivan Andjelkovic, IHP-V, Technical Documents in Hydrology No. 50. Paris, UNESCO.

USACE (1993) *Flood-proofing, How to Evaluate your Options.* USA, National Flood-proofing Committee, US Army Corps of Engineers and National Flood Proofing Committee.

MRC (2002) *Flood Mitigation and Management Programme*, Component #2 and #5. Phnom Penh, Mekong River Commission (MRC).

WRC (1981) *Floodplain Management Handbook*. USA, US Water Resources Council and Flood Loss Reduction Associates.

8

flood disaster preparedness planning

This chapter provides the basis for carrying out Flood Emergency Response (Chapter 9) activities and actions. Plans must also consider linkages to the Recovery Process (Chapter 10).

Chapter Brief

- Flood preparedness activities include simulation, demonstrations and drills as well as training and education in specific skills.

- Flood disaster preparedness planning organises people to carry out specific tasks and delegates responsibilities in the event of a disaster.

- Flood Early Warning Systems (FEWS) must be integrated to link scientific and technical indicators to authorities who can interpret and communicate the message to a general audience.

- Communication to a large stakeholder group must be strategic and well-planned. A range of communications options must be tried and tested, the message must be simple and timely. People need to trust the communication system and the message.

- Governments need to take responsibility for guiding the preparedness activities. Political will, leadership and good governance driven by binding legal framework and policies can institutionalise the processes of preparedness planning and early warning systems.

Key Words

Disaster Preparedness

Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations (UNISDR, 2004).

Early Warning

The provision of timely and effective information through identified institutions that allows individuals exposed to a (flood) hazard to take action to avoid or reduce their risk and prepare for effective response (UNISDR, 2004).

Forecasting

Statement of expected meteorological conditions for a specific period and a specific area or portion of airspace.

Overview

There are simple and effective measures that can be taken prior to floods to lessen the impact and stress of the event, and reduce the risk of loss of life and damages. In Asia, some communities experience annual flooding and they accept a certain level of risk, and cope with these conditions. Yet many communities are changing rapidly, and systems and plans no longer exist. Community perceptions of risks cannot keep up with the changing human and built environment.

Preparedness comprises of a variety of activities including emergency planning, early warning, and specific actions to reduce losses. Flood disaster preparedness determines actions and delegates roles and responsibilities to various government departments, disaster management organisations, volunteer groups, at all sectors and at all levels. The plans need to involve and coordinate all key players in disaster relief.

Timely information such as where the flood will come from, how big the flood will be, how long it will last, and for how long people have to evacuate, is necessary for the smooth execution of the flood preparedness plan. Flood Early Warning Systems (FEWS) is an essential tool that will identify when a flood hazard is imminent. The flood warnings activate the plan and dictate the actions and activities to be undertaken. This information needs to be transmitted and communicated in an understandable way to those who will be affected.

This chapter focuses on planning for emergency response and flood forecasting and early warning systems.

Concepts of Flood Disaster Preparedness Planning

Flood disaster preparedness planning considers the following:

1. Flood response and emergency planning.
2. Flood forecasting and early warning systems.
3. Review and revision of systems and plans, providing specific training in areas needing capacity building to ensure timely and effective response.

(UNDMTP, 1994b)

Slum dwellings along the river in Vietnam

Planning is a complex process that can only be carried out effectively with a good foundation of resources, institutional arrangements, and information.

Flood preparedness framework

A general disaster preparedness framework, developed by the UNDP / DHA Disaster Training Programme presents the following components to consider in disaster preparedness (Twigg, 2004). Flood preparedness planning for response and emergencies demand specific inputs and details that are addressed in the following summary.

Foundations for Successful Planning

- **Resources.** Depending on the level of commitment, there should be financial assistance and human capital allocated for preparedness. The availability of resources determines the extent of the preparedness activities.
- **Institutional framework.** Good plans reflect a responsive and organised government institutional framework. Political will and commitment legitimises and guides the process, as well as making it both transparent and accountable. Planning requires the involvement of a focal point within government responsible for flood risk management. It is also important to have formal structures and arrangements at the community level.

see Box 8.1

Box 8.1

Stakeholders involved in planning in Thailand

Thailand National Level:

Coordination and Logistics:

- Chair: Minister of Interior
- Civil Defense Division
- Civil Defense Secretariat - coordinating body
- National Civil Defense Committee (with members from different line ministries - Ministry of Interior (MOI), Ministry of Agriculture and Cooperatives (MAC), Ministry of Transport and Communications (MTC), Bureau of the Budget, Ministry of Public Health, Thai Department of Meteorology (TMD), Department of Public Welfare.

Forecasting and Warning:

- TMD, Royal Irrigation Department (IRD) under the MAC, Department of Energy Development and Promotion.

(Source: MRC, 2001)

Thailand Community Level (Hat Yai City):

- City Mayor.
- Disaster Management Committee.
- City Municipal Office - MET Department, Civil Engineering Department (drainage, flood protection construction), Urban Planning Department, Road Works.
- Community leaders from targeted municipalities.
- CBOs responsible for emergency relief and response - e.g. Samakhi Foundation.
- Businesses and Schools.
- Radio and other media.

- **Risk assessment.** The basis of all flood disaster preparedness relies on the information collected in the risk assessment. This will assist in determining the risk reduction activities and other types of hazards.

Whilst undertaking the risk assessment, it is important to understand the dynamic nature of the risk environment by carrying out the following:

- Monitor the changing hazard environment and people's changing perceptions and behaviours.
- Create a dynamic database that is updated periodically to track trends and changes. This serves as a reference point for monitoring and reviewing future plans.

A risk map for preparedness should include:

- high flood level
- repeated loss areas
- major water resources
- locations of infrastructure
- critical infrastructures
- transport routes
- spatial demographic information

Data includes:

- Gathering hazard information (rainfall, frequency and location of flooding, etc.).
- Gathering vulnerability information (types of housing, economic status, health trends, demographic characteristics).
- Determining exposure (location and siting of homes, infrastructure and critical facilities).
- Determine existing resources and capacities (number of rescue workers, nurses, volunteer groups, financial support, NGOs, etc.).

Stakeholders

Key stakeholders at the relevant levels (international to community) need to be involved in preparedness. They play an active part in preparedness activities and should be delegated roles and responsibilities. They should all be linked by arrangements for communication and coordination.

see Boxes 8.1 & 8.2

Box 8.2

Who are the planners?

- National Government
- Local Government
- NGOs
- CBOs
- Grassroots Organisations
- Donors
- UN organisations

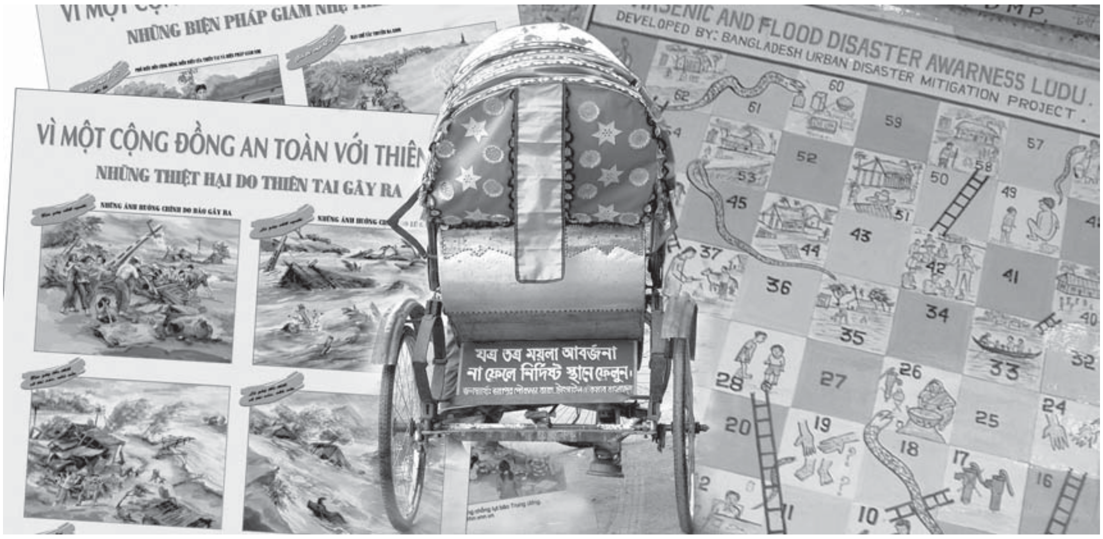
Planning can take place at any level, from national plans to community plans. Planning is not a task only for experts, but for people who represent the target group and who can identify and address their needs and prioritise actions in the event of a disaster.

(UNDMTP, 1994a)

Public Awareness

It is important to inform people of the flood risks prevalent in their community. People's behaviours and attitudes to flooding are diverse, not everyone perceives risk in the same way. Perceptions of flood risk in the community are based on memory and learned experience. People's knowledge and experience will determine how they react and cope in different situations. The community needs to be informed in order for them to make active decisions in their everyday lives to reduce flood risk (ADPC, 2005).

Public awareness campaigns provide a useful method of communicating risk reduction measures, actions, activities and information to the community. Campaigns must be simple, innovative and targeted.



left. Public awareness posters, *middle.* Awareness message on back of rickshaw, *right.* Snake and ladders board game

The following should be considered:

- Who is your target audience?
- What is your message?
- How will you communicate the message?
- When will you conduct your campaign?
- How effective was your awareness campaign?

Multiple channels of communication need to be identified and used to communicate this risk information. Public awareness campaigns must consider the composition of the community to ensure the message gets through. It should be remembered that not everyone has access to television, computers, cinemas, radio, and not everyone can read. Activities need to cater for a wide audience, so combinations of methods should be adopted.

For example:

- Posters
- Brochures
- Television
- School art / essay competitions
- Demonstrations
- Training
- Disaster Day Campaigns
- Advertisements
- Merchandising
- Songs / Drama / Street Theatre
- Soap operas on TV
- Promotions by celebrities
- Mock exercises / drills

Preparedness activities

It is important for all stakeholders to be prepared for flood disasters and make arrangements and plan activities that are specific to their needs.

Household

- Arrange meeting points
- Preparation of emergency supplies and important items (such as medication, money, bank information)
- Stockpiling food and water
- Stockpiling cooking utensils and fuel
- Emergency flood-proofing measures (sandbagging and boarding)

- Drills and practices
- Move car, motorcycle and livestock to higher ground
- Stockpiling fodder
- Turn off gas and electricity

NGO
- Stockpile emergency food and non-food items, equipment for rescue, shelter and relief projects
- Training
- Awareness campaigns
- Organisational emergency and contingency plans

Government
- Designate a national disaster fund
- Capacity building in emergency management for government officials
- National, provincial and local level emergency plans
- Public awareness campaigns
- Plans for debris management

Planning for Emergency Response

> *'The effects of potentially catastrophic incidents can be substantially reduced by systematically prepared and thoroughly tested plans in the hands of informed and trained people' (SIESO, 1986).*

A flood response and emergency plan is a practical written tool that can be used in the event of a flood to explicitly outline the actions that should be taken at what time and by whom. Although it is instructive, it is by no means prescriptive and should be used and adjusted as deemed appropriate to the situation.

The benefits of creating a flood plan are just as valuable as the end result. Planning is an educational activity for all involved and the benefits are numerous:
- Important for good incident management.
- Reduces duplication or omission of relief activities.
- Helps to prevent problems that normally arise from unplanned response and relief activities.
- Reduces thinking time after the emergency has occurred.
- Helps to make systematic, orderly and effective what would otherwise be arbitrary, chaotic and ineffective.
- Helps to contain the emergency, minimise the casualties and speed up rehabilitation.
- Increases awareness of the roles and responsibilities of key stakeholders and highlights the need for integration, coordination and cooperation.

(Adapted from SIESO, 1986)

Box 8.3 lists the components and objectives necessary for an emergency plan.

Box 8.3
Components and objectives for emergency planning

Components

- Resources
- Government commitment
- Targeted skills training
- Education of key personnel
- Simulations and drills
- Effectiveness of the warning system
- Public awareness
- Review and revision for plan improvement

Objectives

- Have a clearly stated objective or set of objectives.
- Reflect a systematic sequence of activities in a logical and clear manner.
- Assign specific tasks and responsibilities.
- Integrate its activities, tasks and responsibilities to enable the overall objective or set of objectives to be achieved.

(Source: UNDMTP 1994a)

Emergency response planning is an extensive process that must include multiple sectors and stakeholders. The process of information gathering, analysis, decision-making, planning and execution of activities must adopt a participatory approach. There are different levels of emergency planning where roles and responsibilities vary, but are important to ensure effective, efficient and reliable coordination by all.

The contents of emergency plans vary according to the situation. Box 8.4 contains a list of aspects that can be included in plans as necessary, so that they can be systematically implemented in a flood emergency.

Box 8.4

Contents of a generic emergency plan

Management Structures and Arrangements

- Management structures (inter-agency coordination, control and communication).
- Disaster Risk Management Committee (DRMC) / EOC to be activated in the event of a flood.

Roles and Responsibilities

- Outline roles and responsibilities for organisations, staff and individuals.

Communications

- Technical communications.
- Information management - how will information be acquired, processed and disseminated to the relevant people?

Procedures

- Evacuation procedures, phases and how it will be organised.
- Initial situation and needs assessment procedures.
- Warnings.

Actions and Sub-plans

- Evacuation camp plans.
- Relief Supplies Distribution.
- Food and Nutrition - supplementary feeding centres.
- Public health - water and sanitation, immunisation, shelter provision, body identification.
- Security - looting and civil security.
- Setting up the emergency operations centre.
- Search and Rescue.
- First medical response - triage process.
- Family reunification activities.
- Debris management plans.

Logistics

- Logistics - list of resources locally and in surrounding provinces, the time in which they can be acquired, transport routes and alternatives, securing rescue equipment and additional personnel, identify storage facilities, security and maintenance of equipment, securing equipment to clear roads, an assessment of logistic capability is important to undertake in the preparedness planning, it considers the likely logistical needs and solutions and the vulnerability of logistical components (communications, vehicles, routes) (Carter, 1991).

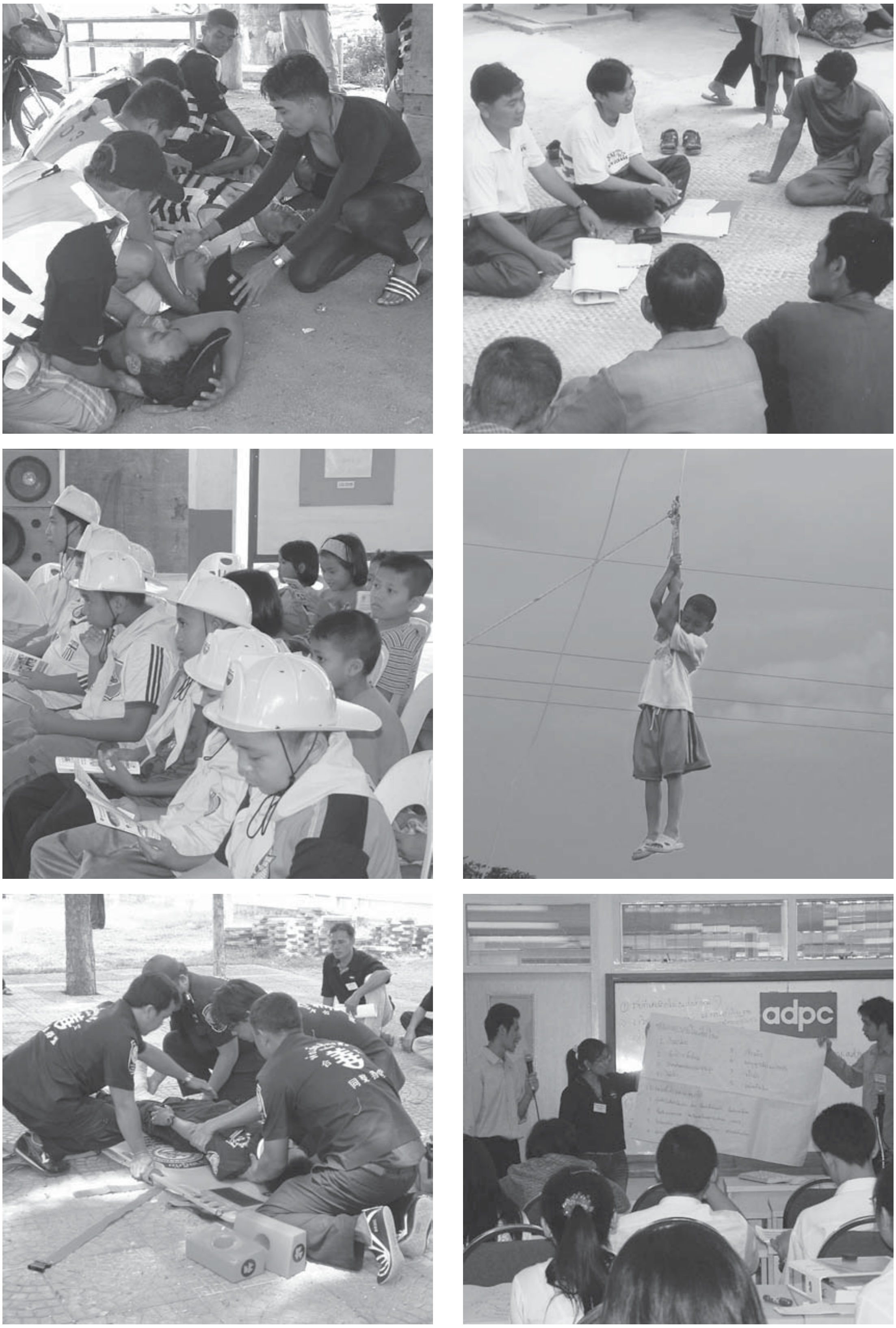
Contact Lists

- Government Sectors and Ministries, NGOs, individual key players, hospitals.
- Meteorological Centre, Experts.
- Media - press and television.
- Private companies - relief supplies, communications support, transport support.

The following factors must be implemented to support the plan:

- **Capacity building.** Capacity building for emergency response ensures that personnel have the key skills to perform their tasks in an emergency. Training programmes include SAR, first aid, temporary shelter construction, food distribution and evacuation management. Volunteers are a vital resource if trained properly. International and national government administrative staff such as foreign affairs, embassies, immigration and tourism should also be trained in emergency procedures to enable them to assist their nationals involved in the disaster.

UN agencies and organisations such as ADPC run participatory training courses in various aspects of disaster risk management for all levels.



Training in various aspects of preparedness and emergency response

- **Simulations, drills and practice of plan.** Those with key responsibilities and the general public need to know what to do. Practice of simulations and drills at the local community level is important for raising awareness of specific important information, as shown below. These can be practiced at schools, on specified public events such as national disaster days, during trainings, and discussed at community meetings.
    - Evacuation routes
    - Location of safe areas and evacuation centres
    - Different phases of early warnings
    - Sources of warnings - radio, flags, markers, loudspeaker, etc.

Box 8.5

Additional characteristics of emergency plans

- Plans need to be realistic and suggest feasible actions to be taken.
- There must be a clear activation mechanism and a deactivation point.
- It is necessary for a number of organisations to have their own plans, for example, hospital plans.
- Plans should be specific enough to cover all foreseeable results of the flood and flexible enough to cope with changing situations.
- Plans may highlight the need to create new institutions and acquire new resources.
- It is important to consider the plan in the light of political, environmental, social and demographic factors, as these will affect its feasibility and the development of the emergency.

see Boxes 8.4 & 8.5

Generic Emergency Planning Process

1. Establish a working team for emergency planning. Decide on an aim.
2. Establish an outline for the plan *based on the flood risk assessment*, and the worst-case scenario. Include the contents and considerations mentioned in Boxes 8.4 and 8.5.
3. Meet with relevant people and assign tasks, agree on roles and responsibilities for both during the planning and when the plan is activated. There should be signed agreements to ensure that assigned roles and responsibilities are fulfilled.
4. Prepare a draft comprehensive plan, with sub-plans where necessary. It should be easy to use and navigate through and in a format that is simple to expand and change.
5. Obtain confirmation and feedback of the plan from the key stakeholders and revise accordingly - check with all participants of the plan.
6. Produce a completed version of the plan. Disseminate to relevant stakeholders and ensure that they know their roles and each other's roles.
7. Test the plan and processes through simulating mock scenarios and drill exercises. Carry out SAR and evacuation exercises. Using the outcomes, review and revise the plan where necessary.

8. Update and revise the plan continuously as individual roles, contact details and contexts (political, environmental, demographic) change.

Flood Forecasting and Early Warning Systems

> *'The early warning process is dependent on the interplay of science, technology and socio-economic factors that dictate the manner in which people understand and react to disasters' (Garcia, 2002).*

Flood early warning systems (FEWS) need to be considered as an integrated network that generates and then communicates information vital for knowing when and where it will flood. FEWS should be part of an integrated watershed management approach and have arrangements for transboundary communications.

Flood forecasting and warnings are essential for the timely execution of the emergency plan. The key to effective forecasting and warning systems is communication and dissemination of understandable information to a mass audience to which they can relate. This is the vital link between hydro-meteorological data and analysis, and the response mechanisms of the public.

Therefore, information systems need to be efficient and reliable at collecting correct data. The information needs to be relayed to the right stakeholders who can make decisions and take decisive actions based on the emergency plan.

see Case Study 8.1

Box 8.6 demonstrates the normal flow of information.

Box 8.6
Flow of information

Originators →

Scientific generators of the information
- Gather and analyse data
- Pass information to key decision-makers

Intermediaries →

Key decision-makers
- Decide whether to issue the warning
- Form a simple message
- Activate emergency plans

Receivers / Disseminators

Multiple target audiences: NGOs, media, emergency services, military, public
- Disseminate warning
- Take appropriate actions
- Activate individual emergency plans

(Adapted from IDNDR Flagship Programme, 1998)

Case Study 8.1

The Flood Forecasting and Early Warning Centre in Bangladesh

Established as a permanent entity in 1972 the centre was first supported by UNDP, WMO and DANIDA. It operates a "Flood Information Centre" as focal point in connection with disaster management for both cyclones and floods.

FUNCTIONS:

A. Data Collection

- Voice data (HF wireless network, 67 stations).
- Mobile telephone (3 stations).
- Telemetry system (14 stations).
- Satellite Imagery (GMS, NOAA-12 & NOAA-14).
- On-line data from Bangladesh MET Dept., including satellite and rainfall radar data.

B. Satellite Imagery:

- Reception of NOAA-12 and NOAA-14 images via direct acquisition facilities.
- Monitoring of cloud and depression movements, precipitation estimation from cloud temperature analysis.
- Cyclone monitoring.

C. Real Time Data Management

- GIS map showing water level and rainfall status (Flood Watch).
- Data entry and processing.
- Automatic data exchange to and from forecasting model.
- Display of forecast water levels and discharges.
- Automatic generation of flood forecast bulletins.
- Generation of flood status at local admin. unit (thana) level.
- Automatic statistics generation.

OUTPUT :

- Daily monsoon bulletin and river situation report.
- River level forecasts for 24, 48 and 72 hours.
- Current warning messages.
- Special flood situation report.
- Thana inundation status map.
- Flood forecast maps.
- Monthly and annual flood report.
- Dry season bulletin (weekly).

DISSEMINATION:

A. Media

- Internet, Email, Fax, Telephone and Wireless, Radio and Television

B. Destination:

- President's and Prime Minister's Offices.
- Minsitry of Water Resources.
- Directorate of Relief and Rehabilitation and other Government Departments.
- Disaster Management Bureau.
- Army Headquarters.
- Public Information Department.
- News Agencies - Radio & TV.
- NGOs and international relief organisations.
- Foreign embassies and consulates in Dhaka.
- Field wireless stations.

(Source: The Flood Forecasting and Early Warning Centre, 2004)

Flood forecasting can be deterministic or probabilistic based on information supplied by hydrologists and meteorologists. Inputs such as rainfall and run off are presented in a model that is determined by geographical circumstances and number of inputs available.

Long-term flood prediction is probabilistic and based on information supplied by meteorologists. Inputs such as historical rainfall data, return periods, weather and climate data are used to predict potential flooding of between 5-10 days. This information is becoming more accurate due to the increasing measurable variables, stringent data collection and ability to interpret this information. **Short-term flood warnings** are provided a few hours to 3 days in advance.

Rainfall and streamflow information is measured and recorded and used to derive flood forecasting models. It is beyond the scope of this Primer to provide details on data collection and modelling, but it is important to have reliable techniques for gathering data and forecasting floods. Often the separate entities such as the forecasting process or the preparedness plans are in place, however, the problem occurs in the transfer of information and when making the separate elements operate as a single early warning system.

Forming the warning

Once the flood hazard has been forecast, the warning needs to be formed which should contain the following information and follow the criteria mentioned in Box 8.7:

- Characteristics of the flood (location, flood level, velocity, volume).
- Areas that will be affected and to what degree.
- People who will be affected and to what degree.
- Recommended appropriate actions and time in which to prepare.
- Time of detection/prediction.
- Source of information.

see Box 8.7

In most countries in Asia, warnings come from multiple sources. The warning information should originate from a single source to avoid confusion. Ideally, a designated national government body should have the sole authority to issue flood warnings.

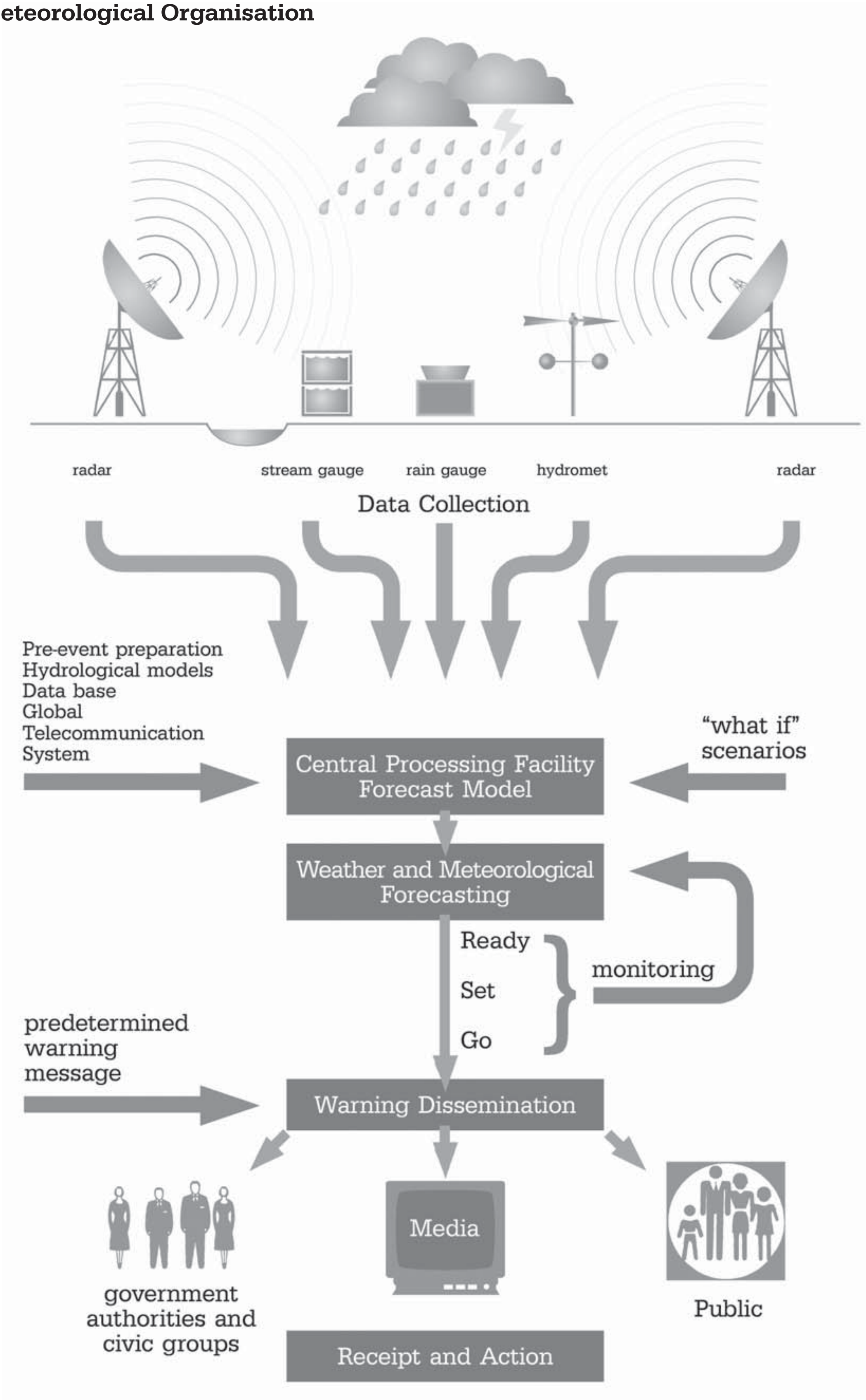
Disseminating the warning

Prudent and timely dissemination of warnings is the key to an effective and reliable system (refer to Figure 8.1). There are two issues to consider:

Warning flags used in Hat Yai, Thailand

see Figure 8.1

Figure 8.1
The major components of an Early Warning System as depicted by the World Meteorological Organisation



(Source: Garcia, 2002)

Box 8.7

Criteria for message design:

- Message must come from a credible source.
- Message should be short and concise.
- Message should be ordered, with the most important information first.
- Substance of the message should include information of the situation, expected flooding and what the recipients of the information should do.
- The message must be in clear simple language and in all necessary local languages.
- The message should be positive - say what to do rather than what not to do.
- Action rather than inaction should be suggested.
- Sociability should be encouraged with messages such as *'Advise your neighbours.'*
- The message should be vivid and draw attention.
- Visual and graphic messages in a locally comprehensible and familiar form should be used.

(Adapted from EMA, 1995)

1. **Is the communication system reliable?**
   Dissemination of forecasts and warnings can be achieved through a variety of communication methods. An inventory of the various communications media will reveal the competency of the dissemination process. It is important to differentiate how and when warnings are transmitted to the public, flood control agencies, emergency services, police and other relevant agencies.

Warning dissemination is dependent on the following:

- Institutional arrangements, policies, laws and mandates
- Human resources, technical and organisational expertise and communication skills
- Communication technology, including telecommunication installations and networks
- Informal and formal communication
- The mass media and broadcasting technology
- The mobile resources of officials
- Size of the target area
- Known effective methods of communication

(Adapted from IDNDR Flagship Programme, 1998)

The means by which people receive information that they feel is reliable and trusted partly determines whether they

Methods of issuing warnings may include:

- Warning flags
- Radio broadcasts
- Television broadcasts
- Internet
- Schools
- Loudspeaker
- Police
- Interpersonal communication
- Telephone – land line and mobile network

act appropriately. This must be investigated to establish the best method of communication with the general public in a given community, district or province.

2. **Is the warning message simple and understandable?**
   People's understanding of the warning will be based on their prior knowledge of the hazard and risk, and the clarity and information given in the warning. Prior background knowledge will allow them to make sense of the warning they are receiving and relate it to a perceived threat. Language and literacy of the population at risk will affect their ability to understand and act, therefore determining the best medium to use for issuing warnings.

3. **Public awareness for FEWS: Do people respond to the warning?**
   Warnings, even if issued in time are not always heeded due to people's perception of risk. '*An understanding of how individuals will perceive the risks communicated to them will influence how effective a warning of a natural hazard will be' (Handmer, 2000)*. The perception of risk determines the actions that people take in response to the warning. There are a number of different prevalent attitudes regarding the risk .

Risk perceptions:

The flood won't happen
The flood won't harm me

The benefits of ignoring the risk are greater than accepting it

Ongoing public awareness campaigns need to be conducted to ensure a culture of heightened awareness to early warnings and preparedness actions. Where floods have a lower frequency, both the public and authorities can become complacent to the risk.

Case Study 8.2

Problems of Heeding Warnings

Livelihood and asset security is an issue that cannot be ignored. Many people are reluctant to leave possessions, livestock and houses even when faced with flood warnings. The appropriate government authority should assure people that their homes and possessions will be safe from looting by ensuring security. This issue is clearly evident in Bangladesh where people return to find all their worldly possessions gone, including their tin roofs.

> *'When we went for shelter, our fans and other items such as clothing and utensils were all stolen. Pieces of our tin roof were taken.'*

(Rashid, 2000)

People at all levels need to be aware of their roles and responsibilities to pass down and spread the information using the authorised process. Getting the public to react to warnings in an appropriate manner is the biggest challenge (refer to Case Study 8.2). Making the link between the issuing of the warning and the preparedness plan is vital to effective flood risk reduction. The community should react in accordance to the plans or as advised by the warnings.

see Case Study 8.2

The following Box 8.8 summarises current initiatives for promoting early warning systems at the international level.

Box 8.8

UNISDR - Promoting a platform for early warning

Early warning has recently become a more important issue following recent disasters. UNISDR has established the Platform for the Promotion of Early Warning (PPEW). The department has developed a four element process based on '***systems thinking*** *which views processes as a whole and directly affected by subsystems and component parts. Where 'failure in one part can lead to failure of the whole system' (UNISDR, 2005)*. Viewing early warning systems in this way is essential because if only one aspect of the system fails or is not carried out properly, it affects the output of the system, which is the action taken '*to reduce the risk of death, injury, property loss and damage' (Handmer, 2000)*. It encourages effort to be placed on ensuring that each part of the early warning system is effective.

The four parts are as follows:
- **Prior knowledge of the risks faced by communities**
  - Risks arise from both the hazards and the vulnerabilities that are present – what are the patterns and trends in these factors?
- **Technical monitoring and warning service for these risks**
  - Is there a sound scientific basis for predicting the risks faced?
  - Are the right things being monitored?
  - Can accurate warnings be generated in timely fashion?
- **Dissemination of understandable warnings to those at risk**
  - Do the warnings get to those at risk?
  - Do people understand them?
  - Do they contain useful information that enables proper responses?
- **Knowledge and preparedness to act**
  - Do communities understand their risks?
  - Do they respect the warning service?
  - Do they know how to react?

(UNISDR, 2005)

Current FEWS existing in South-east Asia

Forecast	Institutions and Infrastructures	Activities
Floods	Department of Hydrology and River Works (DHRW, Mo WRAM) 1 office for flood forecasting 15 provincial hydro-met offices 6 observation stations 3 data loggers 72 rain stations	• Applies local models and regression analyses and SOGREAH model analyses for prediction. • 3 days of water level prediction and warning. • Communication by radio, messenger. • Data sent to MRCS by facsimile. • Receive water level data of 4 countries sent by MRCS.
Weather and Flood	Dept of Met and Hydro (DMH) 74 hydro stations 86 rainfall stations 34 met stations Water Admin Division (WAD) 64 hydro stations 23 rainfall stations	• Hydro-met data collection. • Daily and long range forecast. • Provide hydro-met services to ministry of agriculture, forestry and environment. • Data transferred from local stations by messenger, post, television, internet. • Hydro meteorology data collection. • Data from WAD forwarded to MRCS by email and fed in computers.
Flood	Flood Forecasting Bureau (FFB)	• Monitoring and data collection from rain gauges and sent to Central Flood Forecasting Office. • Flood forecasting models used for analyses of flood situation.
Weather and Flood	Hydro-met services (HMS)	• Prepares weather and flood forecast. • Operates a high resolution satellite image receiving system and 5 radar systems • 2 regional hydro-met centres. Plans for flood hazard zones under UNDP / USAID project and flood alert system on river basins most vulnerable to floods.

Responsibility	Warning	Dissemination
National Centre for Disaster Management (NDCM)	2 levels of flood warning 1. Flood advisory 2. Flood warning	• NCDM transmits information on flood situation, through a sub-national committee on disaster management. • Up to the village level. • Tools used: fax, messenger, and telephones. • Hand held radio used by district offices but not maintained.
NDMO	For rainy season forecast issued twice a day. During inclement weather forecast is issued 3 times a day. Typhoon warning contains typhoon characteristics, risk on people, recommended action to prevent and mitigate.	• Warning sent to a number of media (for further dissemination), all levels of government, ministries and private companies. • Mobile phones and high frequency radio receivers.
PAGASA	3 categories flood bulletin: flood outlook, flood advisory and flood warning. (linked to tropical cyclone alert and warnings).	• Multi-pronged dissemination scheme • Public receives information directly by PAGASA or TV broadcast, regional warning centres and dam offices
Provincial Dyke Management, Flood Control and Storm Preparedness (PDMFCSP)	NA	• Village radio communications • Loud speakers in communities.

(Source: Garcia, 2002:4-5)

Other considerations for early warning systems

Traditional methods

Although there is a strong emphasis on the importance and need for scientific forecasting and early warning systems, historic and traditional methods should not be undermined. A community may have established a system that works on its own or with some level of facilitation.

Animals are generally more aware of potential flooding, and when their movements and behaviour become out of the ordinary, it can be an indication of imminent danger. Some communities have been known to observe animal and bird movements and use this as a warning. This is a field requiring further research.

Policy and institutional arrangements

Policies and institutional arrangements must be in place to guide the inputs and outputs of an early warning system. Almost all countries in Asia have policies directing reliable functioning of flood early warning systems. The important priorities in terms of policy and practice are:

- All players are involved in agreeing on and working towards satisfying the system's purpose.
- There is agreement on what constitutes success.
- To work on ensuring that no identifiable group at risk is ignored.
- That the uncertainty inherent in warnings is conveyed.
- That the media are conversant with - and ideally tied into - the warning process.
- That where legal uncertainty is an issue, it should be clarified.

In terms of research:

- Processes are needed to assist with implementation at the local level of new policies and procedures.
- Research into the impacts of the rapidly changing social and technological environment on the ability of warning systems to perform.

(Handmer, 2000)

Limitations

- It may be difficult to prepare plans for different flood scenarios as well as multiple hazards. There is danger of increasing vulnerability by overlooking risks associated with other hazards. It is essential to strike a balance between a generic plan and hazard specific plan.

- Risk communication is a relatively new concept and there is little research into the evaluation of the impact of the campaign. People's reactions to warnings may be unpredictable and changing attitudes and behaviours is a long-term process.

- Without the right mechanisms and institutional arrangements in place, warning messages may get lost in translation and not reach the target audience. The dissemination of warnings must be based on a trusted, reliable and effective system.

- Obtaining data for FEWS from across national borders can be problematic due to reluctance to share information. This can result in inaccurate warnings causing people to lose trust, and become complacent and apathetic to heeding the warnings. The system then becomes redundant.

Checklist

☑ Do you have the institutional arrangements and resources necessary for preparedness activities?

☑ Is there sufficient information about the flood hazard, vulnerability and risk to guide your planning and ensure that it targets high risk areas?

☑ Are preparedness activities complemented with a flood risk awareness campaign that is suitable for the population?

☑ Have you created realistic emergency plans and arrangements to enable the implementation of an efficient and effective response?

☑ Does the planning process include the active participation of key stakeholders?

☑ Is there a review mechanism that ensures that the plan is regularly updated, tested and revised?

☑ Is the plan linked to the flood early warning system?

☑ Does the early warning system include dissemination of information to all those at risk including minority and marginalised groups?

☑ Does the preparedness plan take into consideration the need to link disaster response with recovery and sustainable practices?

Future Challenges

- *Coordination in the planning process is essential.* It is necessary to direct responsibilities to different stakeholders at all levels and encourage integrated preparedness planning for each sector. Regional institutional arrangements should also exist. It is important for all countries sharing a watershed to collaborate and coordinate to ensure a free flow of information across national borders. Procedures should ensure that countries upstream inform downstream neighbours of fluctuations of river levels to enable preparedness plans to be activated. The challenge is to develop suitable arrangements and frameworks to guide coordination both within nations and throughout the region.

- *Increase public awareness about flood risk.* Changing attitudes and risk perception is essential for building a culture of safety. Although people may be aware of flood risks due to high flood frequency, they may not know how best to prepare and respond. The objective of public awareness is to communicate to people how to reduce damages and losses and protect their lives and livelihoods.

- *All communities in high risk areas should undertake preparedness activities and create emergency plans.* Marginalised groups are often excluded from preparedness activities. There needs to be proactive strategies to involve these groups.

- *Emergency preparedness measures should also exist in areas where flood mitigation has occurred.* It is sometimes assumed that where flood control structures exist, the risk of flooding has been eliminated. There needs to be heightened awareness regarding the possibility of structural failure and potential flooding.

- *There needs to be a clear activation mechanism for emergency plans.* Once plans are completed they cannot merely sit on shelves. The relevant disaster management committee should be responsible for the plans, which includes activating the plans when necessary as well as ensuring that they are practiced, tested and updated.

Resources

Household disaster plans

FEMA (2004) *Emergency Preparedness Checklist.*
http://www.fema.gov/rrr/emprep.shtm
FEMA *'Are you Ready?'* Series helps communities to plan for multiple hazards, including floods.
http://www.fema.gov/areyouready/
Accessed March 2005

UK Environment Agency (2005) *Ideas for a Household Flood Plan.*
http://www.environment-agency.gov.uk/subjects/flood
Accessed March 2005

ADPC (2002) *Floods - Natural Hazards and Disasters*. Bangkok, ADPC.

Emergency (disaster) planning

UN Disaster Management Training Programme (1994) New York, UNDP / DHA.
http://www.undmtp.org/english/disaster_preparedness/disaster_preparedness.pdf
Accessed March 2005

Swami, S.K. (2002) *Trigger Mechanism: A Concept for Emergency Response Plans.* New Delhi, (Department of Agriculture and Cooperation) Ministry of Agriculture, Government of India.

Early warning

EMA (1995) *Flood Warning, An Australian Guide*. Australia, EMA.

References

ADPC:

- (2004a) *Disaster Risk Communication Course.* First Regional Course, February 2004. Bangkok, Asian Institute of Technology.
- (2004b) *Safer Cities 8, Channels of Communication - a Challenge.* Bangkok.
- (2005) *Primer for Disaster Risk Management in Asia.* Bangkok.

Burn, D. H. (1999) *Perceptions of Flood Risk: A Case Study of the Red River Flood of 1997.* Water Resources Research. Volume 35 Number 11. Canada, Department of Civil Engineering, University of Waterloo.
http://geology.ohio-state.edu/modules.php
Accessed February 2005

Carter, N. (1991) *Disaster Manager's Handbook.* Manila, ADB.

EMA (1995) *Flood Warning, An Australian Guide.* Australia, EMA.

FEMA (2004) *Are You Ready? An In-depth Guide to Citizens Preparedness.* USA., FEMA.
http://www.fema.gov/areyouready/
Accessed January 2005

Garcia, L. (2002) *Overview of Early Warning Systems in Selected Countries of Southeast Asia.* Bangkok, ADPC and ECHO.

Handmer, J. (2000) *Are Flood Warnings Futile? Risk Communication in Emergencies,* The Australasian Journal of Disaster and Trauma Studies. Volume 2.
http://www.massey.ac.nz/ trauma/issues/2000-2/handmer.htm
Accessed January 2005

IDNDR (1998) Flagship Programme ________________

Jinchi, H. (2003) *Lessons Learned from Operation of Flood Detention Basins in China.* Beijing, Research Center on Flood and Drought Disaster Reduction.

Lee, B. and Davis, I. (1998) *Forecasts and Warnings, Flagship Programme.* London, Thomas Telford Publishing: IDNDR.

MRC (2001) *MRC Strategy on Flood Management and Mitigation in the Lower Mekong Basin* (Draft). Phnom Penh, Mekong River Secretariat.

Rashid, S.F. (2000) *The Urban Poor in the Dhaka Floods in 1998.* Disasters. Vol. 24, No.3.

Tinh, D.Q. and Hang, P.T. (2003) *Living with Floods in the Mekong River Delta of Vietnam.* Paper for the World Water Forum Poverty and Flood Theme.
http://www.adb.org/Documents/Events/2003/3WWF/Floods_Mekong.pdf
Accessed February 2005

SIESO (1986) *Guide to Emergency Planning.* By The Society of Industrial Emergency Service Officers. UK, Paramount Publishing Ltd.

The Flood Forecasting and Early Warning Centre (2004).
http://www.ffwc.net
Accessed April 2005

Tierney, K. (2004) *Guidance for Seismic Safety Advocate: Communicating Risk to the Public and Other Stakeholders.* USA, Natural Hazards Research and Applications Information Centre.
http://mceer.buffalo.edu/publications/sp_pubs/04-sp02/2-05tierney.pdf
Accessed February 2005

Twigg, J. (2004) *Good Practice Review – Disaster Risk Reduction.* Humanitarian Practice Network. London, Overseas Development Institute.

UNDMTP
- (1994a) *An Overview of Disaster Management.* 2nd Edition. New York, Geneva, UNDP/DHA.
- (1994b) *Disaster Preparedness.* New York, Geneva, UNDP/DHA.
- (1994c) *Contingency Planning.* New York, Geneva, UNDP/DHA.
  http://www.undmtp.org/modules_e.htm

UNISDR
- (2004) *Living with Risk, A Global Review of Disaster Reduction Initiatives.* Volume 2, Annexes. New York and Geneva, UN.
- (2005) *The Basics of Early Warning.*
  http://www.unisdr.org/ppew/whats-ew/basics-ew.htm
  Accessed January 2005

UK Environment Agency (2005) *Ideas for a Household Flood Plan.*
http://www.environment-agency.gov.uk/subjects/flood
Accessed February 2005

Vietnam Red Cross (2000) *Disaster Preparedness Manual.* Hanoi, Vietnam Red Cross Society & DIPECHO

Wernly, D. (1994) *The Roles of Meteorologists and Hydrologists in Disaster Preparedness.* Technical Document WMO/TD-No. 598. USA, WMO.

9

emergency response

9 emergency response

The information in Chapter 8, Flood Disaster Preparedness, is necessary for implementing effective emergency procedures discussed in this chapter.

Chapter Brief

- Effective and efficient disaster response stems from adequate preparedness activities including emergency planning, early warning, drills and simulations, sandbagging, evacuation, etc.

- The decisions made during the response have a significant impact on the recovery and rehabilitation process.

- Good coordination and management of organisations and activities is imperative for containing the flood disaster and minimising loss of life and injury.

- Relief organisations need to cooperate through sharing information and coordinating activities.

- Standards and guidelines exist to encourage good practice.

- All organisations involved in emergency response have a responsibility to uphold proper ethical standards.

- Cultural norms need to be observed and respected during relief operations.

Key Words

Emergency

An extraordinary situation in which people are temporarily unable to meet their basic survival needs, or there are serious or immediate threats to human life and well-being (UNDMTP, 2002).

Environmental Health Management

The intentional modification of the natural and built environment in order to reduce risks to human health or provide opportunities to improve health (WHO, 2002).

Evacuation Camps

Designated places where emergency shelter is provided for those affected by the disaster. Evacuation camps vary in their sizes, services and life spans, but generally exist until people have recovered and found other options for shelter and can meet their own basic needs.

Incident Command System

The system used for commanding, controlling and coordinating the efforts of individual agencies as they work towards the common goal of stabilising an emergency in an effort to protect life, property and the environment.

Non-food Items

Essential items, excluding food, that are required in an emergency such as blankets, clothing, cooking equipment, oil lamps, gas heaters, storage containers, medicines, house repair materials, personal items, etc. Non-food items can also be provided following an emergency during the recovery stage.

Response / Relief

The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term or protracted duration (UNISDR, 2004).

Triage

A brief clinical assessment that determines the time and sequence in which patients should be attended to in the field. These decisions are generally based on a short evaluation of the patient and an assessment of vital signs. The patient's overall appearance, history of illness and / or injury, and mental status are important indicators to consider.

Overview

The aims of flood emergency management are to:
- Provide first response to the disaster through saving lives and preventing further losses.
- Contain the disaster and prevent escalation.
- Provide strong leadership and coordination to enable an effective response.
- Ensure decisions taken will be a positive contribution to the recovery and rehabilitation process and link to long-term development planning.

Scope and time-frame of emergency management depends on the:
- Magnitude and impact of the flood.
- Capacities and resources of the affected population and the organisational structures in place.
- Issuance of and adherence to flood warning.
- Existing emergency preparedness plans.
- Coordination and integration of emergency response organisations.

In disasters the stakeholders include the victims and affected groups, government, NGOs, donor organisations, UN organisations, surrounding communities, private sector companies and international donor governments. All of these stakeholders have their own agendas, objectives and perceived roles. It is important to understand that disaster response can be extremely charged politically. It is the role of the lead agency to enable an effective response to meet the needs of the affected population. The lead agency must provide strong leadership and coordination and address the necessary issues in disaster response whilst balancing the interests of the different stakeholders.

The first few hours of the disaster are the most crucial. It is important to recognise that the community provides the first response. Their natural coping mechanisms and capacities enable their survival. People are resilient and have the ability to support each other, drawing on relationship ties and any resources available.

This chapter on emergency response is not intended to be a handbook for operational response activities. It is aimed to highlight important issues that need to be addressed in response activities and guide emergency managers in their tasks. Guidelines exist on many topics, for example, water provision, sanitation and camp arrangements. However the emergency manager should base decisions on the situation. It is difficult to set specific standards on the issues related to emergency response as each flood disaster is different. Resources are listed throughout this chapter that provide in depth coverage of the topic.

Concepts of Emergency Management

see Chapter 8

Flooding disasters can be widespread or localised, therefore flood response operations need to be suited to the specific disaster conditions. Awareness, early warning and preparedness plans enable a more efficient response and should be encouraged for all communities at risk. Without emergency plans the response is prone to being ad hoc and disorganised. However, by following principles mentioned in this chapter, measures can be taken to reduce loss of life and meet basic human needs in a systematic organised manner.

Relief comes from a variety of sources and should not be only associated with emergency services and international organisations. The list below states some of the key players involved in relief.

- Affected community.
- Surrounding communities.
- National volunteers from unaffected parts of the country.
- Community-based organisations
- Local and national government
- Civil and Military Defence (land, sea, air)
- Outside NGOs (national or international) specialising in:
    - First medical response
    - Water and sanitation engineers
    - Search and rescue
    - Telecommunications
    - Trauma and mental health
    - Public health
    - Emergency shelter provision
    - Relief supplies
    - Needs assessments
- UN agencies
- Private sector companies
- Local, national and international Red Cross and Red Crescent Societies

Emergency Response Management

> *'Response operations usually have to be carried out under disruptive and sometimes traumatic conditions. They are difficult to implement and place heavy demands on personnel, equipment and resources.' (Carter, 1991)*

Role and function of an emergency operations center (EOC)

The EOC manages the emergency response effort through the Incident Command System, comprising of command, control and coordination of organisations and resources (ADPC, 2005b). It should be the central operational, tactical or strategic point for the lead agency and supporting staff to manage the emergency. Not all flood disasters have a formal EOC; however, there needs to be a central body for management of operational command.

The location and establishment of key roles and responsibilities within the EOC is dependent on whether the flood disaster is localised or transboundary. National guiding principles determine where responsibility falls. If the disaster is local, then the management will be at local level as shown in Case Study 9.1. If the flood disaster spans provincial boundaries, it is likely that the national government will take control as the lead agency.

Case Study 9.1

Community Level Management - Hat Yai

In Hat Yai city municipality in Songkhla Province, Thailand, locally-based Sammakhi Foundation specialises in emergency response. It trains local volunteers in first aid and search-and-rescue (SAR) and issues emergency warnings via radio. It is generally first on the scene and works closely with local government in emergency response. Its good track record of emergency response management has gained it trust within the Hat Yai community to take the lead role during disaster events. Most recent examples are during the November flood, 2001 when Hat Yai was inundated (ADPC, 2005).

EOC provides the following key services:

- *Strategic direction:* As all key decisions will be made in the EOC it will be possible to influence the management of the response in a strategic overall manner. It needs to continuously monitor the emergency and adjust to changes accordingly.
- *Information management:* The EOC provides a central information facility for the whole response phase, and will therefore provide an entire picture of the response and relief effort.
- *Task and problem management:* The EOC can be used to identify tasks and problems, decide the best plan of action, and implement it.
- *Forward planning:* The EOC can be used to identify possible future tasks and problems and in doing so, will be able to self-monitor its own effectiveness.

(ADPC, 2005b)

The EOC at operational level

A physical room or building near the affected area(s) is required in order to run the operational management. This should be a coordination point through which flows all operations related information and decisions. The roles and responsibilities should be pre-arranged in the preparedness plans. They include:

- Key decision-making (government, disaster risk managers).
- Advice and liaison officers (including media management and information analysts).
- Forward planning (programme officers, logistics, camp management).
- Support functions (administration, IT support, accountants).

The people that fill these roles are determined by the disaster itself. The EOC is run by, but not limited to the lead agency. Other personnel can include key representatives from the local authority, fire / police and disaster management organisations who should be involved as well as representatives from NGOs and UN organisations where necessary.

Coordination

The coordination of organisational activities is essential. Box 9.1 outlines how to achieve joint operations to strengthen the response, improve the quality of services, avoid replication and ensure compatibility between projects and activities.

see Box 9.1

Inter-organisational communications

One of the main hindrances to effective response is the poor communications between organisations. The following should be considered to improve communications:

- Keep up to date through daily situation reports, notice boards and meetings.
- Talk and listen to each other.
- Share information and receive instructions.
- Make preparedness plans with outlined communication protocols and arrangements.
- Encourage reporting to the appropriate people.

Box 9.1
Joint operation outlines

Sharing baseline information on:	Working together at:	Sharing plans and resources:
• Roles and responsibilities	• Assessing needs	• Joint contingency planning
• Resources and capabilities	• Setting standards for assistance	• Joint strategic planning
• Types and quantity of capabilities	• Mobilising resources	• Joint operational planning
• Type and quantity of assistance	• Ensuring access	• Sharing experts
• Areas of operations	• Building capacities	• Sharing security
• Priority needs	• Joint training	• Sharing logistics
• Projects and gaps		
• Local context		

(WHO/EHA/EHTP, 1998)

The roles of the UN and national government in strategic management

Strategic emergency management occurs off-site at provincial or national level depending on the scale of the disaster. These too are comprised of an EOC whose activities are determined by the nature and development of the disaster. The lead agency is responsible for strategically managing this response effort.

The UN Disaster Management Team (DMT) can assume the lead agency position or assist the lead agency. The team is lead by a resident UN coordinator, and is composed of country level representatives from a number of disaster related UN agencies. UN agencies generally play a supporting role providing funding, expertise, resources and management assistance. The role and level of their involvement at strategic level management depends on the emergency and capacities of the government.

Coordination and management arrangements for disaster response have taken a number of forms as listed below:
- Host government as lead agency.
- UN organisation as lead agency.
- Military operation with humanitarian assistance.
- No lead agency (decentralised leadership with special coordination from NGO consortium).

(UNDMTP, 2002)

Ideally the government should be the lead agency at the strategic level (specifically the NDMO). Other departments such as the ministry of health, utilities and environment the UNDMT, other UN organisations and NGOs should provide support where necessary.

The benefits of the government being the lead agency are:

- Builds capacities of the disaster management team.
- Encourages responsibility and ownership of the disaster response.
- Allocates responsibility in disaster response prompting action for future preparedness and flood risk reduction.
- Enables better recovery plans by understanding the disaster, response constraints and complexities.

If the government lacks capacity to co-ordinate, then the UNDMT can increase its level of support. However, whether or not the government is willing or capable to assume the responsibility for disaster management determines the success of the response (UNDMTP, 1992). Throughout Asia many governments such as in India, Bangladesh and Thailand, are increasing their capacity and desire to be key players in disaster response.

NGOs are extremely active in emergency relief and require permission to operate in different countries. They should enter into a legal agreement with the government in order to be accountable for their response activities. The lead agency should register NGOs and allocate roles and responsibilities (expertise, resources and relief supplies) according to area or sector. It is useful to have a roster of pre-qualified NGOs to call on during an emergency, thus avoiding delay due to the selection process.

Operational Response Activities

Assessments

> *'Good assessment practice is about having enough relevant information on which to base sound analysis and judgment about response' (Darcy and Hofmann, 2003).*

Relief activities should be based on rapid needs assessments carried out within the initial stages of the flood disaster to identify the effect of the disaster on people and their immediate needs. Needs assessments during emergencies have the following objectives:

- Confirm the reported emergency and estimate the overall magnitude of the damage.
- Identify, characterise and quantify "populations at risk" in the disaster.
- Help to define and prioritise the actions and resources needed to reduce immediate risks.
- Identify local response capacity, including organisational, medical and logistical resources.
- Help anticipate future serious problems.
- Help manage and control the immediate response.

(UNDMTP, 1994c)

Organisations should not make assumptions that their assistance is by any means required or necessary. The assessments should lead to the following decisions:
1. Whether to intervene.
2. The nature and scale of intervention required.
3. Prioritisation and allocation of resources.
4. Programme design and planning.

(Darcy and Hofmann, 2003)

Criteria for good assessment practice:
Timeliness. Assessments for emergency response are conducted immediately after or even during a flood disaster. It is pointless to arrive 3 weeks after the disaster strikes to carry out search and rescue.

Relevance. Know the capacities of your agency and staff. Assessments should be based on the area of expertise, knowledge and experience.

Coverage. The needs assessment should determine the scale of potential response and recovery projects.

Validity. Methods of data collection should be appropriate for information needed. For example, it is more appropriate for women interviewers to collect data about lactating mothers.

Transparency. Make information available and state methods of collection. Be aware of personal bias and assumptions made.

(Adapted from Darcy and Hofmann 2003)

Needs assessments need to have a simple format. For example, checklists, lists of questions and tables and should be categorised into sectors beginning with general demographic information as shown below.

Box 9.2
Water needs analysis

Serial Number	**Location** (district, town or village)	**Total number of people without potable water**	**Response Status** (number of people being supplied with potable water under local arrangements; condition of supply system and repair status; availability of surafce water)	**Unmet needs** (number of people for whom external supplies of water are requested. Say if treatment supplies, containers of trucks are needed)	**Priority**
(a)	(b)	(c)	(d)	(e)	(f)
8.1					
8.2					
8.3					
etc.					
total					

Box.9.3
General tools for gathering information

Ensure that a representative cross-section of the population is surveyed. This includes, gender, age, ethnicity, occupation, etc. General tools for gathering information:

- Key informant interviews
- Focus group discussions
- Surveys
- Participant observation
- Secondary sources

The general contents of the assessment should include:

- Description of event
- Geographic area
- Number of people / households affected (deaths, injuries)
- Number of dwellings / buildings / roads / bridges destroyed / damaged
- Number of livestock lost, dead or injured
- Financial costs and asset loss
- Survey accessibility, transport routes
- National level capacity to deal with it first

Specific sector based assessments should cover the following topics:

- Protection and security
- Medical and health
- Shelter and clothing
- Food
- Water
- Sanitation
- Access and infrastructure
- Overall public and environmental health

Situation assessments and updates should be provided for incoming agencies, the media and the national government.

Logistics and communications

Logistics is the backbone of emergency response. It puts everything in place to enable the relief operation to be effective and be based on assessments. It has been described as *getting the right thing to the right place at the right time at the right cost (Davies and Lambert, 2000).* Good planning will reduce waiting time and delay in procurement.

Logistics covers the following areas:

- **Transport and access:** Determine modes of transport and access routes for evacuation and rescue operations and relief projects.

- **Identification of sites**: Identify locations for safe zones for temporary shelter and meeting places.
- **Communications**: Maintain technical communications with head office, field workers and other organisations.
- **Control of resources**: Stock control, prioritisation, deployment of resources.
- **Procurement and management of equipment**: Ensure the transparency, availability and timely maintenance of relief and project equipment, for example water storage tanks, rescue boats, etc. Consider sources of supply: local, national, international. Use local human and material resources where available.

Communications

During a flood disaster, normal telecommunications systems such as landline telephones, mobile / cellular phones, internet and email services may be disrupted or fail. In this case, contingency communications systems may need to be established to meet essential emergency communications needs.

Recently, the exponential growth of mobile phone usage has dramatically increased the ability of people to communicate. During a flood, mobile phone transmission towers are generally, but not always still in working order. However, networks become saturated due to inundation of calls and SMS messages, jamming systems so they are unusable for a number of days. Although they can be of great assistance, they should not be relied upon. Alternative communications must be considered and arranged.

Box 9.4

Communications systems

Radio communications provide a good long-term option for failed telecommunications systems. It is both cheap to operate and reliable. However, the initial equipment is costly.

Satellite communications provide a good short-term option and support multimedia communications. They are compact, mobile, and easy to set up if correct training is provided. However, they are expensive to operate.

Some organisations have their own in-house telecommunications systems such as satellite phones and radio equipment. However, others enter an emergency situation unprepared. It is not viable for some NGO's to own their own system as they are costly to purchase, maintain, operate and replace. Therefore, there are some specialised NGO's with the specific objective to provide this much needed service during the initial response (as shown in Case Study 9.2).

see Case Study 9.2

Box 9.5

TSFI in action

TSF providing communication

In Asia, Telecom sans Frontier International (TSFI) has recently established itself as a reliable and effective telecommunications service provider for emergency response. They provide satellite phone, fax, email and video transmitting services to response organisations and affected people. As first telecommunications responders, they enable response and relief organisations to communicate information between each other and with their headquarters about the situation on the ground and needs. For more information see: *www.tsfi.org*

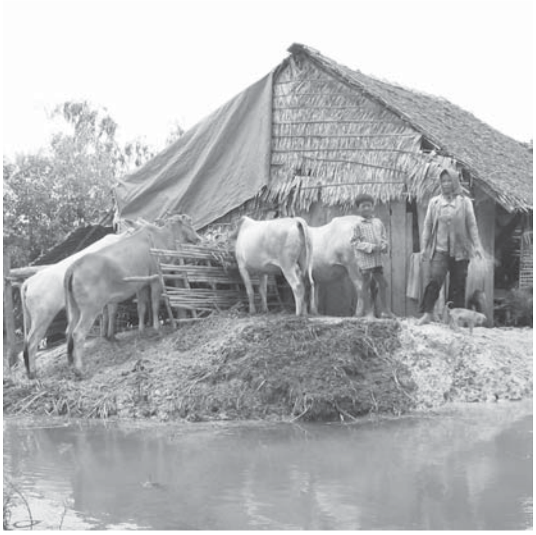
Box 9.6

Communications issues

- Some organisations arrive without equipment.
- Lack of technical skill to set up equipment rapidly (2-3 hours from arrival).
- Lack of technical skill to operate equipment.
- Lack of technical coordination to bring the correct equipment, for example, not knowing the correct passwords, not understanding compatibility with other equipment.
- High cost of specialised emergency telecommunications systems.
- Lack of planning.

Results of poor communications:
- Directly affects response activities and results in further loss of life and / or damages.
- Potential security risks.
- Uncoordinated response.
- Potential to exacerbate the already chaotic situation.
- Inability to transfer information to headquarters (assessment and situation results / reports, requests, etc.).

Evacuation



Safe areas for animals and livestock may also need to be provided. Common practice in Asia is to raise roads above annual flood levels. During flood times, people herd livestock such as cattle and chickens to these higher grounds along with enough fodder to ensure the survival of these precious resources

The aim of evacuation during the response is to move people away from the flooding and danger. Evacuation can be a complex task and it is likely to turn into a large rescue operation if no prior flood warnings and evacuation has occurred. The evacuation process demands a high degree of coordination and planning. During flood disasters, preparedness plans may provide guidelines regarding evacuation locations and routes. However, if no plans exist the following factors should be considered:

- *The severity of the flood (height and velocity)* determines whether people can walk or drive out of the area as this is only possible in shallow slow moving water or they may have to move to higher ground or the top of a building and await assistance.
- *Warning lead time* determines the evacuation procedures.
- *Secondary hazards* such as landslides, mudslides, moving debris, polluted floodwaters, live power cables, snakes, etc.
- *Vulnerable groups* such as children, elderly, pregnant women, people with disabilities, etc.
- *Availability and type of transport* such as walking, non-motorised vehicles, buses, cars, boats, helicopter, army vehicles, etc.
- *Designation of routes and alternative routes.*
- *On route communications,* such as situation updates.
- *Communication* to notify people of evacuation and safe areas (through rescue workers and loud speakers).
- *Destination* such as designated safe areas and reception centres.
- *Amount of people*.

Safe areas

Plans may allocate areas to provide a safe and temporary location for people to convene before evacuation camps and temporary shelters are arranged or until they can return to their houses. It allows people to find their friends and relatives and provides them with basic needs such as blankets, water, food and sanitation facilities. A coordinating team or NGO should start registering missing

Safe areas can include:

- Schools.
- Religious meeting places (such as temples, churches, mosques).
- Community centres.
- Higher ground (roofs, upper floors, embankments, trees).

Case Study 9.2

Vietnam Flood Kindergarten

Floods are the busiest time of the year for parents who make their livelihood from fishing. Extensive flooding in 2000 and 2001 claimed the lives of many children, catalysing the government to respond by setting up safe places for parents to leave their children during flood warning times. These 'flood kindergartens' have reduced the number of child casualties, caused by separation from their parents, disorientation in crowds and panic, and being swept away by floodwaters. They are suited to the prolonged flood periods and activities in Vietnam. In 2002, a total of 20,273 children were recorded to have used the 918 emergency flood kindergartens as safe places, resulting in a decline in loss of life.

(UNISDR 2003)

persons. The location should be close enough for people to get to, but far enough not to be affected by the flooding if it worsens. It may be a building or simply a cordoned off area away from the danger.

Security

Many people in Asia may resist evacuation and rescue in order to protect their households and assets, thus endangering their lives. Preventing looting after the emergency phase by protecting people's assets will reduce the individual loss incurred. The military or police may take the role of providing security for a given period of time after the disaster before people can return to their homes.

People not leaving their abodes

Search and Rescue

Search and rescue (SAR) should commence as soon as possible, but the safety of the workers must also be considered first. The decision to deploy personnel must be based on the current floodwater conditions, the suitability of the equipment and support available to enable a safe rescue. The search method should be systematic, based on information gained from survivors, geographic area or known populated sites, such as schools. There are often many volunteers for SAR, they


Rescue workers in action

can be valuable resources and should be included. However, most will be untrained and will need to be led by experienced team leaders or allowed to undertake low risk roles where they cannot endanger themselves or other rescue workers. The staffing should be arranged on a rotating basis, to enable ongoing SAR operations and minimise stress and exhaustion. A SAR work plan should be arranged allowing for 4 - 6 hours on, 4 – 6 hours off, for each rescue worker.

see chapter 8

SAR may require the equipment listed below as available. Appropriate rescue methods (boats, swimming, airlift, etc.) will depend on the nature of the water in relation to the safety of the proposed method of rescue. There will be time constraints as people will be prone to shock and hypothermia after extended time spent in cold waters. Rescue workers need to consider the transportation of injured people and must have information on the nearest triage site. They should have communications equipment to maintain contact with the operations unit at all times.

Suggested Equipment

Suitable rescue ropes[1]
Ladders
Buckets
Harnesses
Floating rescue devices
Life jackets
Inflatable boats and dinghies[2]
Torches
Loudspeaker
Blankets
Tools – axe, metal cutters, crowbar, rescue knife
2 way radios or other reliable communications equipment

Triage

There should be an area for triage where injured people are brought and treated. Because flooding can cover a vast area, there will need to be a few triage points as rescue workers may not be able to travel far with injured people. The following points should be considered:

- Ambulances and field medical staff should be informed to convene at triage points.
- A prioritisation system should be set up to determine the level of treatment required.

---

[1] Not all ropes are suitable for water SAR. By using ordinary ropes you are risking both rescuers and victims. Characteristics of water SAR rope: Floats, excellent strength to weight ratio, abrasion resistant, excellent wet / dry strength retention, torque-free, stays flexible and very easy to handle, and spliceable.

[2] Ideally boats should be inflatable, consist of different air compartments. Many rescuers and victims have perished during rescue, due to the boat. Fibreglass and alloy boats are not stable for rescue operations. The rescue boat should have an outboard motor (OBM) with 30HP as the minimum for 6-8 personal capacity. No one will be allowed in the boat without any life jackets, both rescuers and victims.

- Patients should be stabilised first in the field before transporting. Only the most serious casualties are taken to an identified hospital or clinic.
- The walking wounded or those with non-critical injuries should be treated onsite.
- An Advanced Medical Post (AMP) in the field provides medical treatment in case of mass casualty incidents.
- Doctors and medical NGOs should help in operating the areas.
- Areas should be allocated for bodies and a process of photographing and tagging for identification purposes may be necessary (see Section on Environmental Health).

Guidelines

There are a number of recommended standards and guidelines directing response and emergency procedures, activities and actions. It is important to realise that the flood disaster will ultimately dictate the appropriate decisions to make. For example, sometimes conditions do not allow for the required quantity of 15-20 litres of water per person per day for standards during emergencies. However, this may not take into account different cultural aspects of water use and more may be necessary. The following key guidelines should be applied as the situation allows.

Sphere guidelines

The Sphere Project's Humanitarian Charter and Minimum Standards in Disaster Response sets an international standard for relief efforts based on its humanitarian charter. The charter itself addresses the *"most basic human requirements for sustaining the lives and dignity of those affected by calamity or conflict" (The Sphere Project, 2000)*. The Standards advocate a 'rights based' approach to disaster response. The Standards in Disaster Response concern the relief assistance for water supply and sanitation, nutrition, food aid, shelter and site planning and health services (The Sphere Project, 2000). The guidelines are accepted and becoming more widely used by NGOs, but governments and their agencies also have a role in applying and striving to meet these standards in their response efforts. For further information see: *http://www.sphereproject.org*

UNHCR Handbook For Emergencies

The UNHCR Handbook for Emergencies is a practical guide to implementing emergency operations. The book specifically covers how to address refugees and internally displaced people, which in the case of flooding, thousands can become displaced. The book contains much about setting up and managing camps and the issues surrounding refugee and evacuation camps (UNHCR, 1999).

Relief Projects

> *'In all stages of the emergency, the problems and needs of the affected population must be seen comprehensively, and sector specific tasks be set within a multi-sectoral framework, since the action in one area is likely to affect others. For example the real solution in addressing health problems might be found in improving the water supply. Ensure the correct balance in resource allocation between the different sectors'(UNHCR, 1999).*

Relief efforts should be implemented following project management principles and processes. It ensures that they are well-planned. The project management processes include time, resource, quality and human resources management. Response activities include a number of different 'projects' such as setting up a temporary camp, water distribution, sanitation and relief supplies distribution. The implementation of these projects like any other project should be done using project management skills, which are summarised in Box 9.7.

Box 9.7
Project management

Project Management Skills	Project Management Process	Constraints and Considerations
Managing self and people	Instigation	Time
Leadership	Planning	Security
Finance and accounting	Implementation	Stakeholders requirements (donors and beneficiaries)
Coordination	Closing	Funding
Negotiation	Evaluation	Competition
Communication		

Figure 9.1 provides a contextual framework on which to base the planning for projects in emergencies.

Figure 9.1
Contextual framework for project planning

Environment

Climate
Accessibility
Land Features
Setting (urban/rural)
Duration of flooding

Project Management

- Time: Immediate, intermediate and long-term service activities
- Link to recovery for sustainability
- Agency coordination
- Assessments
- Roles and responsibilities of government and NGOs
- Integration with other projects, sectors and agencies
- Beneficiary participation in planning and implementation

Technology

Cost
Availability
Operation
- Skills
- Equipment
- Maintenance

Social

- Population density
- Health
- Demographic mix and changes

- Time-frame
- Cultural and religious practices and norms

Political

Local
- Conflicts
- Access to resources

National
- Level of commitment
- Level of investment

International
- Media
- Responsibilities
- Pressure

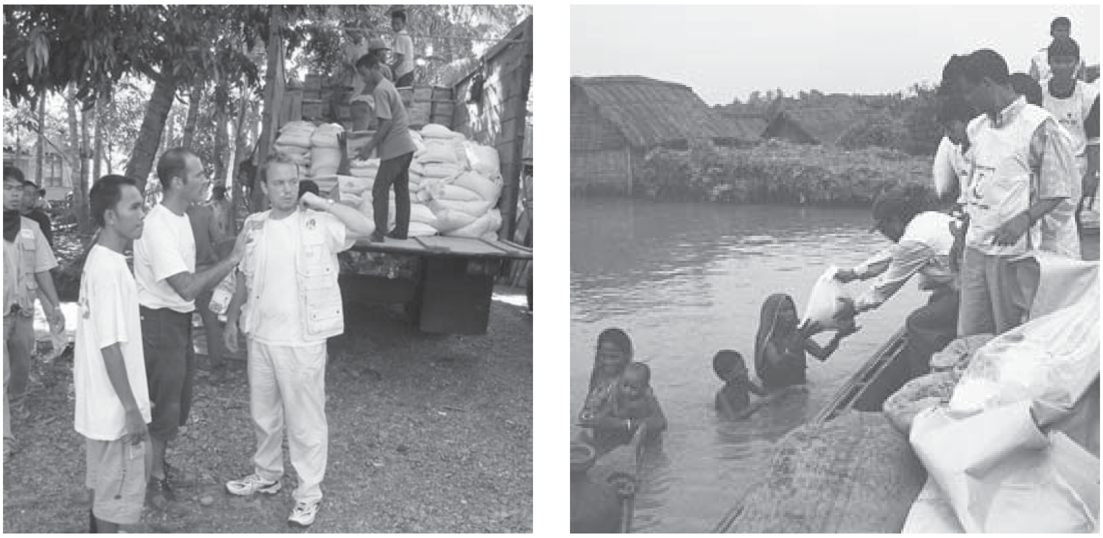
Relief items distribution

Relief items can include food or non-food items donated from surrounding areas and from other parts of the world. Coordination of relief items is essential and it should be managed systematically under the EOC. There should be a collection area for supplies where they are registered and allocated to specific areas or groups. Although there are often time constraints, effort should be made to provide a comprehensive system and inventory to ensure that all areas in need are served and duplication is avoided. The system should take into consideration access and the ability to distribute items to people or their ability to come to collection points. Relief items can include shelter materials, food, clothing, medicines, cooking utensils and general household items.

Local and international NGOs and the international community often send supplies. However, they need to be sorted as donors may send items that are inappropriate. Many organisations distribute their relief items themselves, resulting in unaccounted incoming and outgoing relief items. There should be coordination with the Relief Items Coordinator to decide on where to distribute them and to whom, based on prioritised need.

> Dear International Donors,
>
> Thank you for expressing your desire to help us. We need 2000 cakes of soap, 1000 blankets, 300 torches, 200 tents, water tanks, purification tablets, antibiotics, sterile dressings, tetanus and cholera inoculations, mosquito nets, condoms, cooking utensils, and sari material. We do not need medicines with instructions written in a different language, out dated drugs, diet or heart disease medication, tinned food, inappropriate clothing, unusable appliances...
>
> Thank you,

The relief distribution system should ensure that the supplies get to the affected population. In some cases, supplies have been intercepted and sold on the black market instead, or politicians have made false claims about donating supplies causing potential political problems.



Distribution of relief supplies

Health

The response must include measures to address and reduce the health impacts of flooding to the entire population. It must be appropriate in terms of the conditions, injuries and patients (refer to Case Study 9.3). The health response must be able to deal with a large number of people, water-related diseases and injuries directly from flooding. It should be led by the national health authority, but may involve agencies and outside assistance where required. The health and medical response involves triage, hospitals, evacuation camps (basic health units) and clinics, and should ensure provisions are made for those who are not staying in camps. The health response should consider:

- Coordination with agencies, SAR and the EOC.
- Coordination with health related and medical NGOs with the national health sector.
- Health centre administration, treatment and redistribution between evacuation centres.
- Health management in shelters and camps.
- Mass casualty management.
- Identification of bodies.
- Epidemiological surveillance and monitoring.
- The changing nature of health needs.
- The need for additional human resources and medical supplies.
- Public health and immunisation programmes where necessary.
- Common flood related illnesses and injuries (water-related, venomous spider, snake and scorpion bites).

Case Study 9.3

Appropriate Medication

Medication needs to be provided in an appropriate form, depending on the patient, the injury and conditions. For example:

> *My son is very sick; for the last few days he has had dysentery and is very sick. The NGO doctor gave us some tablets, but how can a child eat tablets? We need syrup. They sell syrup in the market. Why do they give us these big tablets. Our children will not be able to swallow these big tablets?*

(Rashid, 2000)

Environmental Health

Environmental health concerns maintaining good public health by the provision of improved sanitation facilities, adequate water supply and shelter to disaster affected communities. It also involves managing the risk of diseases and epidemics (WHO, 2003).

Communicable diseases

Many communicable diseases are water-related and are therefore high risk during and after a flood. Infectious water-related diseases have been classified into four categories.

- **Water borne** diseases include cholera and typhoid, acute diarrhoea and other intestinal diseases. They are transmitted by a pathogen through the excreta - oral route. They are highly transmissible in water, but it is not the only source of infection.
- **Water washed** diseases include trachoma (blindness), scabies and skin infections, lice and faecal-oral diseases which can be prevented by good sanitation practices. These diseases can be treated and avoided by increased water supply for washing.
- **Water based** diseases are caused by pathogens which spend part of their life cycle in an aquatic animal such as water snails and other helminths and fungi, which can transfer to humans.
- **Insect vectors** spread diseases such as malaria, dengue and sleeping sickness. These are insects which breed or bite near water.

(Cairncross and Feacham,1993)

These diseases can be prevented by encouraging good hygiene practice and preventing flies from gathering in excreta disposal areas. Clearing and preventing standing water reduces breeding sites for vectors, water-based parasites and fungi. It is important to make the link between health problems and water quantity and quality.

Although disease outbreaks do not usually occur for a number of days or weeks after the initial flood impact, it is important to monitor prevalence rates in order to identify public health problems.

The management of dead bodies

There has been great concern about the spread of disease from decomposing bodies, however, this has been proven to be myth. Whilst it can still be a risk, the main issues in this regard are:

- Psycho-social aspects of grieving relatives.
- Ensuring the management of the dead complies with the need for people to grieve (that is, allowing identification of relatives).

- Prioritising victim identification.
- Avoiding burial in mass graves before formal identification.
- Establishing a database of dental records, DNA, photographs, etc. before burial if victims cannot be identified in the short-term.
- Ensuring cultural and religious practices with regard to treatment of the dead are acknowledged and allowed where possible. For example, not cremating dead bodies when people are usually buried, dealing with the dead within a 24 hour time frame.
- Ensuring that personnel dealing with dead bodies have personal protection including gloves, masks, goggles and gowns.

(Interpol, 2005; PAHO, 2005; Morgan, 2004)

Box 9.8
Environmental health actions in the acute emergency phase

- Provide facilities for people to excrete safely and hygienically.
- Protect water supplies from contamination.
- Provide a minimum amount of water for drinking, cooking, personal and domestic hygiene.
- Ensure that people have enough containers to collect and store water cleanly.
- Ensure people have sufficient cooking utensils, equipment and fuel to cook and store food safely.
- Ensuring people have the knowledge and understanding they need to avoid disease.
- Ensuring that people have soap for hand washing.
- Containing or removing sources of contamination to ensure they are no longer exposed to the hazards.

(WHO, 2002)

Considerations for a water supply system

Objective:

- To assure the availability of enough water to allow its effective distribution in the required quantities, and to ensure that it is safe to drink (UNHCR, 1999).

Assessments must be made to determine a suitable water supply system as soon as possible. Water supply during flooding is critical as contamination of fresh water supplies may occur. In some events, bottled water is provided. Organisations and private companies doing this should make arrangements for the collection, recycling and disposal of water bottles.

- **Source of water.** Include groundwater, surface water, springs, rainwater harvesting, tankering water in from other areas.
- **Quality of water.** Determines the need for water treatment.
- **Environment.** Consider the climate, soil type, depth to water table, slope, location from latrines and living areas.
- **Protection of water source.** Include covered wells and boreholes, concrete surfaces, located away from latrines. Consider possible downstream seepage contamination.
- **Delivery of water.** Consider tankering, pipe distribution systems, collection from a point source, minimising leakage, consider the distance travelled to collect water.
- **Storage.** Water storage tanks, tanker-lorries, storage per household.
- **Continuity of supply.** Consider demand and provision of water, for example constant or limited supply, temporary or ongoing.
- **Uses of water.** For drinking, cooking, washing, washing clothes, animals.
- **Coverage.** Consider the required quantity for the affected population taking into account changing demographics.
- **Other considerations.** Equipment available, social issues, political climate, education about sanitary practices.

Considerations for sanitation systems

'Act first, Improve Later' (UNHCR, 1999).

Objectives:

- To isolate and contain human excreta in a culturally appropriate manner.
- To modify the environment in which disease-carrying organisms are simultaneously most vulnerable and threatening to humans.

(Chalinder, 1994)

- **Environment.** Consider the climate, soil type, depth to water table, slope, location from water sources and living areas.
- **Excreta disposal.** Systems include managed defecation areas, trench, pit, borehole, Ventilated Improved Pit (VIP) latrines, water flushed systems.
- **Maintenance.** Ensure the areas are hygienic and suitable for use. Employ people to clean and encourage people to leave areas in a suitable condition. Provide materials for cleansing such as toilet paper, water, paper or other. Ensure they are compatible with the latrine system.
- **Waste Treatment.** Stabilisation and treatment ponds as necessary.
- **Cultural Acceptability.** Create a planning committee made up of the affected people to ensure that the sanitation facilities are appropriate according to cultural practice.
- **Security.** Ensure facilities are safe for women and children to use, for example, not in isolated, unlit areas. Ensure that they provide an adequate amount of privacy.
- **Sanitary practices.** Provide water and soap for hand washing.

Temporary shelter

'The key to providing adequate shelter is provision of a roof' (UNHCR, 1999).

Temporary shelter provision must be adequate enough to protect people from the elements and provide them with a level of security and privacy. Shelter provision must be in accordance with water and sanitation facilities and other service activities. It is often most appropriate and manageable to set up camps for displaced people. Shelter provision may include the transformation of existing buildings or the construction of new buildings. It is essential to include the affected people in planning for shelter provision to ensure that shelters and layout are appropriate.

Shelter type will depend on:
- Location (urban / rural).
- Climate.
- Projected time length of occupation.
- Facilities provided such as for cooking, latrines (planning should be in conjunction with these sectors or camp planning).
- Size of population.
- Resources available.
- Hazards associated with shelter (fire, collapse).
- Cultural and traditional requirements.

Considerations for Planning Evacuation Camps

> *'Whatever the circumstances, the overriding aim must be to avoid high density population refugee camps' (UNHCR, 1994).*

Evacuation camps require much planning in order to meet needs and provide a sanitary and safe environment. Evacuation and the movement of a large amount of people can cause public and environmental health problems. The movement of people should be coordinated where possible to prevent overcrowding and depletion of resources. The movement of the population must be managed so that requirements do not exceed supplies. The following points must be considered when planning an evacuation camp.
- Site Selection.
- Environmental protection (conduct EIA) to reduce environmental impact.
- Accessibility.
- Location and capacity.
- Shelter type and layout, fire risk reduction.
- Water distribution.
- Drinking water sources and supply.
- Sanitation - latrine design and location.
- Drainage and wastewater disposal.
- Registration of displaced people.
- Basic health units with waiting areas sheltered from the sun and rain.
- Wet / dry feeding centres.
- Supplementary feeding centres.
- Meeting areas - religious / school.
- Solid waste disposal.
- Cemetery.
- Security and protection.
- Time considerations (duration of camp lifetime).

Camp management

There are a number of other issues that need to be considered by camp management, which include:

- **Registration of people, health and supplies**
  This should occur at an appropriate time in the emergency, not during the height of it, but soon enough to provide information about requirements to direct relief supplies. Ongoing relief distribution must be managed.
- **Provision of information**
  Information on the demographics, needs and facilities of the camp should be provided to the EOC and NGOs.
- **Monitoring needs and providing facilities as needed**
  Be aware of the changing environment of the camp, the morale of people, their behaviour and development as a community in a high stress condition.
- **Managing social issues that may occur**
  Conflicts, disputes and other social issues may arise. The camp manager should appoint community leaders to resolve issues and provide leadership.
- **Provide a link between affected people and recovery planners**
  Participation is essential to enable people to be part of their own recovery planning and process. A platform for dialogue and communication must be established to foster the link.

Sphere guidelines provide suggestions for the relative locations of sanitation facilities, fresh water sources, washing areas and living areas. It is essential in camp planning to ensure the best public health possible.

Box 9.9

Evacuation camps in Asia

In most cases in Asia, the affected people do not commonly rely on evacuation camps. Instead of depending on outside assistance, they tend to lean on strong kinship ties and community-based networks. They will seek refuge in the homes of others, share food and other resources, look after each other's children, and protect each other. Evacuation camps are used more as a point for relief item collection rather than a temporary home.

Key Planning Issues

Utilising local resources

The affected communities can provide valuable human resources. Many will be willing to assist the relief effort and help set up and run activities. Organisations should seek to utilise local human resources such as nurses, project managers and assistants, translators, etc. This will be beneficial to the relief effort as local people understand the situation, geographic area, needs and cultural specifications. They also know more about the material resources available in the area.

Media

The media can be the disaster manager's greatest enemy or best friend. Emergency managers at all levels need to understand how to relate to and use the media to benefit the relief operation. An information officer should be allocated to provide briefings to ensure the media have the right information to disseminate to the public. They should be used to give vital information to the national and international communities. They should be treated with respect and as allies.

However, the media plays a large role in determining the size of the response effort. Extensive media coverage makes a disaster high profile, encouraging more NGOs to respond. This can have extremely negative consequence resulting in overcrowding, publicity-based response activities and competition for media attention.

Responsible reporting of disasters should be encouraged as the media is powerful in shaping perceptions of viewers and listeners. The following points below highlight some of the issues surrounding media coverage, disaster response and the organisations involved.

- The media and response organisations should respect the disaster affected population and not exploit them to achieve their own goals.
- NGOs should avoid using media coverage as an organisational campaign or advertisement.
- The EOC should utilise the media to relay information. Giving clear messages regarding the need or lack of need, for funds, relief items and further NGO assistance.
- The media should bring people's attention to the forgotten stories. Often severe floods can occur for months. Continued coverage and follow up stories will maintain awareness about the disaster situation.
- Extensive media attention of one particular disaster diverts public, government and NGO attention away from other disasters and development issues.

Contingencies

Contingency plans should be put into effect where necessary. Measures outlined in emergency plans may not be possible to execute, therefore decisions must be made swiftly to enable the response to continue.

Contingency plans may need to be adopted when:

- Allocated buildings for emergency management are affected by the flooding.
- Designated managers and people of other positions with particular roles are injured or die.
- Secondary or multiple hazards occur which escalate the disaster.
- Political situations or civil unrest develop.

Limitations

Do's	Dont's
Do base donations on requests of what is needed or not needed.	Don't make assumptions about needs.
Do think carefully about your capacity to respond effectively to the needs of the disaster affected people. Respond according to a request for assistance and as initial needs assessments dictate.	Don't base response on media hype.
Do provide a timely response if you are going to respond.	Don't arrive late to provide SAR or medical response. These activities must be undertaken within the first few days of the emergency.
Do record and document your response activities. You are accountable for all your decisions and actions.	Don't use emergencies as organisational advertisements and promotions of your actions. For example, don't set up "mock" activities for publicity purposes.
Do proper assessments and research that lead to projects which meet the needs of people and are within your organisational capacity.	Don't implement response activities based on donor financial incentives. Donors should not compete with each other to meet most visible needs in a country.
Do construct platforms and mediums for communication and dialogue.	Don't exclude the affected people in planning response as well as recovery activities.
Do consider the impact of your project on the environment. Conduct an EIA.	Don't destroy the environment.
Do consider existing relationships and power structures in the community.	Don't cause tension in the community by ignoring social structures.
Do ensure projects meet the needs of the people not the needs of the donor.	Don't encourage project implementation without stringent assessment.
Do attend NGO and organisational meetings, register with the lead agency upon request, share information, where possible collaborate, cooperate and form partnerships.	Don't ignore requests of the national government and also the lead agency for the disaster area.
Do respect all cultural practices and consider how they affect your project, for example, evacuation centre design, housing style, etc.	Don't ignore cultural norms, for example, appropriate dress, religious customs and traditional lifestyles.
Do consider the well-being of response personnel including sleep, mental health, food, water.	Don't overwork response personnel.
Do go prepared to carry out specific tasks, for example, take the correct equipment and skilled personnel.	Don't forget providing relief assistance to the disaster-affected people which is your main aim.

Emergency Response Activities Checklist

☑ Decision to respond should be based on an invitation or identified needs, and your organisation's capacity to provide critical help.

☑ Ensure you have a logistics plan.

☑ Register with the lead agency, attend meetings and coordinate activities.

☑ Carry out assessments to guide your work (needs assessments, EIA).

☑ Address the immediate needs of the affected populations including SAR, water and sanitation, food and shelter.

☑ Undertake your project using good project management practices.

☑ Ensure project closure and complete your monitoring and evaluation process.

Future Challenges

- *Good management is imperative.* There is no denying that emergencies cause a great deal of panic, stress and chaos. Response needs to be well-coordinated and controlled, and good leadership needs to command and direct activities and operations. Each flood disaster presents a different situation, which demands a flexible and adaptable approach to managing the emergency response.

- *Emergency response should be sought within the national borders of the affected areas first.* No one should enter a flood emergency with preconceived ideas about the situation, the needs of the affected people, and the process for carrying out response. There will be key areas needing immediate attention, however, to what degree, is dependent on the situation. No assumptions should be made in regards to immediate international interventions and that the affected people need your assistance. Community, national and regionally based organisations have capacities to deal with flooding emergencies to a certain level. This presents a future challenge for international organisations to step back when appropriate enabling the affected country to take greater responsibility in the relief effort.

- *Sharing information will prevent replication.* Assessments are necessary, however, the current practice leads to replication and repetition of information. Agencies and organisations have their own agendas... *'they tend to assess situations in relation to their own programmes making it hard to generalise from results of aggregate data' (Darcy and Hofmann, 2004).* This is a waste of resources and unnecessary personnel presence. It can also cause further post trauma stress for affected people if they are asked sensitive questions or to recount the event through survey questions on multiple occasions. Organisations should collaborate with their resources such as finances and skills to conduct joint assessments. The lead agency needs to take charge and delegate areas and sectors for assessments. All assessments and situation reports should feed back into the lead agency and affected government to ensure open transparency of the response effort and create a centre-point for handling information.

Resources

Assessments

ADPC (2000) *Post-disaster Damage Assessment and Needs Analysis.* Bangkok, ADPC.

ADPC (2000) *Tools and Resources for Post-disaster Relief.* Bangkok, ADPC.

IFRC (2000) *Disaster Emergency Needs Assessment.*
ReliefWeb resources *http://www.reliefweb.int*

Field Operations and Response Guide for Disaster Assessment and Response, USAID, Bureau for Humanitarian Response, OFDA (Chapter 2 – Assessments). *http://www.usaid.gov/our_work/humanitarian_assistance/disaster_ assistance /resources/pdf/fog_v3.pdf*

Relief

Vietnam Red Cross Society (2000) *Disaster Preparedness Manual*. Hanoi, Vietnam Red Cross Society and DIPECHO.

Wisner, B. and Adams, J. (ed.) (2002) *Environmental Health in Emergencies, a Practical Guide.* Geneva, WHO.
http://www.who.int/water_sanitation_health/emergencies/emergencies2002/en/

UNHCR (1999) *Handbook for Emergencies*. 2nd Edition. Geneva, UNHCR.

The Sphere Project (2000) *Humanitarian Charter and Minimum Standards in Disaster Response*. Oxford, Oxfam Publishing.

PAHO (1999) *Humanitarian Assistance in Disaster Situations, A Guide for Effective Aid.* Washington D.C., PAHO.

Edwards, M., et al (ed.) (2002) *The Earthscan Reader on NGO Management.* Fowler, Earthscan Publications Ltd.

Chalinder, A. (1994) *Water and Sanitation in Emergencies.* Good Practice Review 1. Humanitarian Practice Network. London, Overseas Development Institute.

Media and disasters

www.alertnet.org
Accessed April 2005

www.reliefweb.int
Accessed April 2005

Reference

ADPC (2005a) *Safer Cities 13: What is the Appropriate Mitigation Mix.* Bangkok, ADPC. Soon to be online.

ADPC (2005b) *Contingency Management Course (TBA).* Draft. Bangkok, ADPC.

Cairncross, S. and Feacham, R. (1993) *Environmental Health Engineering in the Tropics.* New York, J. Wiley Publication.

Carter, N. (1991) *Disaster Management: A Disaster Manager's Handbook*. Manila, Asian Development Bank.

Chalinder, A. (1994) *Water and Sanitation in Emergencies.* Good Practice Review 1. Humanitarian Practice Network. London, Overseas Development Institute.

Darcy, J. and Hofmann, C.A. (2003) *According to Need: Needs Assessment and Decision Making in the Humanitarian Sector*. Humanitarian Policy Group. London, Overseas Development Institute.

Davies and Lambert (1995) *Engineering in Emergencies.* 2nd Edition 2002, RedR.. London, ITDG Publishing.

Interpol (2005) *Victim Identification Guide*.
http://www.interpol.int/Public/DisasterVictim/guide/default.asp
Accessed March 2005

Morgan, O. (2004) Infectious Disease Risk from Dead Bodies following Natural Disasters. *Pan Am Journal Public Health*, Vol. 15, No 5.

PAHO (2005) *Myths and Realities in the Management of Dead Bodies*. Washington, D.C., (PAHO).

Rashid, S. F. (2000) *The Urban Poor in the Dhaka Floods in 1998.* Disasters Vol. 24, No. 3.

The Sphere Project (2000) *Humanitarian Charter and Minimum Standards in Disaster Response*. Oxford, Oxfam Publishing.

UNDMTP
- (1994a) *An Overview of Disaster Management*. 2nd Edition. New York, Geneva, UNDP/DHA.
- (1994c) *Disaster Assessment*. 2nd Edition. New York, Geneva, UNDP/DHA
- (2002) *The Roles and Responsibilities of the UN Disaster Management Team*. New York, Geneva, UNDP/DHA

http://www.undmtp.org/modules_e.htm
Accessed April 2005

UNHCR (1999) *Handbook for Emergencies*. 2nd Edition. Geneva, UNHCR.
Also available in PDF.

UNISDR (2003) *Living with Risk.* Geneva, United Nations.

WHO (2002) *Environmental Health in Emergencies and Disasters.* Ed. Wisner, B. Adams, J. Geneva, World Health Organisation.

WHO/EHA/EHTP (1998) *Emergency Health Training Programme for Africa.* Draft 1-1999. Addis Ababa, Pan-African Emergency Training Centre.
http://www.who.int/disasters/repo/5530.pdf
Accessed April 2005

recovery and rehabilitation

10

10 recovery and rehabilitation

This chapter is based on Risk Assessment (Chapter 4), Integrated Watershed Management (Chapter 5), Structural Interventions (Chapter 6), Coping with Floods (Chapter 7) and Flood Disaster Preparedness Planning (Chapter 8). These chapters are essential for sustainable recovery and rehabilitation.

Chapter Brief

- Recovery and rehabilitation presents an opportunity to integrate risk reduction measures into development planning.

- Recovery programmes should aim to build resilient communities, ensuring that measures are taken to address issues of sustainability. Communities should not form dependency relationships, they should be part of the decision-making process to ensure ownership.

- Comprehensive loss and damage assessments provide the information needed to develop an overall strategy, framework and programming for recovery activities.

- Sustainability is the key to achieving successful recovery. The process relies upon a holistic and integrated approach, allowing for multi-stakeholder and multi-sector participation.

- Governments need to take the leading role as the central body or recovery team or taskforce. They should be responsible for leadership, coordination, management and planning.

Key Words

Holistic Recovery

Recovery from a disaster that takes into account all the principles of sustainability in decision-making and action (Natural Hazards Research and Application and Information Centre, 2001).

Recovery / Rehabilitation

Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk (UNISDR, 2004).

Reconstruction

Actions taken to re-establish a community after a period of rehabilitation subsequent to a disaster. Actions would include construction of permanent housing, full restoration of all services and complete resumption of the pre-disaster state (OFDA, in UNISDR, 2001).

Sustainability

The ability or capacity to keep something going, or the state of being durable, or able to persist over time. Disaster resilience is one of the six principles of sustainability (Natural Hazards Research and Application and Information Centre, 2001).

Sustainable Development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs (Brundtland Commission, 1987 in UNISDR, 2004).

Sustainable development is based on socio-cultural development, political stability and decorum, economic growth and eco-system protection which all relate to disaster risk reduction (UNISDR, 2004).

Overview

Once the emergency aspect of the disaster has subsided, affected countries are faced with the tasks of recovery, rehabilitation and reconstruction of the area. The impact of the flood will have left considerable devastation to physical infrastructure, households and livelihoods. The relief effort is short-term and does not deal with the wide-ranging and varying issues of environmental, economic and social impacts.

A variety of impact assessments and needs analyses should be carried out to determine strategies and programming for the recovery effort. Programmes should not be limited to simply reconstruction and rehabilitation, but should integrate risk reduction initiatives. In many cases, this is not done and risk is often recreated. This can result in subsequent floods and other hazards bringing more destruction and hardships to affected communities, thus continuing the downward disaster spiral. In order to address this ongoing disaster ↔ vulnerability correlation, initiatives planned under any recovery programme must consider risk reduction along with other issues related to recovery needs.

Whilst recovery provides great opportunities for rebuilding an improved society, there are many problems and issues that can arise to prevent goals from being reached. It is vital that the planning process enables such problems to be highlighted and addressed.

Programmes must be sustainable with a view to reducing future vulnerabilities. Coordination and guided stakeholder consultation is the key to effective management. The recovery process needs to be community-driven to ensure ownership and pride in rebuilding lives. Public awareness, transparency, communication and consultation are essential to enable the community to participate.

This chapter raises the issues surrounding holistic recovery, which enables the swift return to normal activities, whilst addressing risk reduction to achieve sustainable development.

Concepts of Recovery and Rehabilitation

The recovery and rehabilitation process aims to restore the function of public services, socio-economic systems and the everyday routine of the household. The process has the potential to catalyse significant improvements in the social, economic and environmental welfare of the affected population. However, when there is urgency placed on restoring livelihoods and rebuilding infrastructure, the opportunity to link risk reduction measures with development practice can be overlooked. The result is ad hoc and unplanned development that can contribute to increasing risk.

Recovery and rehabilitation should aim to be holistic and address the principles of sustainability (Monday, 2002). In the same way, applying the principles of sustainability will contribute to increasing the resilience of the people and therefore reducing risk. Recovery provides an opportune time to implement mitigation and preparedness strategies to reduce the effects of future flood events. It is also a favourable time for institutional strengthening for disaster risk management. The goals set out in a recovery programme will be difficult to achieve unless rebuilding is undertaken with a sound strategy backed up by political will, policies, legal and institutional arrangements, as well as coordination, participation and proper assessment-based planning. The following guidelines must be placed at the core of recovery and rehabilitation.

- Clear objectives in bettering, and ensuring the future safety and welfare of all affected communities, their living conditions, livelihoods and socio-economic status.
- Undertaking activities to address the present and future needs, and possible development changes in the natural and built environment.
- Recognising the need to adapt and respond to changing environmental and physical conditions in the watershed. This includes considering the likelihood of other potential natural hazards.
- Maintaining compatibility with prevailing legal provisions, social norms, cultural ethics and other considerations such as gender, age, culture, religion, people with disabilities, etc.
- Awareness of all types of biases such as personal, scientific, bureaucratic, political, and ignorance of professional views and interference of other powerful sections of communities.
- Sourcing suitable funding that does not limit the potential of the recovery plans or reduce options for project implementation.

Assessments

Assessments should form the basis of recovery and rehabilitation programming. They should cover social, physical, environmental and economic aspects and span all sectors. The Economic Commission of Latin American and the Caribbean (ECALAC) provides a detailed methodology for impact assessments of disaster events including floods and provides guidance for practitioners involved in post-flood damage assessment.

Assessments can be carried out by a variety of people and organisations. Teams should be multi-disciplinary to ascertain losses and make links between sectors and impacts. They should comprise of experts in the sector that is being assessed as well as representation from other sectors to give a holistic view of impacts. Information from assessments should be shared in order to reduce repetition. See Chapter 9 "Assessments".

see Chapter 9

Damage assessment

> '*Assessments make it possible to identify sectors and geographic areas requiring priority attention. Thus serving as invaluable input for defining reconstruction strategies, plans and projects.' (UNECLAC, 2003)*

Damage assessments have a number of different uses and applications. Essentially the aim is to measure in monetary terms the impact of the disaster on the affected area (UNECLAC, 2003).

Purposes of damage assessments:
- Provide information for the allocation of compensation, grants and funding according to damaged property and livelihoods.
- Record data about the severity of the impact for future mitigation.
- Compare the economic impact with the cost of implementing mitigation strategies in a cost benefit analysis.
- Identify the need for specific risk reduction projects.
- Assess the structural integrity of buildings to determine whether they can be occupied, repaired or rebuilt.
- Identify issues related to policy changes, development of regulations and capacity building.

The total damages left by a flood are very difficult to quantify. Data is often not calculated or produced, but is mostly estimated. Damages can be physical and quantifiable such as damage to structures and loss of assets. Losses can be non-physical and difficult to quantify, such as productivity loss, injury and death.

Damage assessments should consider the impacts on the following sectors:

- Housing
- Education
- Health
- Energy
- Water and sanitation
- Transport
- Communications
- Agriculture
- Trade
- Industry
- Tourism

Box 10.1
Damage sector-based assessment

Damage assessments should be sector-based to determine the structural and resultant economic damages incurred.

- *The housing sector* is generally the worst affected due to the extent of damages and losses, because shelter is a basic necessity.
- *The agricultural sector* takes a long time to recover. If agricultural land is destroyed or covered with debris, it can be beyond restoration and the land-use may need to be changed in order to increase productivity.
- *Trade and export sectors* can be affected by damages and losses in other sectors. For example, the impact on the agricultural sector has a cascading effect because it dictates food availability for domestic consumption and economic export.
- *The utilities sector* experiences damages which may hinder services and have resulting effects on the functioning of other sectors.

Sectoral analysis (refer to Box 10.1) allows for the identification of vulnerable groups. For example, it will highlight areas without safe water or adequate sanitation facilities and people who have lost sources of income. It is important to recognise the cascading impacts and indirect losses from one sector to another. Everything is interconnected and damages can exist far beyond what is perceived or visible.

Box 10.2
Categorising damages and losses

Impacts	Physical / Quantifiable / Direct	Non physical / Non-quantifiable / Indirect
Infrastructure Damage	X	X
Household		
• assets	X	
• employment	X	X
• injury		X
• death		X
• mental health		X
Economic Loss - business		
• assets (merchandise)	X	
• labour	X	X
• down-time	X	X
• productivity loss	X	
Agricultural Loss and Damage		
• crops destroyed	X	
• surplus damaged	X	
• fields damaged	X	
• equipment damaged	X	
• labour	X	X
• time lost		X

Box 10.2 simplifies and categorises direct and indirect, quantifiable and non-quantifiable, physical and non-physical impacts. However, there are indirect effects on individuals and households that are invisible and cannot be simply assessed.

When carrying out damage assessments, the following should be considered:
- Time allocated.
- Expertise of assessors.
- Micro, household level assessments should also be conducted.
- Focus should be on both immediate and long-term impacts.
- Secondary and indirect losses such as how the economic effects will impact on social well-being.
- Linking sectors and their impacts on each other.

Socio–economic assessment

The loss of loved ones is devastating not only emotionally, but also economically. In Asia, if the primary breadwinner (often the male head of the household) has died or is injured, income generation for the household will be reduced, thus limiting the activities of family members. The ability to attend school, use healthcare services, and purchase food will be affected.

It is difficult to put an economic value on social losses incurred, these assessments are conducted to determine immediate and ongoing needs. For example, shelter provision, water and sanitation, medical programmes and mental health counselling provided during disaster relief may need to continue until facilities have been rehabilitated in the community.

Information can also be gathered from work-places, hospitals and schools to determine who has re-established themselves, and who has not, and what assistance is required. Socio-economic assessments allow people to participate in the recovery process as it provides a platform for them to express their losses and how they want to recoup.

To gather information, the following tools can be used:

- Interviews
- Focus groups discussions
- Household surveys
- Ranking of priorities as perceived by the community
- Forums and meetings

Environmental assessments

Floods can affect the environment both positively and negatively. Assessments should be conducted to determine the impact on the environment and subsequent consequences on production sectors such as agriculture and tourism. Risk may be altered due to changes in the environment. Flooding may cause erosion, siltation, washing away of topsoil, pollution or increased risk of landslides. On the other hand, it may also increase the fertility of the soil, replenish soil moisture and deposit soil and rocks to use in agriculture and construction.

Assessing the cost at household level

Once the extent and severity of the damage has been ascertained, financial cost estimations based on the structural damages, loss of assets and loss of services can be made. Costs can then be multiplied according to the area or extent of damage to gain an overall cost estimate; for example, assess the cost of damage to an average household, including loss of 'normal' contents. Multiply this value by the amount of houses actually or expected to be damaged according to the flood characteristics. This gives a gross estimate of the cost of total damages at the household level.

see Chapter 11

Similarly, cost of damage to infrastructure can be estimated by considering the height and turbulence of the floodwaters with the structural damage, loss of income, loss of function and down-time.

Management of Recovery Programmes

The first step to managing effective recovery programmes is to develop a recovery strategy including broad frameworks and guidelines for operation. This should be devised either by the national government or where the capacity of the government is not adequate, external assistance can provide technical and capacity building services.

There may be a need to build the capacities of people such as government officials who are involved in the recovery effort. Training and education in planning and implementation enables them to advocate and apply the principles mentioned throughout this chapter.

Government

The responsibility of recovery and reconstruction lies mainly with the government. A central body, or recovery team or taskforce, should be responsible for leadership, coordination, management and planning. It should have legal authority to make major decisions in accordance with good practice (appropriate assessment, planning and consultation). For example, to decide whether to retrofit or reconstruct, to build in the same site or move to another site, etc. They should comprise of a variety of stakeholders with relevant expertise and interest. A disaster risk manager and community representatives must also be included.

see Case Study 10.1

- *Responsibility of sectors:* Government sectors are generally responsible for the recovery and rehabilitation of their services and sectors in accordance with the overall development strategy.
- *Direct government implemented programmes:* Government can undertake the recovery process of government facilities and infrastructure if it has adequate capacity to do so.
- *Sub-implementing agencies:* NGOs or UN line agencies can work as sub-implementing agencies under the government, UN or other international implementing body.

- *Contracting the private sector:* Often tenders are requested and private sector companies contracted to undertake recovery projects.
- *Financing:* Contributions can come as cash assistance, food / cash-for-work, building materials, ready-made houses, soft loans, technical manpower, type designs and estimations.

see Case Study10.3

Case Study 10.1

Orissa State Disaster Mitigation Authority

The experience in other countries shows the feasibility of forming a new authority to undertake recovery programmes. For example India has created special institutions after the Gujarat Earthquake and Orissa Cyclone namely Gujarat State Disaster Management Authority (GSDMA) and Orissa State Disaster Management Authority (OSDMA).

The Government of Orissa constituted OSDMA after the October 1999 super cyclone, to have a systematic and planned approach to disaster management. As a Government owned autonomous body, OSDMA combines flexibility of operations. With the objective of making the State more disaster resilient, OSDMA coordinates various types of disaster mitigation activities including capacity building of the community and the disaster managers, and strengthening of infrastructure, etc. OSDMA works closely with:

- Government of India and its agencies.
- Government of Orissa, its various departments and agencies.
- Administration of all 30 districts of the State.
- Local self government, communities, NGOs and CBOs.
- Bilateral and multilateral aid agencies.
- U.N. agencies.
- Governments of other states in the country.
- Specialised disaster management organisations and institutions.

OSDMA deals with disaster mitigation and project management. The Disaster Management Unit deals with planning, capacity building, preparedness, social development, documentation, awareness raising and education, inter-organisational coordination and partnership. The Project Management wing deals with construction projects aimed at reducing disaster risk and vulnerability. The Managing Director, the executive head of the organisation coordinates all activities. The Chief Secretary of Orissa is the chairperson of the Governing Body of OSDMA, which is constituted by senior Government functionaries, representatives from UN agencies, and civil society.

(Source: *http://www.osdma.org*)

NGOs

Some NGOs remain after their relief effort to support recovery and rehabilitation. Others may arrive specifically to carry out recovery projects. They are particularly effective at the community level and can provide assistance on programmes from housing to economic regeneration through micro-financing. Internationally NGOs should be linked through partnerships with civil society and community-based groups. NGOs should be committed to completing projects and providing quality work.

Community

Community-led recovery efforts normally start immediately after the event. Activities can include strengthening through rebuilding homes, creating support groups, land sharing, establishing social security systems and rehabilitation of the community and individuals. The community can contribute their own financial resources, labour, building materials (recycling of damaged material) sharing and pooling of resources. Funding options are as follows:

- Credit programmes and delivery mechanisms for self-employment.
- Revolving fund schemes, savings fund schemes, etc. to support livelihood programmes.
- Self employment opportunities for vulnerable groups such as widows, orphans, elderly, disabled, etc.
- Micro-credit programmes to help small-scale informal sector traders, shop owners, fisherfolk, etc.

see Chapter 11

Private sector

Private sector companies should be encouraged to participate in the recovery effort and provide targeted health to contribute to the long-term development of the area. They should consider:

- Providing project and programme funding.
- Distributing low interest or non-interest bearing loans to local businesses and households to rebuild homes or purchase income-generating assets.
- Providing employment.

Donors

- Donor contributions to housing programmes can come as building materials, ready-made houses, technical manpower, soft loans and grants.
- Donor demands shape recovery processes as they have the power to channel funds in certain directions.
- Donors should advocate good practice such as hiring local personnel and procuring local goods to kick-start the economy.

- Donors must collaborate and partner on projects and programmes to ensure the best use of financial resources.
- Donors must share information from assessments to minimise repetition.
- The aim of donor assistance should be directed at sustainable projects and programmes.
- Tied aid in the form of loans can undermine the capacity of local efforts (refer to Case Study 10.2).
- Dependency on donor funds should not be encouraged, especially over the long-term.

Case Study 10.2

Funding Choices

Some disaster-affected nations are now rejecting aid they view as too expensive or too tied to donor conditions, aid which in effect undermines indigenous capacities. In autumn 1999, floods destroyed a coastal lagoon in central Vietnam, where prawn farms were vital to the local economy. Foreign donors offered technical and financial assistance, which would have involved Dutch engineers building a Dutch-designed sea wall. A third of the project's cost would have been a grant, with Vietnam having to raise the rest through a loan. The Vietnamese government, turned down the foreign scheme, preferring to build the barrier themselves, even if their initial solutions were not to the same technical specification as the Dutch design. The loan, design and foreign consultants were turned away and the repair work finished by local people in autumn 2000 at half the cost. In the process, Vietnam's domestic capacity to respond to recurrent disasters was improved.

(Extracted from: IFRC, World Disasters Report 2004)

The recovery programme involves a number of different players with responsibilities depending on the situation. For example, the contractor-based option is best for high intensity zones for reconstruction of destroyed facilities, and community-based in low-intensity zones where there is a need for repair, retrofitting, etc.

see Box 10.3

Coordination

Coordination is the key to an effective and organised recovery. The lead agency, recovery team or taskforce should be the central point for coordinating all activities. They should drive a holistic recovery taking into account all the principles of sustainability by maintaining quality, focus and support.

see Chapters 3 & 4

Box 10.3
Roles and responsibilities for risk reduction

- Build capacities of district and provincial level government and non-government personnel in planning and implementation of comprehensive recovery programmes.
- Ensure that the reconstruction and rehabilitation of the public and private sector critical infrastructure such as housing, roads, bridges, schools, hospitals, telecommunications are risk resilient and do not contribute to further risks.
- Ensure that risk reduction strategies and measures are incorporated in the revival of the local economy and livelihoods of affected people.
- Ensure that actions are taken for the reduction of vulnerability and social protection of the poorest, most vulnerable and special social groups; children, elders, women, widows, minority communities, wage labourers, etc.
- Reduce future vulnerability through mitigation programming aimed at multi-hazard land-use planning / zoning, appropriate construction and watershed management.
- Improve the disaster preparedness and emergency response capacity of the governments and societies to deal with different types of potential disasters.

Case Study 10.3

Recovery and Rehabilitation after Floods in China

Persistent torrential rains in the summer of 1998 caused enormous flooding in the Yangtze River Basin and Northeast China. The floods affected one-fifth of China's population in 29 provinces, over 3,600 people died, and about 5 million hectares of crops were destroyed. There was severe damage to infrastructure and social service facilities, disrupting economic production and activities. Economic losses were estimated at over US$ 36 billion. There was an urgent need for flood recovery works to restore and rehabilitate the damaged and destroyed public infrastructure and social services so as to restore rapidly the economic production systems.

Project Objectives

The objective of the proposed project was to rebuild social and economic infrastructure damaged by the devastating floods in Hubei, Hunan and Jiangxi provinces, thereby restoring rapidly economic production and social services.

Priorities were given to water supply and health facilities to prevent the spread of diseases, and roads to restore access to the flooded areas to re-generate economic activities.

The main restoration and reconstruction components of this project consisted of:

- **Roads:** 84 county and rural roads covering a total length of 945 km.
- **Water Supply:** 55 damaged county and township water supply systems, serving a total population of about 2.5 million people.
- **Schools:** 199 county and township secondary and primary schools serving a total student population of about 222,000.
- **Hospitals and Clinics:** 146 county and township hospitals, health centres and clinics, serving a total population of about 4.0 million people.
- **Irrigation:** 18 irrigation areas covering a total of 44,200 ha and benefiting about 446,000 farmers.
- **Studies and Technical Assistance:** Provision for each province to develop or upgrade flood forecasting, simulation and dispatch systems, taking into account the recent flood experience.

Project Costs and Financing.

The project cost was estimated at US$ 132.5 million. The World Bank Group will provide a loan of US$ 40 million and credit of US$ 40 million, which will meet 60 percent of the total cost. The remaining US$ 52.5 million will be provided by the Government.

Project Management Structure

- Project Leading Groups (PLGs) established at the province, prefecture, city, and county levels were to organise and direct implementation of project works. The main functions of the PLGs are to coordinate the different government agencies and to approve major policies related to the flood reconstruction activities.
- The members of these PLGs would include directors or vice directors of Finance, Planning, Construction Commission, City / Urban Construction, Transportation, Health and Education Bureaus.

Recovery and rehabilitation costs can be massive. There may be the need to establish new institutional arrangements to implement recovery and rehabilitation programmes. This case study shows the extent of damages across many different sectors and the need for central coordination for all projects.

Sustaining Recovery and Rehabilitation Activities

see Chapters 3, 4, 5, 6 & 7

A comprehensive risk assessment builds the solid foundation for a sustainable recovery and rehabilitation strategy. The information collected is essential for decision-makers to plan and prioritise activities. The flood event often catalyses the public to demand political action to begin seeking options to reduce flood risk. The environment is ripe for policy formation and dialogue to consider institutionalising disaster risk reduction measures into development planning. Priority and incentives should be provided to encourage the implementation of mitigation and preparedness measures. Windows of opportunity arise to improve quality of life and rebuild sustainable livelihoods.

Whilst carrying out recovery and rehabilitation activities, there are a number of considerations to ensure that the process is both holistic and integrated, as well as including the participation of multiple stakeholders and sectors. The bottom-up activities of the community must complement the top-down strategies and frameworks.

The following factors (Natural Hazards Research and Application and Information Center, 2001) should be integrated into recovery and rehabilitation activities:

Maintain and enhance the quality of life

Improving housing

Shelter is one of the most important sectors to prioritise. There is usually pressure to rebuild homes rapidly, but planners must decide where the home will be rebuilt and the methods that should be applied to reduce flood risks. They can include the following:

see Chapters 5, 6, 7, & 9

- Reduced exposure to flooding through the application of zoning regulations.
- Construction of adequate drainage to reduce vulnerability to waterborne diseases and reduction of flooding.
- Construction of temporary housing to provide shelter whilst permanent homes are being planned and built.
- Application of appropriate technical solutions, designs, resources and construction methodology for reconstruction of flood-proofed housing.
- Training on hazard-resistant construction for artisans, technicians and professionals.

see Case Study 10.3

Relocation may be part of the rehabilitation process. It is a big request to ask people to relocate. Although this may be for their own safety, people are often reluctant to leave their homes. It is imperative that the community is consulted in the relocation programme. This can ensure a less problematic and smooth transition. If communities are scattered it may be necessary to request settlement in one place where services and facilities can be provided centrally.

Provide healthcare

Health effects (physical, emotional and social) can appear immediately or a while after the disaster and can continue for varying amounts of time. Some are stress related and others are linked to the aftermath of the flood such as disease and malnutrition. The strategy employed during recovery and rehabilitation should take into account the health effects from flooding and address them as necessary. Many may be severe and acute or some may become apparent in the long term and affect large portions of the flood-affected population.

see Case Study 10.3

The following should be considered:

- Actions to reduce the risk of water related diseases.
- Training of volunteers to teach about good sanitary health and hygiene practices.
- Organisation of regular programmes for immunisation, ante-natal and post-natal services.
- Organisation of satellite clinics and family planning.
- A water supply system to ensure adequate water quality and quantity.
- A strengthened sanitation system.
- Establishing day care facilities, early childhood development centres within affected areas and training caretakers (refer to Case Study 9.3, Vietnam Flood Kindergarten).
- Identification of community-managed remedial actions for health related shocks and stress on livelihoods of women.
- Mapping of affected health service facilities and consider relocation to lower risk areas to ensure the continuation of healthcare services.
- Research on social impacts related to community health (maternal, reproductive, child health, nutrition of pregnant women, lactating women, malnutrition, deficiency of common micro-nutrients).
- Training to create a cadre to assist community mental and physical health for village / slum level including counselling services.

see Case Study 9.2

Disasters affect people psychologically and emotionally and it can be a long process coming to terms with what has happened. People will have different attitudes and reactions, and community focus groups should be encouraged to help cope with this.

Enhance economic vitality

Incorporating flood protection structures such as those suggested in Chapter 6 together with strategies for coping with floods in Chapters 5 and 7 can enhance both quality of life and attract economic investment. By reducing flood risk, investors both domestic and international may find the area more conducive for doing business.

see Chapters 5, 6 & 7

Incoming donor funds for structural mitigation projects can boost the economy if programmes and projects can hire local personnel and procure local products, resources and services. The following mitigation measures can be considered in the rehabilitation and rebuilding stages to boost the local economy:

- Create parks and open spaces that can double up as flood retention ponds.
- Improve and strengthen electricity, gas and water provision services.
- Rebuild and maintain roads and transportation routes, and ensure that they have culverts for drainage.
- Clear the waterways and ensure that they are maintained.
- Strengthen and heighten bridges where necessary, prevent scour at the base of abutments.
- Reconstruction and strengthening of appropriate structural interventions, levees and dykes.
- Ensure community access to necessary livelihood, farmland, fisheries and the water systems.
- Rebuild public areas and places of work.
- Restore and conserve historic, cultural and heritage sites.
- Improve and strengthen the sewer system to prevent the outpouring of sewerage in the event of a flood.

Livelihood support programmes

Recovery efforts should support livelihood security programmes. To achieve this link, there must be active participation of key stakeholders from a multi-sector base as well as the community, in the decisions made for each programme. Activities, where possible, should be linked with government, local enterprises, organisations and industries.

see Case Study 10.4

- Providing of temporary work schemes such as debris clearance, construction, public awareness, project management, assessments, etc.
- Partnering with NGOs to provide sustainable livelihood support (provision of seeds and tools, animals, capacity building).
- NGOs can play a big part in new initiatives and micro-crediting.
- Adapting farming techniques, plant seasonal crops that are not at risk from seasonal flooding.
- Providing compensation based on loss of livelihoods.
- Developing forums and focus groups for particular industries to enable them to pool resources, share equipment and experiences, and support each other as well as plan for the future.
- Setting up a community funding scheme to help people restart businesses.
- Availing of loans from the government or private sector.
- Utilising government grants.
- Diversifying the industry in the area so that the local economy and people are not dependent solely on agriculture (particular crops) fishing or tourism. Seeking different sources of income through capacity building and apprenticeship programmes should be considered.
- Enhancing skills through training to supply more construction sector artisans (masons, carpenters, electricians etc) and train them in hazard-resistant construction technology.

Case Study 10.4

Recovery from Bangladesh Floods of 2004

The following report was written during recovery and rehabilitation.

Assessment of the situation
International media attention has faded from the disaster, and rivers are mostly flowing below danger level. In many areas the recovery and rehabilitation effort is well underway as people attempt to rebuild their lost and damaged property and livelihoods. However, recession of floodwaters is only partial, often complicated by drainage congestion, and many areas remain under water.

Acute shortages of seeds and seedlings seriously threaten the Aman rice harvest. Despite Agriculture Ministry efforts to distribute seeds among the flood-affected small and marginal farmers, shortages are limiting distribution and pushing prices above the reach of many.

The number of new cases of diarrhoea and other communicable diseases are still increasing in districts where floodwater is receding. The figures remain alarming, with 176,041 cases of diarrhoea and 1,795 cases of dengue fever since 12th July, and 13,413 cases of pneumonia, 4,808 eye infections, 21,686 cases of skin disease officially reported since 4th August.

Response to the crisis

Government
- Latest figures from Ministry of Food and Disaster Management indicate that the Government has allocated over 48,000MT of rice, TK 60million (US$ 1million) for reconstruction of housing, TK 2.4million (US$ 40,700) for clothing, and TK 42 million in cash (US$ 715,000).
- The government will distribute 96,000 Vulnerable Group Feeding (VGF) cards from next week to provide emergency food aid in six districts that were worst affected by floods (Netrokona, Kishoreganj, Sunamganj, Hobiganj, Brahmanbaria and Sirajganj). 10kg of rice will be provided against each card until December in addition to the amount given under regular VGF programme. The regular VGF in another 33 flood-hit districts will start from the month of September.

UN, NGO and International Community
The UN Flash Appeal continues to act as the focus for soliciting international assistance to meet rehabilitation and recovery needs over the next six months in key sectoral areas. At the same time, UN agencies are active in the ongoing relief and rehabilitation effort with governmental and NGO partners. Some of these responses are summarised in the following table.

UN Agency	Form of Assistance	Quantity/target population coverage
WPF	rice	9,636 mt
	pulses	1659 mt
	salt	165 mt
	oil	663 mt
	biscuits	695 mt
	polypropylene bags	104,495 bags
UNDP	water/sanitation	1,002,800 families
	shelter	16,000 families
	agricultural assistance	98,800 families
	medicines	800,000 packets
	CRS	20,000 families
	hygiene kits	20,000 families
	other non-food	448,800 families
UNFPA	medical tems, WPT, CRS, IV fluid	5 teams
UNHCR	financial assistance	US$ 25,000
UNICEF	water purification tablets	7 million
	IV fluid	25,000 bags
	CRS	25 mt
	children's food	100 mt
	Jerry 10-liter cans	10,000
	500-liter water tanks	40
	new tube-wells	6,000
	tube-wells repaired	8,000
	bleaching powder	10 mt
	new latrines	500
	toys	20,000
WHO	medical technical support	flood-afftected districts
	emergency procurement (medical supplies, CRS, WPT, bleaching powder)	UD$ 56,310 UD$ 13,922 UD$ 1,972 UD$ 1,130 UD$ 1,820 UD$ 1,390
	total	UD$ 76,546

The government, UN and NGOs all interact to provide a range of services during recovery.

Status	Channels	Funding Source
quantity to date	BDRCS, SCFUSA, SCFUK, TDH-IT, IR, Concern, OXFAM, BRAC, ADRA, GK, CAREBd, UNFPA LCI, RIC, CCDB, Scouts, VERC, BURO-T, IRD, IFRCBDRCS	Country Programme; emergency allocation and conversion; Swiss DC; DFID
ongoing	Save the Children UK, Oxfam GB, BRAC, Islamic Relief, Care Bangladesh, Concern Bangladesh, Christian Aid, ADRA	DFID
ongoing	GoB - Directorate General Health Services	Country Programme
committeed	GoB - Prime Minister's Fund	
US$ 200,000 already provided. Further US$ 500,000 committeed	Department of public health Services, Government of Bangladesh (GoB)	Country Programme; German NetCom
ongoing	WHO Divisional Coordinators and districts surveilance medical officers supporting Civil Surgeons	Country Programme
	DG Health Services BMA Red Crescent Societies UN Offices Dept.of Public Health Services Sylhet City Corp.	Country Programme and other donor programmes

(Source: UNDMT 2004)

Ensure social and intergenerational equity

Plans should consider the impact of actions on future generations whilst meeting immediate needs. Social planning needs to be considered to ensure established relationships between socio-economic networks are not disrupted.

Long-term focus:
- Consider the possible expansion of the settlement.
- Implement risk reduction strategies that take into account the dynamic human and natural environment.
- Resume to traditional practices where effective.
- Consider the impact of changes in local industry on the way of life.
- Efforts should be made to include previously marginalised groups.

Preserve social connections in and among groups:
- Rebuild schools, community centres and places of worship.
- Rebuild homes close to services.
- Consider the cultural traits and norms of society.
- Ensure that all the points of an economic system are able to function.

Enhance environmental quality

The environment and conservation of natural resources is the key to reducing flood risks and ensuring the sustainability of the area. The points below list some examples, for further information.
- Land use planning can be applied to limit adverse human activities.
- Good watershed management practices should be adopted to reduce flood risk.
- Awareness about the need to preserve natural resources.
- Agreements from parties in the watershed to reduce destructive activities.

see Chapters 5

Protect open spaces:
- Zoning.
- Creation of recreational facilities.
- Reconstruct and redevelop harbours, lakes and parks.

Manage stormwater:
- Adopt best management practices regarding stormwater management.
- Create natural systems such as swales, retention ponds that allow natural infiltration and filtration.
- Redesign and reconstruct open drainage.

Participatory approach

Ensure community and stakeholder participation through all aspects of recovery planning. Gain opinions on different options for reconstruction and the most suitable actions for flood risk reduction.

The benefits of community involvement are as follows:

- Allows for accurate identification of problems, opportunities and the most effective way to address the situation.
- Is based on people's own personal definition of their needs and real priorities.
- Ensures that activities are coordinated with each other and with other community goals and activities, preventing conflicts and reducing the costs of implementation.
- Educates communities and other stakeholders on available resources and capacities for protecting themselves against flood risks.
- Builds support and ownership of the project, thus increasing the possibility of interventions beings sustained after the project ends.
- Promotes commitment to decisions made.

Community participation can have a variety of meanings. The following lists different forms of participation:

- The community can be presented with a plan and decide YES or NO.
- The community can implement (participate in construction) a decided plan.
- The community can submit ideas to be considered in the plan.
- The community can be fully engaged in planning discussions.

Research has shown that the success of reconstruction programmes depends on how closely communities participate in the planning and implementation of the programme (Narayan, 2001). Both the community and officials need to incorporate sustainability ideals into recovery planning.

Risk reduction

Risk reduction is a theme that runs through all of the principles. Other specific risk reductions measures can include:

- Integrating a watershed management approach including structural and non-structural mitigation initiatives.
- Flood early warning systems.
- Flood disaster preparedness plans.
- Awareness campaigns.
- Capacity building.

see Chapter 5, 6 & 8

Monitoring and evaluation

The recovery process and the effectiveness of the programmes and the strategy should be monitored, evaluated and fed back into the process. The strategy should be considered within the wider context. For example, a risk of landslides, civil unrest or economic crisis may develop, requiring changes in plans. A reassessment of the position and goals must take place and the strategy altered in order to achieve it.

Process for Holistic Recovery

1. **Get organised.** The community makes a commitment to sustainability by designating appropriate responsibilities for the recovery. A new or existing entity assumes the task of managing the recovery. It should set up measures for integrating sustainability into ongoing disaster recovery.

2. **Involve the public.** Participatory processes should include all stakeholders to create a vision of the community post-recovery. Participation should be a part of all phases of recovery. Effort should be made to include people who are normally excluded from society.

3. **Coordinate with other agencies, departments and groups.** Expand the team so that there is representation and expertise to address all of the principles of sustainability. Formal and informal ties should be developed with local groups, government institutions, private sector and experts. This will increase the diversity of ideas and options for recovery.

4. **Identify post-flood problems.** Systematically consider ways to build sustainability into plans and management of recovery. Consider all the impacts of the flood that must be remedied. Gather information by carrying out assessments.

5. **Evaluate problems and identify opportunities.** The recovery team should evaluate the problems and impacts highlighted in step 4. Options (as those listed in this chapter) should be considered as ways to address the problems. They should be applicable to the community's situation, needs, concerns and aspirations.

6. **Set goals.** Agree on what can realistically be done. Limit the list of activities decided in step 5. Reach a consensus in terms of public support, cost-effectiveness, community goals, available resources, etc. Establish the decisions as clear goals.

7. **Develop strategies for implementation.** Review the tools, financial support and expertise available to achieve each goal. Create an implementation strategy stating:
   - Aim / end result
   - Lead agency
   - Partnerships
   - Expertise
   - Legal action required

8. **Plan for action.** Draft a complete plan for the recovery activities. This should be part of the community's comprehensive plan. It should include:
   - Budget
   - How to obtain funding
   - Schedule for meetings, public participation, data collection, report writing, implementation
   - Monitoring, evaluation and reviewing process
   - Provision for public review and comment

see Chapter 11

9. **Get agreement on the plan for action.** Obtain agreement from the local / provincial government as required. Enter into memoranda of understandings with parties involved. Confirm agreed actions and expectations.

10. **Implement, evaluate and revise.** Some goals and strategies may need to be modified. Have a continuous monitoring system in place to keep activities from being abandoned and to help drive the process. Have regular reviews and evaluate the successes of the recovery programme.

(Natural Hazards Research and Application and Information Center, 2001)

Limitations

There can be a number of obstacles to holistic recovery. These include:

- Degree of damage inflicted on the community.
- Rules, regulations and policies limiting expenditure.
- Property rights, development, insurance, land-use (conflict of land-use within a community).
- The time pressure to return to normal.
- Lack of awareness about redevelopment possibilities.
- Changes in roles and procedures of local government officials.
- The lack of systematic communication between decision-makers, departments, agencies and stakeholders.
- Lack of political will to do the right thing.

Planners should be aware of these limitations and take measures to address them where possible.

(Natural Hazards Research and Application and Information Centre, 2001)

Checklist

☑ Are there appropriate institutional arrangements that enable the effective coordination of all the stakeholders involved in recovery and rehabilitation?

☑ Have you encouraged hazard-resistant construction?

☑ Have you established community participation mechanisms and facilitated decision-making at the community level?

☑ Have you disseminated information about the rehabilitation programme and people's entitlements?

☑ Have you emphasised social and community development and gender empowerment?

☑ Have you created awareness about the risks and impacts of other hazards?

☑ Is there a public-private partnership set-up that recognises the role the private sector can play in funding and implementing projects?

☑ Are you actively addressing vulnerability through improving housing, health, education and economic systems?

☑ Is there political will to enhance the quality of life for all the disaster-affected people?

Checklist for Funding

see Chapter 11

☑ Are people compensated for their losses and is this enough to rebuild houses?

☑ Are low interest loans available?

☑ Does the government have partnerships with NGOs and the private sector for reconstruction?

☑ Is there a national budget for disasters covering long-term recovery needs?

☑ Are funds from international aid trickling down?

Future Challenges

For effective disaster risk reduction, synergies are needed between sustainable development and disaster risk management practices. Moving from analysing risks to taking concrete actions to reduce their impacts is a challenging step. Ideas and practices coming from different disciplinary areas will complement what is already practiced in disaster risk management.

Environmental and natural resource management are some of the most effective measures to reduce flood risks. Physical and technical measures, such as flood control techniques, soil conservation practices, retrofitting of buildings or land-use planning, are effective for flood control. Financial instruments in the form of insurance, calamity funds and catastrophe bonds are useful to lessen the impact of disasters. The challenge for recovery lies in combining appropriate mix of mitigation strategies and convincing decision-makers to apply their uses.

Recovery programmes provide a golden opportunity for putting into practice initiatives that will help to build safer communities and promote sustainable development. However, many institutions and organisations do not take seriously the need to integrate risk reduction interventions in recovery programmes. Reconstruction is often confused with relief, and organisations tend to overlook the risk reduction aspects and instead focus on simply providing inputs into the community in the form of projects. The challenge for recovery, rehabilitation and reconstruction is to focus on sustainability and a genuine interest in implementing risk reduction measures. Implementers and managers should not succumb to pressures to rapidly rebuild infrastructure and livelihoods without comprehensive planning and considerations. Governments should take the lead to direct and control recovery efforts in a direction that improves society and incorporate a greater degree of resilience to the impact of future floods than existed before.

Resources

IFRC (2001) *World Disasters Report.* Ed. Walter, J. Geneva, IFRC.

UNDMTP (2002) *Training Modules - Rehabilitation and Reconstruction.*
http://www.undmtp.org/modules_e.htm
Accessed March 2005

Natural Hazards Research and Application and Information Center (2001) *Holistic Disaster Recovery: Ideas for Building Local Sustainability after a Natural Disaster.* Boulder, Colorado, Natural Hazards Research and Application and Information Center.
http://www.colorado.edu/hazards
Accessed April 2005

Community participation

ADPC (2004) *Field Practitioners' Handbook.* By Abarquez, I. and Murshed, Z. Bangkok, ADPC.

ADPC (2005) *Primer for Disaster Risk Management in Asia*. Bangkok, ADPC.

Damage assessment

ADPC (2000) *Post-Disaster Damage Assessment and Need Analysis*. Bangkok, ADPC.

EMA (2002) *Disaster Loss Assessment Guidelines.* Australia, EMA.

FEMA (2002) *Getting Started, Building Support for Mitigation Planning*. USA, FEMA.

Kelly, C. (2003) *Guidelines for Rapid Environmental Impact Assessment in Disasters*. London, University College.

UNDP (1999) *A Guide to Successful Damage and Needs Assessment*. By Planitz, A. New York, UNDP.
http://www.reliefweb.int/hin/lib.htm
Assessed March 2005

UNECLAC (2001*) Environmental Values, Valuation Methods and Natural Disaster Damage Assessment*. Ed. Dosi, C. Santiago, UNECLAC.
http://www.reliefweb.int/hin/lib.htm
Accessed March 2005

UNECLAC (2003) *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters*. Santiago, UNECLAC partnered with The World Bank.
http://www.proventionconsortium.org/toolkit

References

ADPC (2005) *Primer for Disaster Risk Management in Asia*. Bangkok, ADPC.

IFRC (2004*) World Disaster's Report*. Ed. Walter, J. Geneva, IFRC.

Monday, J.L. (2002) *Natural Hazards Informer*, Number 3, January. USA, Natural Hazard Center.
www.colorado.edu/hazards
Accessed March 2005

Narayan, A. (2001) *Transforming Disaster Relief into Community Building.*
http://www.changemakers.net/journal/01october
Accessed March 2005

Natural Hazards Research and Application and Information Center (2001) Holistic Disaster Recovery: Ideas for Building Local Sustainability after a Natural Disaster. Boulder, Colorado, Natural Hazards Research and Application and Information Center.
http://www.colorado.edu/hazards
Accessed April 2005

Orissa State Disaster Mitigation Authority (OSDMA)
http://www.osdma.org
Accessed March 2005

UNDMT (2004) *Joint Bangladesh UNDMT Situation Report.*
http://www.lcgbangladesh.org/flood2k4/sitrep/Floods%20Sitrep%2019%20Aug% 202004.pdf
Accessed April 2005

UNISDR (2001) *Updates and Expanded Terminology on Disaster Reduction.* First draft, Geneva, UNISDR.

UNISDR (2004) *Living with a Risk.* Volume 2 annexes. Geneva, UNISDR.

World Bank Group (1999) *Yangtze Flood Emergency Rehabilitation*.
http://www.worldbank.org.cn/English/content/247n1214549.shtml
Accessed April 2005

economics of flood risk management

This chapter links to all chapters as flood risk management activities and actions will require financing.

Chapter Brief

- Following a flood of large magnitude there tends to be a large decline in economic activity. This is typically followed by a policy response that involves increased government spending, leading ultimately to economic recovery in a year or so. If the impact is localised national economic activity will not be significantly affected.

- Nations with high levels of foreign debt and significant budget deficits will struggle to finance the cost of flood response and rehabilitation measures. Many Asian economies such as Thailand, Malaysia and India are reasonably well-placed to fund flood risk management activities and recover financially following a flood.

- Low-income households are particularly vulnerable to floods. Households may sell assets, alter consumption patterns, migrate for work and diversify their livelihood activities to prepare for and recover from a flood.

- Micro-finance products and services can enhance traditional financial coping mechanisms that may be weakened during a large-scale flood.

Key Words

Balance of Payments

The difference between the amount paid to foreign countries for imports (goods and services purchased abroad) and the amount received from them for exports (goods and services sold abroad).

Budget

A financial statement describing a nation's planned expenditures and anticipated revenues in one financial year.

Credit

Credit is borrowed funds with special repayment terms regarding interest rates, installment sizes and repayment frequency.

Exports

Goods and services sold to other countries.

Foreign Debt

Money owed to other countries and institutions carrying with it an obligation to repay the principal amount borrowed usually with interest.

Gross Domestic Product (GDP)

The total value of goods and services provided in a country in one year.

Imports

Good and services purchased from other countries.

Inflation

An increase in the general price of goods and services and a fall in the purchasing value of money.

Insurance

An agreement to provide compensation for damage, loss or injury in return for payments made in advance.

Interest Rates

The cost of borrowing money expressed as a percentage of the amount borrowed.

Livelihoods

The combination of assets (physical, financial and social), income, capabilities and activities required by households for a means of living.

Micro-finance

The provision of financial services - credit, savings and insurance - to low-income households who are typically denied these services by the formal financial sector for reasons of perceived risk, unrecognised productive potential, social and geographical barriers, and high transaction costs associated with small amounts.

Savings

Savings (cash and jewellery, for example) are surplus funds that households store to cover probable future costs of life-cycle events (such as births, deaths and marriage), consumption, seasonal variations in cash flow and investment opportunities.

Overview

Following a flood of magnitude, there tends to be a large decline in economic activity. In the short run, household incomes decline, causing reduction of expenditure on goods and services. On the broader level, industrial and agricultural sectors may suffer losses to inventory and equipment, reducing income and productivity. Similarly, domestic and foreign investment will decline.

This period is typically followed by a policy response that involves increased government spending on key infrastructure. To finance this and other risk management activities, nations will draw on budget surpluses, borrow foreign finance or seek financial aid. Many Asian economies such as Thailand, Malaysia and India are reasonably well-placed to fund flood risk management activities and recover financially following a flood, but also, many others with weaker economies face severe setbacks due to such disasters.

At a micro-economic level, households will reduce their consumption, attempt to diversify their sources of income, accumulate and sell assets, borrow funds and take out insurance to prepare for and recover from a flood.

The vulnerability of Asian economies is changing quickly as a result of economic transformation such as rapid physical and economic growth, urbanisation, and technical and social change. While increased economic development improves the capacity of developing Asian economies to prepare for and respond to a flood, it also increases their exposure due to the widespread and rapid expansion of settlements, infrastructure and concentration of population in urban centres..

Concepts of the Economics of Flood Risk Management

Floods and the Economy in Contemporary Asia

Floods can have severe negative short-term economic impacts, and pose adverse longer-term consequences for economic growth, development, and poverty reduction (Benson and Clay, 2004). However, where the impact is localised, national economic activity will not be significantly affected.

Gross domestic product

Following large floods, there tends to be a significant dip in economic activity or gross domestic product (GDP). This is typically followed by a policy response that involves increased government spending, leading ultimately to economic recovery in a year or so.

The immediate economic impact tends to be direct, reducing consumption, business activity and investor confidence. In Asia, tourism, agriculture and fisheries are likely to be most affected by a flood. Donor-supported reconstruction and continued growth in unaffected industries may, however, offset these losses. For example, despite widespread and destructive flooding in Bangladesh economic growth slowed only slightly in 2005 as activity was sustained by donor-supported reconstruction efforts, continued expansion in export-orientated production and greater workers' remittances.

The ability to prepare for and respond to shocks such as floods is greatly assisted by the current economic and political climate. Following three years of strong growth, the economies of India, Thailand and Malaysia in particular, are in a strong position to overcome a flood. The bigger economies impacted by a flood will tend to be resilient and the smaller ones will need more assistance.

Budget and balance of payments

When preparing for or responding to a flood, the economies of developing Asia may increase their imports to fund preventative infrastructure, and meet immediate emergency and long-term recovery needs. To do this, nations will either spend finance that is already available or borrow money from other countries. For example, Sri Lanka's ability to cope with a flood or the threat of a flood will be hampered by its severe lack of public funds due to a large budget deficit. In contrast, India may avoid balance of payments pressure because of its large surplus.

Any balance of payments pressure may be offset by an increase in foreign assistance, substantial donor resources, or with the endurance of key export

Hat Yai flood in 2002

industries. This economic activity would assist covering a nation's financing needs and contain the effects of the flood on the budget and the balance of payments.

For 2004, exports from developing Asian economies have increased strongly. However, this has been offset by strong increases in imports brought on by income growth and high oil prices (Asian Development Bank, 2005a).

The corresponding decline in surpluses or (for some economies) increased deficits has the potential to reduce a nation's ability to finance flood risk management activities without borrowing.

Foreign debt

The ability of developing Asian economies to service foreign debt when preparing for or responding to a flood may be significantly reduced as finances are re-diverted to cover the cost of flood risk management. Suspension, deferral or re-scheduling of foreign debt repayments to creditors such as the World Bank, IMF and the Paris Club bolster reserves to help finance risk management and reconstruction needs without requiring offsetting cuts in spending or a diversion of domestic financial resources.

Developing Asian economies have a history of borrowing money from abroad to finance domestic growth. The Asian financial crisis of the late 1990's highlighted the inability of these nations to finance these high levels of foreign debt. Today, foreign debt remains high in China, Indonesia, Korea, Philippines, Sri Lanka, and Thailand.

see Chapter 10

Inflation

The prices of goods and services will rise following a flood at the area of impact. If the flood significantly damages the key economic sectors, thereby reducing supply, these price increases will be felt on a national level.

By limiting the damage to key economic sectors and offsetting the resultant fall in supply (a key determinant of price), flood risk management activities have the potential to stabilise the level of inflation. Alternatively, flood risk management activities may effectively limit the need to import large quantities of food aid (for example), which (through large supply increases) may actually decrease the prices of local goods and services and inhibit local economies.

see Chapter 10

In spite of generally sustained high growth over the past few years and high oil prices, inflation in most Asian nations remained largely subdued in 2004 (Asian Development Bank, 2005a).

Micro-economic impacts

The household economies of Asia's poor are disproportionately affected by the severe impacts of floods. In particular they are more likely to lose their workplaces, livestock, assets and tools, and are vulnerable to the high incidence of water-borne diseases during and after floods, thus limiting their level of productivity and employability (refer to Case Study 11.1).

Case Study 11.1

Bangladesh Floods 1998: Micro-Economic Impact

The Bangladesh floods of 1998 had a major direct impact on rural households because of the decrease in agricultural production and the losses of standing crops and other assets.

Damage to houses and losses of other valuable assets were strongly correlated with flood exposure. The values of the losses were significant for many households and especially for poorer households. Not only did the poor have fewer assets than richer households, but they suffered proportionately bigger losses as well.

Even though there was little recorded unemployment, labour participation rates were very low. The few people in each household who relied on finding a daily-basis job in the labour market for their livelihood worked fewer days and suffered losses of wage earnings during and immediately after the floods. Thus, the leanness and unreliability of the labour market increases the vulnerability of day labourers to large economic shocks such as the 1998 floods.

(Source: Del Ninno, Dorosh, Smith and Roy, 2001)

Economic Analysis - Costs and Benefits of Floods and Flood Risk Management

see Chapters 5 & 6

Box 11.1 illustrates the costs and benefits incurred through adopting various intervention measures.

Box 11.1
Costs and benefits of interventions

Intervention	Costs	Benefits
Creation of flood free land (successful)	Significant financial investment. Loss of wetland rejuvenation. Loss of soil enrichment. Loss of reservoir replenishment. Decline in agricultural productivity.[1]	Increased land for economic development. Increased land for settlement. Increased economic security. Increased economic growth and income.
Creation of flood free land (unsuccessful)	Significant financial investment. Increased non-productive foreign debt. Increased flood risk and damage.[2] High maintenance costs.[3] Increased economic vulnerability where large investments are at risk to failed flood control measure.	Increased wetland rejuvenation. Increased soil enrichment. Increased reservoir replenishment.
Reduce consumption	Decreased productivity. Decreased employability.	Increased savings.
Asset accumulation and disposal	Decreased investment income. Decreased productivity. Foregone present consumption.	Increased savings. Increased ability to purchase food. Decreased immediate economic vulnerability.
Migrate for work	Destabilising sociopolitical, economic, ethnic and communal tensions in the recipient region.	Increased income.
Livelihood diversification	Some start-up costs. Some initial productivity losses.	Increased economic security.
Credit	Interest repayments.	Increased ability to purchase income-generating assets. Increased ability to finance shelter strengthening and reconstruction.
Insurance	Increased financial exposure of agencies to flood. Insurance premiums.	Increased ability to replace income-generating assets.

---

[1] In China flood-affected areas account for 80% of the country's gross domestic product (Fox, 2003).

[2] Despite significant investments in infrastructure designed to control floods, the risk of floods and the associated damage are increasing (Fox, 2003).

[3] Few authorities responsible for the management of this infrastructure have the organisational capacity and means to adequately maintain flood control works (Fox, 2003). In developing nations there is a tendency to rely on foreign funds and expertise to maintain infrastructure.

see all Chapters

Existing Financing Flood Risk Reduction Programmes and Funding

Box 11.2 lists the major bilateral and multilateral agencies financing flood risk reduction programmes throughout Asia.

Box 11.2
Donors and focus areas

Donor Agency	Relevant Focus Areas
Asian Development Bank	Agriculture and Natural Resources *http://www.adb.org/Documents/Profiles/sctr.asp?sctr=10* Finance *http://www.adb.org/Documents/Profiles/sctr.asp?sctr=101* Industry and Trade *http://www.adb.org/Documents/Profiles/sctr.asp?sctr=130*
AusAID	Humanitarian and Emergency Assistance Program[4] *http://www.ausaid.gov.au/human/program.cfm*
DFID	Millennium Development Goals (environmental sustainability) *http://www.dfid.gov.uk/mdg/*
European Union	Asia Invest Program *http://europa.eu.int/comm/europeaid/projects/asia-invest/html2002/main.htm* Asia Pro Eco Program *http://europa.eu.int/comm/europeaid/projects/asia-pro-eco/index_en.htm*
UNDP	United Nations Capital Development Fund (Microfinance) *http://www.uncdf.org/english/microfinance/*
USAID	Economic Growth and Trade Program *http://www.usaid.gov/our_work/economic_growth_and_trade/* Humanitarian Assistance *http://www.usaid.gov/our_work/humanitarian_assistance/*
World Bank	Economic Management *www.worldbank.org* refer "Project Database, By Sector" Social Protection and Risk Management *www.worldbank.org* refer "Project Database, By Sector"

---

[4] AusAID's Humanitarian and Emergency Assistance Programme includes funding for disaster preparedness and vulnerability reduction activities.

Local Level Flood Financing

In a disaster situation, traditional risk mitigation strategies break down when whole communities are affected on a large scale. At a time when the demand for goods and services (such as food, shelter, medicine and asset replacement) increases, the ability of a household to generate income is diminished as a result of damage to or loss of life and income-generating assets. This loss of income is exacerbated by market disruptions that result in increased costs of goods and services.

Low-income households with few assets tend to be more highly exposed and vulnerable to external stresses and shocks, such as floods, and struggle to adequately deal with the associated costs of preparedness and response activities (World Bank, 2001; Sebstad and Cohen, 2000; Brown and Churchill, 1999).

To reduce this vulnerability, low-income, asset-poor households employ a combination of risk mitigation and coping strategies.

- **Reduce consumption**
  Households faced with a decline in income or a decrease in the supply of basic items (and food, in particular) may reduce the number of meals eaten each day, purchase less expensive food and limit portions at meal times (Del Ninno, Dorosh, Smith and Roy, 2001).

- **Migrate for work**
  Where floods are isolated, household members may seek employment and consumer markets in other regions to supplement household income.

- **Livelihood diversification**
  Households may diversify their source of income and adapt to changing market conditions. For example, farmers who are unable to plant their usual crops and feed their livestock following a flood, may cultivate alternative crops, seek alternative means of feeding livestock and alternative forms of employment within the water sector (boating and fishing, for example) (Del Ninno, Dorosh, Smith and Roy, 2001).

- **Asset accumulation and disposal**
  Savings (cash and jewellery, for example) are surplus funds that households store to cover the future probable costs of life-cycle events (such as births, deaths and marriage), consumption, seasonal variations in cash flow and investment opportunities. During a flood households can draw on these savings to meet their consumption needs in the face of income scarcity and diminished income-generating assets.

  At a local level, individuals make equal, regular and small savings deposits that are held by a deposit collector (for a fee) until they are withdrawn.

see Chapters 8 & 9

Individuals form small groups and make regular contributions to the savings group. At each group meeting, members take turns to receive the full amount. There are no fees or interest payments. Individuals hold cash in the home and invest in grain, livestock and gold.

Micro-finance institutions have attempted to adapt these traditional savings methods to address some of the security, flexibility, divisibility and accessibility shortcomings of these savings options.[5]

- Credit

  Credit is borrowed funds with special repayment terms regarding interest rates, installment sizes and repayment frequency. Individual credits may be provided to individuals based on their ability to provide evidence of their capacity to repay (such as strong cash flows, character and historical financial results) and some level of collateral.

  Alternatively, households may wish to access credit as members of a group of people with whom they have an established relationship, common financial requirements and a certain degree of trust. These groups already exist in many countries (Ledgerwood, 1999) and micro-finance institutions have adapted and built on these traditional models of informal credit groups.

  Micro-finance institutions may offer loans to encourage households to construct stronger shelters to protect assets (Brown and Nagarajan, 2000) or to diversify their income-generating activities. They may adjust and reduce existing repayment rates during known flooding periods to reduce the level of non-repayment.

see Case Study 11.2

Disaster loan funds

To protect themselves against liquidity risk and to respond quickly to household demand in a flood, micro-finance institutions may establish disaster loan funds (Brown and Nagarajan, 2000). Disaster loan funds are financial reserves, typically established by an initial, one-time grant, held for future credit distribution for disaster relief or reconstruction. They are maintained and increased over time by retaining the principal amount or interest as loans are repaid, through separate contributions or by investing in liquid assets when not being utilised.

see Chapter 10

---

[5] Ledgerwood (1999) for a more comprehensive description of traditional savings mechanisms.

Case Study 11.2

USAID Findings on Female Borrowers

In a USAID study of eleven successful microfinance organisations, findings indicated that microfinance does reach a large number of women, whether because of direct policy decisions (Grameen Bank in Bangladesh, for example) or because of a commonly held belief that women demonstrate stronger repayment performance and are more willing to form groups.

Among programmes concentrating on women, motivations generally include the belief or experience that women are good credit risks and are more likely to have poor access to resources and services. Female participation rates in programmes without gender preference are determined by the prevalence of women in client groups served and by features not studied that may impede or facilitate women's access.

(Source: Christen, Rhyne, Vogel and McKean Christian, 1995)

Insurance

Rutherford (2000) and Brown and Churchill (2000) describe burial and marriage funds as traditional forms of insurance products. Here deposits are collected from many households to create a fund from which payments are made to people who suffer a loss. In this community-based insurance model, the policyholders own and manage the insurance programme.

Similarly, micro-finance institutions draw on their extensive household networks to collect relatively small amounts of money from a large number of households. This fund is used to pay relatively large amounts of money to a small number of households to cover the costs of risky events (such as disaster, death, health, property and disability). This risk-pooling mechanism reduces a household's vulnerability to disaster by allowing large groups of households to share the losses resulting from the occurrence of a risky event and receive a more complete compensation for their loss than they could have provided on their own.

Food becomes difficult to ensure when large portions of the population are affected at the same time. Contributions of the unaffected are insufficient to protect the numbers of affected households.

Here, re-insurance transfers the original insurance to another insurance provider, thereby spreading the total risk more broadly (Brown and Churchill, 1999; Development Alternatives Incorporated, 2000). Insurers utilise the efficient delivery mechanism of micro-finance institutions to provide sales and basic services to clients. Refer to Case Study 11.3 for an example of a government led trial in China.

see Case Study 11.3

Case Study 11.3

Flood Insurance on the Yangtze River Basin

The People's Republic of China (PRC) has been experimenting with flood insurance in the Yangtze river basin, where the limits of flood control have been exhausted and the use of flood detention basins had become problematic.

Flood control on the Yangtze River is based predominantly on flood embankments backed up by flood detention basins designed to be brought into operation when flood levels become dangerously high. Unfortunately, the flood detention basins incorporate highly fertile agricultural land as well as sizable towns and villages. Since operation of the basins for temporary flood storage is infrequent, there is considerable resistance among the affected persons to pre-emptive release of floodwaters into the basins.

Realising that it is unreasonable and uneconomic to depend solely on structural measures to solve flood problems, and that flood damage losses are too great to be borne by the community alone, a crop insurance programme for inundated areas was jointly implemented on a trial basis, from 1986-96. Participation was compulsory - the central and provincial governments bore 70% of the cost of premiums and the affected persons the remaining 30%.

Following a trial period of operation, in which it was found that the government-backed insurance helped overcome the residents' resistance to utilisation of the basins for flood detention, the cost of the scheme was spread more equitably by including beneficiaries living outside the detention basins as contributors. Insurance helped raise people's awareness of flood risk and the need to manage floods for the greater safety of the community. The compulsory payment of premiums and the inclusion of a cap on the amount of compensation, which the insurers are required to pay, act as disincentives to investment in high-risk areas. Given the difficulty of estimating actual crop losses and property damage occasioned by release of water into detention basins, compensation is paid according to the policy limit of each participant. This eliminates the need to make time-consuming and contentious estimates of flood damage following each event.

(Source: Fox, 2003)

Process and Checklist

The following checklist summarises the main issues that should be addressed in making an economic analysis of a flood risk management project. They follow the structure of the Asian Development Bank's (2001) *Guidelines for the Economic Analysis of Projects*.

Project rationale

- What is the rationale of the project: what market or government inadequacy does it address?
- What is the rationale for public sector involvement or private sector operations?
- What is the main alternative to the project?
- Have changes in policy been considered as an alternative to investments?
- Have efficiency improvements been compared with capacity expansions?

Macroeconomic and sector context

- How does the project relate to the overall development strategy?
- What particular development problem does it address?
- What is the policy environment for the project: taxes and subsidies, trade controls, exchange rate and interest rate?
- How does the project relate to sector strategy?
- What is the sector policy context in terms of market structure and regulation?
- Is the project a priority public investment?

Project alternatives

- Have project alternatives been considered in terms of location, scale, and timing?
- How has the best alternative been chosen?
- Has the least cost alternative been identified for the project or major sub-projects?
- Has cost-effectiveness analysis been used when benefits cannot be quantified or valued?
- Has the most cost-effective means been identified?
- Is it also the most effective means?
- What is the additional cost of the most effective means?
- Does the project have several outcomes: how have they been weighted to assess cost-effectiveness?

Demand analysis

- What is the basis for projecting the demand for project output?
- How will demand be affected by income growth?

- What other sources of supply are there for meeting the demand?
- How will demand be affected by an increase in price or user charge?

Identification of costs and benefits

see Chapter 4

There are four basic steps to analysing the economic viability of a project: 1) identify the economic costs and benefits; 2) quantify the costs and benefits, as much as possible; 3) value the costs and benefits; and 4) compare the benefits with the costs. The comparison of without-project and with-project situations is the principal basis of the estimation of net benefits for any project.

- Have the "without and with" project situations both been described?
- Have all project costs, comparing the "with and without" project situations, been identified?
- Have all project benefits, comparing the "with and without" project situations, been identified?
- Which benefits have been quantified and valued, and which have not?

Sensitivity analysis

Sensitivity analysis assesses the effects of adverse changes on a project. It involves changing the value of one or more selected variables and calculating the resulting change in the project's value or rate of return.

- Have the key variables been identified?
- Have switching values been calculated?
- Where the project is shown to be sensitive to the value of a variable that is uncertain, have mitigating actions been considered: long-term supply contracts or pilot phases; price changes or technical assistance programmes; changes in tax and incentive policies?
- Where there is exceptional uncertainty, has a project re-design or pilot programme been considered?

Risk analysis

see Chapter 4

Risk analysis associates a probability of occurrence with different values of key variables. Decision-makers will compare the scale of net benefits from different projects with their level of risk to select a project.

- Have probabilities been attached to any of the key sensitivity variables?
- Have institutional risks been assessed?
- Are there sufficient incentives for government participants in the project?
- What measures have been proposed for reducing project risks?

Financial sustainability

The availability of adequate funds to finance project expenditures, especially funds drawn from the government budget; the recovery of some of the project costs from the project consumers; and the financial incentive necessary to ensure participation in the project are key aspects of financial sustainability.

- Have the financial returns to different project participants been calculated?
- Are they adequate to attract investment and ensure active involvement?
- What is the level of charges for goods and services?
- Have the average incremental financial and economic costs been calculated?
- What is the level of cost recovery?
- Are there any subsidies available to the project?
- What will be the source of funds to meet net fiscal requirements: extra taxation, extra borrowing, or a reallocation of expenditure?

Environmental sustainability

Although it is not possible to put monetary values on all types of environmental effects, such costs and benefits should be as explicit as incorporated into the economic analysis, together with related mitigation or monitoring costs.

- Have the environmental effects of the project been identified: costs and benefits?
- How have they been quantified and valued?
- Are they expressed in the same form as the basic economic analysis?
- Have they been integrated into the economic analysis: for choosing between project alternatives and for assessing economic viability?
- Have required mitigation and monitoring expenditures been identified?

Distribution of project effects

Project sustainability is strongly affected by who benefits, and by how much, relative to who pays. The distribution of project benefits among government, consumers, and private investors is a key input in negotiating build-own-operate-transfer agreements, in pricing services, and in the economic return to the national economy.

- Have levels of income been projected both without the project and with the project?
- Has the effect of different levels of charges for goods and services been assessed for operators, customers and government?
- Has the distribution of costs and benefits, especially on the poor, been identified?
- What proportion of net benefits will go to poor people?
- Is the distribution of costs and benefits analysed by gender?
- Is there foreign involvement in investment and operation?
- Has the proportion of incomes and revenues going to foreign investors, lenders and workers been identified?

Lessons Learned

Macro-economic

- Flood risk management should be integrated into longer-term national investment policies, development strategies, and reflected appropriately in the allocation of financial resources (Benson, Charlotte and Clay, 2004).

see Chapter 3

- A full reassessment of the economic and financial impacts of a flood should be made eighteen to twenty-four months after the event. It should be taken into account in reviewing the affected country's short-term economic performance and the assistance strategy for the country (Benson, Charlotte and Clay, 2004).
- Assessment should be made whether the level of investment in flood control infrastructure has significantly led to an increase in the level of productivity and economic security (Fox, 2001).
- Generally speaking, very large amounts of money are spent on disaster response, often with little time to adequately prepare and design projects. By contrast, investments in preparedness, including preparing to respond to a disaster, and in reducing the vulnerability of poor people can, and should, be incorporated into broader development programmes and can prove to be cost-effective in the long-term (DFID, 2001).

Micro-economic

- Credit may be inappropriate in the immediate post-flood environment, particularly where households are extremely dispersed, highly mobile, unstable, dependent upon a single economic activity and vulnerable to civil violence, or where the regulatory environment creates significant barriers to sustainability.

see Chapters 7 & 8

- Voluntary savings mobilisation is not always feasible or desirable for micro-finance institutions. The administrative complexities, costs, compliance with prudential regulations and legal issues can make savings difficult. High inflation, political uncertainty and extensive government intervention (such as interest rate controls) compound these challenges by making it difficult to attract voluntary savings from households and exposing them to very high risk.
- Large micro-finance institutions with significant liquidity and a diverse portfolio are best able to continue operations in a post-disaster situation (Nagarajan, 1998).
- The provision of agricultural inputs such as seeds and tools must arrive in time for the planting of seasonal crops if they are to have any impact on the economy and household livelihoods (IFRC, circa 2000).

Future Challenges

The vulnerability of Asian economies is changing quickly as a result of economic transformation such as rapid growth, urbanisation, technical and social change (Benson and Clay, 2004). With increased economic development, the costs of preparing for and recovering from a large-scale flood will increase.

Similarly, the capacity of developing Asian economies to cover the costs associated with flood preparedness and recovery activities will increase. The Asian Development Bank (2005a) anticipate domestic demand will support overall economic growth in 2005–2007. Strong income growth will boost consumer confidence and spending. At the same time, investor interest is strengthening in many major economies of the region, and increased domestic and foreign investments are forecast.

However, any acknowledgment of developing Asia's strong economic performance in 2004 must be tempered by the fact that too many economies, in particular smaller economies, are far from closing the income gap with the better-off countries in the region. These economies remain highly vulnerable to external shocks such as floods and have weak domestic fundamentals. They include Mongolia; Cambodia, Lao People's Democratic Republic, Myanmar (Burma); Afghanistan, Bangladesh, Nepal; Kyrgyz Republic and Tajikistan *(*Asian Development Bank, 2005a).

The need to reinforce regional cooperation in Asia to effectively deal with floods should be underscored in the context of increasing economic linkages across the region.

References

Asian Development Bank (2005a) *'Developing Asia: Economic Highlights of 2004 and Prospects for 2005'* in Asian Development Outlook 2005.
http://www.adb.org/Documents/Books/ADO/2005/highlights/part010100.asp
Accessed April 2005

Asian Development Bank (2005b) *'Developing Asia: Sub Regional Trends and Prospects'* in Asian Development Outlook 2005.
http://www.adb.org/Documents/Books/ADO/2005/highlights/part020000.asp
Accessed April 2005

Asian Development Bank (2005c) *'Risks to the Outlook, and Challenges for Developing Asia'* in Asian Development Outlook 2005.
http://www.adb.org/Documents/Books/ADO/2005/highlights/part010500.asp
Accessed April 2005

Asian Development Bank (2001) *Guidelines for the Economic Analysis of Projects.*
http://www.adb.org/Documents/Guidelines/Eco_Analysis/default.asp
Accessed April 2005

Benson, C. and Clay, E.J. (2004) *Understanding the Economic and Financial Impacts of Natural Disasters.* Washington D.C., World Bank.

Brown, W. and Churchill, C. (1999) *Providing Insurance to Low-Income Households Part I: A Primer on Insurance Principles and Products - USAID Micro-enterprise Best Practice.*
www.mip.org/pubs/mbp/providing_insurance_to_low_income_households-part1.htm
Accessed July 2003

Brown, W. and Nagarajan, G. (2000*) Disaster Loan Funds for Micro-finance Institutions: A Look at Emerging Experience - USAID Micro-enterprise Best Practice*.
www.mip.org/pubs/mbp/disaster_loan_funds-draft.htm
Accessed July 2003

Christen, R., Peck, Rhyne, E., Vogel, R.C. and McKean, C. (1995) *Maximising the Outreach of Micro Enterprise Finance: An Analysis of Successful Micro-Finance Programs.* Washington D.C., USAID.

Del Ninno, C., Dorosh, P.A., Smith, L.C. and Roy, D.K. (2001) *The 1998 Floods in Bangladesh: Disaster Impacts, Household Coping Strategies, and Response.*
http://www.ifpri.org/pubs/abstract/abstr122.htm
Accessed April 2005

Development Alternatives Incorporated (2003) *Rapid-onset Natural Disaster Brief No. 7 Pre disaster Planning to Protect Micro-Finance Clients - USAID Micro-enterprise Best Practice.*
www.usaidmicro.org/pdfs/mbp/rapid_onset_brief_7.pdf
Accessed July 2003

Development Alternatives Incorporated (2003e*) Rapid-onset Natural Disaster Brief No. 5 MFI Liquidity Problems after a Natural Disaster.*
www.usaidmicro.org/pdfs/mbp/rapid_onset_brief_5.pdf
Accessed July 2003

DFID (2001) *Evaluation of DFID-B Response to South West Bangladesh Floods October 2000 - Mid 2001*.
http://www.alnap.org/lessons_tsunami.htm
Accessed April 2005

Fox, I.B. (2003) *Reducing the Vulnerability of the Poor to the Negative Impacts of Floods.*
http://www.adb.org/Documents/Events/2003/3WWF/Floods_and _the_Poor_Final.pdf
Accessed April 2005

IFRC (International Federation of Red Cross and Red Crescent) (circa 2000) *Seasonal Flooding Synthesis of Recent Evaluations and Reviews.*
http://www.alnap.org/pdfs/458.pdf
Accessed April 2005

Ledgerwood, J. (1999) *Micro-finance Handbook: An Institutional and Financial Perspective.* Washington D.C., World Bank.

Nagarajan, G. (1998) *Micro-finance in the Wake of Natural Disasters: Challenges and Opportunities - USAID Micro-enterprise Best Practice.*
www.mip.org/pubs/mbp/disas.htm
Accessed July 2003

Parker, J. C. and Nagarajan, G. (2000) *Can Micro-finance Meet the Low-income's Financial Needs in Times of Natural Disaster? - USAID Micro-enterprise Best Practice.*
www.mip.org/pubs/mbp/can_microfinance_meet_the_low-incomes.htm
Accessed July 2003

Rutherford (2000)

Sebstad, J. and Cohen, M. (2000) *Micro-finance, Risk Management, and Poverty - USAID Assessing. the Impact of Micro-enterprise Services.*
www.mip.org/pdfs/aims/wdr_report.pdf
Accessed July 2003

Sanderson, D. (2000) *'Cities Disasters and Livelihoods'* in Environment and Urbanisation Volume 12 Number 2. London, IIED.

World Bank (2001) *Social Protection Sector Strategy: From Safety Net to Springboard.* Washington D.C., World Bank.

cross-cutting issues

12

Chapter Brief

- There are issues that need to be considered in all aspects of flood risk management.

- Flood risks are not confined within national borders. Countries sharing a river system in a watershed must establish good relations by creating an environment that enables constructive dialogue and discussion regarding the use of water resources and measures to reduce flood risks.

- There needs to be a strategy for meeting the needs of displaced people that includes addressing vulnerability prior to flooding to boost their resilience and well-being after flooding.

- The foundation of lasting risk reduction efforts begins at government level. Good governance supported by political will and commitment is necessary for effective flood risk reduction.

- Integrated flood risk management depends on a mutual understanding by all stakeholders that the natural environment is a delicate and intricate system in which all elements are interconnected and integrated. Although risks cannot be completely eliminated, a balance is required between the natural environment and human activities to reduce the level of risk.

- Climate change has the potential to increase flood risks, which needs to be addressed at the international level and reflected regionally.

- The significance and importance of culture, tradition and religion should not be undermined. These play an enormous part in shaping people's perceptions and actions.

- Gender issues must be acknowledged and incorporated into flood risk management. Biological differences and socially constructed roles play a large part in defining the different needs of men and women.

Overview

This chapter addresses some cross-cutting issues that should be acknowledged and given full consideration in flood risk management. These issues do not have clear or simple solutions, they can only be considered within the specific context of the plan or programme, which will dictate the appropriate measures to apply.

The result will be a more sustainable approach to flood risk management that is both forward-looking, integrated and people-centred.

Cross-cutting Issues

Transboundary

> *'Transboundary problems often contain the seeds for both cooperation and conflict at the same time' (Spector, 2001).*

It is widely recognised that there is a need to address water resource issues in order to meet consensus on the diverse uses and needs of countries sharing a watershed. River management is best addressed according to the natural river basin boundaries, rather politically determined administrative boundaries. However, needs and objectives for water use are often different between countries. This difference has the potential to cause aggravations and allow the water resources to be exploited at the will of others. In the context of flood risk management, an integrated approach is essential to manage and coordinate activities on a river system such as land-uses, water extraction and utilisation, and flood control and drainage in order to benefit all the countries involved.

Controlling the use of water is a highly contentious topic requiring collaboration and cooperation to ensure that decisions made are acceptable for all neighbouring provinces and countries. Economic goals and political motivations drive the disagreement of countries on transboundary issues. Reaching consensus and agreement is unrealistic given the current context of short-term life of political leadership. Problems such as water shortages, pollution, depleted aquatic life and fish stock (and hence diminished livelihoods), and flooding require long-term planning and commitment. The first step is to establish open communication channels between countries.

An impartial mediatory body can provide more neutral ground to enable countries to begin discussing issues. A unified effort propelled by the formation of partnerships and collaborations may assist to broach the problem of flooding and water resource management. The MRC Flood Management Programme described in Case Study 12.1 provides a good example of a body established to specifically attempt to improve transboundary communications and cooperation for flood risk management.

see Case Study 12.1

The objective of the MRC is to strengthen cross-border water management institutions by:

- **Building politically feasible institutions**: Enable essential communication between riparian countries in technical and political matters to develop mutually acceptable strategies and visions.
- **Process financing:** Provision of process financing to improved stakeholders' willingness to invest in measures reducing transboundary impact.

Case Study 12.1

Mekong River Commission (MRC) Mediation of Transboundary Flood Issues

Objective: 'Enhanced mediation and coordination capacity of the MRC in issues of non compliance in transboundary flood management.'

Investments in transboundary institutions developed as outlines below would support the development of effective environmental governance in the lower Mekong basin.

1. To find improved means by which stakeholders at cross-border locations can be made accountable for differences in non-compliance in water management while maintaining a full respect for national sovereignty, non-interference in domestic matters, and consensus-based decision-making processes.
2. To define norms and rules from which inter-riparian communication on technical matters and difference in transboundary water management can progressively develop within the existing MRC agreement
3. To effectively narrow the lag-time between any identification of substantial cross-border difference and decision-making solutions.

(MRC, 2002)

- **Creating conditions for legal transboundary agreements:** Norms and rules on participation, enforcement, sharing and monitoring must be worked out as key institutional processes.
- **Regional institutions:** Promotion of investments in transboundary public goods through partnerships between regional institutions.
- **Cost recovery on transboundary water resources:** Introduction of new financing mechanisms in robust river basin institutions.
- **Private sector engagement:** Encourages private sector participation, compliance and discussion in transboundary water management.
- **Transboundary water allocation and prioritisation:** Consideration of the benefits of allocating water based on percentages rather than fixed volumes of hypothetical flows. This will improve the water management taking into account fluctuations in flow.

(Adapted from MRC, 2002)

Checklist for transboundary issues:

☑ Do the surrounding riparian countries and provinces support my plans to address flooding?

☑ Are my land-use practices affecting the downstream watercourse? Is it resulting in increased pollution, sedimentation, drought, flooding, etc.?

☑ How do I approach my neighbouring countries to address the problems they are causing within my boundaries?
☑ How do we approach information sharing to enable a flood early warning system for the river?
☑ How do we collaborate for funding to implement multinational projects to address flooding?
☑ How do we identify and accept our roles in integrated watershed and river management?
☑ How do we collaborate in carrying out risk assessments?
☑ How do I include neighbouring countries in my preparedness plans and response efforts?
☑ Is there a way of consolidating the neighbouring countries affected by flooding to enable us to have the power and resources to address the causes and solutions for flooding in the region?
☑ How do we create a platform for sharing ideas and information, and learning from best practices in the region?

Population displacement and movement due to flooding

Population displacement is one of the greatest social consequences of flooding (as shown in Box 12.1). It has impacts spanning from the individual household to hindering the attempts to achieve national long-term development goals. The effects of internal displacement of people caused by natural hazards has not been widely researched, they are often ignored or labelled simply as 'affected' by the flood disaster.

Box 12.1

Statistics of displacement due to floods

- Half a million people displaced by flooding - Bangladesh, 2003 (Earth Observatory, 2003)
- 3.7 million people displaced in Assam - India 2003 (AFP, 2000)
- 440,000 displaced by large-scale floods in the eastern, central and southern provinces of China. The floods left about 3.5 million people homeless (Canadian Red Cross, 2003)

People are displaced by flood when they have nowhere to go, their homes are destroyed and livelihood support systems become dislocated and dysfunctional for a period of time after the disaster. They can include:

- People who are temporarily without anywhere to live during floods, but return to their homes thereafter.
- People who are permanently displaced due to flooding and need to migrate to another area to live.
- People staying in refugee / evacuation camps after a flood, with or without homes to return to.

- People who are either part of, or not part of relocation schemes.
- People who do not own land and lose their rights to occupy land after floods.
- People who live on temporary land such as chars (sediment deposits in a river forming islands) that are sometimes permanently inundated or washed away after floods.

Population displacement due to flooding is a very complex issue. Although it is certain that flooding causes millions of people in Asia to be displaced, there are several uncertainties about the nature of their displacement (refer to Case Study 12.2). Governments with the help of international organisations and NGOs should look to provide sustainable solutions by examining root causes and mechanisms for addressing them. Displacement needs to be recognised and dealt with, not simply as a consequence of flooding that can be addressed with emergency response and rehabilitation, but as an increasing and ongoing social and environmental issue. It is important to find answers to the following questions in this regard:

- What happens to people displaced by flooding? Do they return to the former areas or migrate to other areas? What are their conditions of living?
- What help are displaced people given?
- Are there people who are displaced year after year due to flooding? (This does not include those who cope with flood by relocating during flood season.)
- What are the possible solutions for protecting internally displaced persons (IDPs)?

Case Study 12.2

Char Dwellers in Bangladesh

Chars are riverine islands and bars that form in the channels of Bangladesh's main rivers. An estimated 600,000 people live on chars in Bangladesh. They are often forced to move during the flood season as the chars become totally submerged by floodwaters. People tend to return after the floods however, there is the issue of land ownership. Laws state that all newly emergent land previously lost by dilution should be restored not to the original owner, but to the government' (Order No. 135). In 1972, this law was meant to recover land from powerful 'jotedars' who claim it and redistribute it among landless people. However, it has not been enforced, resulting in often violent clashes over landownership.

These landless and homeless people are regularly displaced by flooding and are caught in a perpetuating cycle struggling for the basic means and rights to live. These people are poor and vulnerable, and also internally displaced.

(Sarker et al, 2003)

- What are the possible solutions for reducing the root causes of displacement due to flooding?
- Is flood risk management viewed as a viable method of addressing displacement?
- Do plans to deal with displacement include all vulnerable people living in flood-prone areas as they all have the potential to become displaced irrespective of income level?
- How could displacement affect human and economic development in the area?

The issue becomes increasingly problematic when the displaced populations are already politically or economically marginalised, such as minority groups, with low-incomes, and unrecognised by governments as citizens of the country. There is also an embedded human rights issue to address and to establish who will be responsible for dealing with these vulnerable groups. The Guiding Principles on Internal Displacement presented in Box 12.2 provides governments with an outline of their responsibilities.

Box 12.2

Guiding principles on internal displacement

IDPs are recognised in the UN Commission on Human Rights 'Guiding Principles for Internal Displacement' (1998). The guidelines, though not legislative, are widely accepted and being applied as a standard by international organisations, NGOs and governments.

'National governments have the primary responsibility to prevent displacement, protect displaced people from violations of their human rights, provide humanitarian assistance and facilitate return.''

"Internally displaced persons are persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalised violence, violations of human rights or *natural or human-made disasters,* and who have not crossed an internationally recognised State border."

"Principle 3.2 Internally displaced persons have the right to request and to receive protection and humanitarian assistance from these authorities. They shall not be persecuted or punished for making such a request."

"Principle 6.1 Every human being shall have the right to be protected against being arbitrarily displaced from his or her home or place of habitual residence."

(Extracted from Global IDP Project, 1998)

Governance

see Chapter 3

Appropriate governance for disaster risk management is a fundamental requirement if risk considerations are to be factored into development planning and if existing risks are to be successfully mitigated (UNDP, 2004).

Good governance is a prerequisite for flood risk management. Without good governance and strong leadership, the government or other leading organisations will not have the legitimacy or support to carry out flood risk reduction measures. Many aspects of flood risk reduction, such as early warning systems or relocation programmes require participation and trust between a decision-making body and its citizens. There needs to be assurance of commitment to risk reduction by displaying the following qualities:

Accountable: Follows the rule of law
Transparent: Effective and efficient
Practices equality and tolerance: Responsive
Encourages public participation: Consensus orientated

Measurements for governance that governments, private sector, NGOs and CBOs should aim for:

- Political commitment and elevating disaster risk reduction as policy priority.
- Legal and regulatory frameworks.
- Institutional frameworks and structures.
- Multi-stakeholder participation.
- Capacities for disaster risk reduction.
- Financial resources for disaster risk reduction.

(Westgate, 2005)

see Box 12.3

In Asia, improvements in the governance of government sectors, private sector, NGOs and donors will serve to improve the workings of the whole flood risk management framework, as illustrated in Box 12.3. Good governance calls for a reduction of corruption, nepotism, corner-cutting, bribery, non-compliance, mistrust and many other such practices that contribute to hindering the progress and preventing the success of risk reduction measures.

Checklist for addressing good governance:

☑ Is there the political will at local, provincial or national level to address flood risks?
☑ Are all minorities and marginalised groups considered in the planning process?
☑ Are you willing to be held responsible for your actions or lack of action concerning flooding risk reduction measures?
☑ Do you seek the consensus of countries, farmers, NGOs, government bodies, the public before implementing risk reduction measures?

Box 12.3

Flood risk reduction outputs of good governance

Regional / international level

- Defining and shaping common regional level strategy.
- Development of national capacities.
- Knowledge, information and documentation.
- Addressing transboundary issues.
- Framework for scientific, technical and professional interface with government and non-governmental structures.
- Advocacy and galvanising support and assistance.
- Facilitating technology development; technology acquisition.
- Providing development and technical assistance.
- Provide finance for programmes dealing with poverty alleviation.

National level

- Political will and commitment t o sharing decision-making power.
- Effective policies to address flood risk.
- State's ability to use available state and non-state capacities to make and implement them.
- National strategy to address flood risk.
- Institutional framework consisting of an NDRMO to enable the coordination and implementation of flood risk reduction activities.
- Formation and implementation of legislation.
- Supporting risk reduction measures, advocating emergency preparedness, awareness and early warning systems.

Local level

- Decentralised local governance structures.
- Encouragement of citizen participation.
- Partnerships with local government and NGOs, private sector and CBOs.
- Effective municipal and local government institutions.
- Coordinating structures for disaster risk management.
- Political will and commitment.

Community

- Favourable political environment that supports and promotes participatory practices, and specific opportunities for the community, taking into consideration issues such as equality and the inclusion of women and minority groups in the decision-making and implementation of flood risk reduction programmes.
- Establishing leadership roles.
- Community participation and ownership in all aspects of flood risk reduction.

(Adapted from Cadribo, 2004)

- ☑ Are you striving to address flood risks in a suitable time-frame, such as in the quickest time possible whilst optimising consultation, participation and planning?
- ☑ Are your plans, financial records, business interactions and organisational records available for viewing at any time?
- ☑ Do you make choices that reduce the quality of your work, are contrary to the expected output or that compromise the integrity of the organisation?
- ☑ Do you understand how the way you conduct your organisation impacts upon the success of any risk reduction programmes?
- ☑ Can you see how good governance provides a positive environment and will improve and maintain good relations with all stakeholders?

Environmental governance

The environment has been widely exploited in the quest to achieve a higher status of development through modernisation and economic growth. It has been altered to make space for settlements and to reap the economic value of natural resources. This is now an age where attention must focus on attempting to achieve higher levels of sustainability of human life through the conservation of the natural environment. Integrated flood risk management should seek to recognise the adverse affects caused by unsustainable human practices, and the link between environmental degradation and natural disasters.

To date, there are no binding international or regional mechanisms to address this issue. Few national policies exist purely to acknowledge governance of the environment. The beginning of the 1990s saw the evolution of a number of initiatives, signatory conventions and agreements established to raise awareness and advocate greater commitment to environmental sustainable development and governance. Although signing international agreements is not binding as legislation, it promotes influence through peer pressure from other countries and lays down standards and guidelines to work by. Agenda 21 and the Kyoto Protocol for Climate Change are two such agreements.

Environmental governance concerns all actors who make choices about the conditions for utilising natural resources. It provides a framework for working together to address environmental concerns. It calls for action through agreements, policy, legislation and institutions that work to protect the natural environment, not in opposition to development, but as a necessary part of development.

Checklist for considering environmental governance:

- ☑ Do you understand the implications of the following on your surrounding area: Loss of biodiversity and natural resources including trees, organisms, fossil fuels and water, depletion of the ozone layer, climate change?
- ☑ Do you understand the relationship between aspects of environmental degradation and increasing flood risk?
- ☑ Are you aware of how each sector is contributing to environmental degradation?

☑ How would you create an institution to deal specifically with environmental governance to enable networking, information sharing and research, and to advocate policies to protect natural resources?

☑ Do your current institutional arrangements enable contact with other organisations to express views, information and advice about issues relating to the environment?

☑ Are you, either as a government or other organisation, adhering to or advocating international agreements such as Agenda 21, the Kyoto Protocol and the millennium goals?

☑ Is there an institutional arrangement that allows you to unite with other countries, giving you power and a standpoint in order to be able to encourage and insist other governments to adhere to Agenda 21 and the Kyoto protocol?

Climate Change

The link between climate change and disasters, particularly floods, is still unclear. Natural disasters by nature are complex events with multiple human vulnerabilities of which climate variability is only one issue. For example, although flood hazards can be predicted to a reasonable extent, high impact floods generally have a high uncertainty rate. The link between climate change and disasters is still under speculation and debate. There is an understanding that it may hold possible consequences, which may be of critical concern. The lack of certainty through scientific proof makes policy formulation difficult as people are still unsure and policy makers are still unconvinced of the true relationship.

The IATF for Disaster Reduction considers that, '*the central idea is that action to reduce vulnerability to today's climate extremes through disaster risk reduction is a potent means of adaptation and an excellent way of building adaptive capacity in the long run. For example, the ongoing work to study the El Nino phenomenon and develop practical applications of seasonal forecasts will strengthen countries resilience to any major changes in seasonal climate in the future' (IATF/DR, 2003).*

By viewing increasing flood risk as a potential result of climate change, policies and programmes related to climate change can be used to further flood risk reduction activities. Linkages between activities can be made in the following areas: early warning systems, seasonal climate forecasts and outlooks, collecting and analysing patterns of historical data and creating workable database, insurance and financial risk management, land-use planning, integrated water resource management, conservation and natural resource management, regional flood management, awareness raising and information provision.

Climatic issues related to flooding:

- The climate varies naturally on all time scales and there are internal interactions causing regular fluctuations such as El Niño Southern Oscillation (ENSO) phenomenon.

- Although natural variability often leads to climate extremes, record breaking extremes will occur from time to time.
- Growing human vulnerability is transforming more and more extreme events into climatic disasters.
- More intense rainfall events may lead to greater flooding in some regions.
- Global warming is expected to accelerate the hydrological cycle and raise the percentage of precipitation that falls in violent bursts. Greater flood run-off could decrease the amount of surface water captured for irrigation and other purposes, although it could help to recharge the floodplain aquifers.
- The intensity of tropical cyclones is likely to worsen over some areas.
- Major climate patterns could shift.
- It is becoming increasingly difficult to predict local and regional trends for extreme events.
- Although extreme events are abrupt and random, the risks they pose can be reduced.
- Climate change has the potential to cause large-scale singular events.
- Snow cover has declined by approximately 10% since the late 1960s. This affects mountain glaciers and lakes, and arctic sea ice.

(UNEP and UNFCCC 2002)

Checklist for considering climate change:

☑ Is there a national organisation focusing on monitoring climate change and research about the impact on increasing flood risks?

☑ Is effort being made to prevent contribution to climate change such as reducing the release of harmful gases?

☑ Have you carried out an assessment of all the potential impacts of climate change on throughout the country including the impact of sea level rise and increased icemelt?

☑ Are you encouraging other countries to take action or are you part of an international effort to address climate change?

Culture, Tradition and Religion

see Case Study 12.3

Past flood disaster experiences in Asia have highlighted the need to be conscious of cultural diversity, traditional practices and religious rituals when planning flood risk management activities. Even during the worst flood crises, people will try to return to their daily routines, and this involves observing and practicing normal customs. This includes expressing modesty in dress and action, being able to conduct daily prayers, complying with dietary requirements, appropriate burial of the dead, treating the injured, etc. (refer to Case Study 12.3). These considerations must be acknowledged and addressed in preparedness planning, response and emergency, recovery and mitigation.

Case Study 12.3

The Significance of Traditional and Cultural Practices

In Tamil Nadu state, where the tsunamis killed some 8,000 people, villagers live on a staple diet of rice and, if they are lucky, fish. Unlike people from northern India they do not eat wheat bread, potatoes or meat. The Sikh community in Punjab dispatched 110 chefs to the southern coast of India. *"They wanted to set up community kitchens and we told them the food they cook will not be eaten by the local people. Instead the cooks can be used as volunteers for help in other areas,"* Nair said.

"Their intention was good but they did not bother to find out whether local villagers like what they cook."

(Daily Times Pakistan, 2005)

Oversights such as building inappropriate dwelling types, unfamiliar structures, and not taking into account how existing patterns of social relationships can be affected by infrastructure planning, can severely affect the recovery of communities. The needs of the affected must be considered through mechanisms that allow them to participate actively in their flood management options. All flood plans, activities and actions need to consider the contexts of the society they are managing.

Checklist for considering culture, tradition and religion:
☑ Have you considered minority ethnic groups affected by floods?
☑ Have you explored traditional indigenous practices and strategies for coping?
☑ Does the dominant religion influence people's perceptions of risk? Can it be used to motivate people to consider risk reduction measures?
☑ Have your flood preparedness plans considered cultural and religious practices? For example, ensuring that women's latrines are discrete and covered.
☑ Does your response planning consider religious rituals, beliefs and practices? For example, burial of bodies, ghosts and spirits of the dead, fasting, prayer times, observing events of religious significance, etc.
☑ Do you have a policy addressing cultural practices for disaster management practitioners, and response and relief personnel? For example, wearing conservative clothing, practicing purdah, observing dietary requirements, body language, avoiding alcohol, female interviewers for female key informants, female doctors for female patients in gender sensitive areas, etc.
☑ Does your early warning system cover all languages spoken in the area?
☑ During emergency and response, do you pay particular attention to ensuring that people can fulfil all religious, traditional and cultural practices?

Gender

The roles of men and women in society affect the way they react to different flood hazard situations. Gender roles and responsibilities are important to acknowledge during flood risk management planning. Men and women will be affected by flooding differently, and their reactions and behaviours will change in response to the stress that a flood crisis places upon their ability to carry out normal roles. To a greater extent, their needs will also be dependent on their biological differences and socially constructed roles.

Gender roles and responsibilities are greatly influenced by religious and cultural norms. There is often overlapping considerations that need to be addressed or at least acknowledged, and planners need to be aware of the relationship between gender, religion and culture and how it can affect the implementation of preparedness, response and recovery flood plans.

Case Study 12.4

A qualitative study was carried out in 5 slum areas in Dhaka city by BRAC (NGO), interviewing 32 men and women to determine actual needs of people living in the slum areas. Informal interviews were conducted, and these are some findings:

- Due to the openness of latrines, women often waited until nightfall to use them, fearing the gaze of men loitering around the latrine areas.
- During severe flooding when food relief is the only option, women have to wade through flood waters to collect food for the family. Their saris cling to their bodies, (considered inappropriate in public) making women feel uncomfortable and vulnerable. Men feel useless when they cannot provide proper clothing for their wives.
- A great deal of stress is placed on men to provide food and clean water for the family, however, as prices of food inflate, they can no longer provide. The stress and frustration of the situation results in an increase of domestic violence cases.

(Rashid, 2000)

There is now greater attention focusing on the role of women and girls and their associations with flood hazards, in particular their roles as mothers, care givers, food providers, interaction with natural resources, and relationship with other people in the community. Similarly, the role of men is becoming of greater interest, particularly due to the expectation in many societies in Asia, for men to provide for their families (refer to Case Study 12.4). Experience suggests that the social construction of gender roles needs to be assessed, and findings applied in the planning and execution of activities. One must be aware of how gender roles will affect projects. There is currently advocacy directing the mainstreaming of gender into disaster risk management, which focuses consciously on addressing gender norms in management plans.

- Women often know more than men about how people in their community live - for example, those who are sick or disabled and may need help leaving their home in a cyclone, and those who can readily help. The newcomer in the neighbourhood and people like prostitutes or widows who may be 'outsiders' to some, are often known to women in the neighbourhood.
- Women also tend to listen to warnings about danger and pay attention to hazards like flood-prone rivers that children must cross to reach their school. When asked to evacuate, many times women leave more readily than men.
- Because women so often use the land, water and animals to earn a living and feed their families, they try to conserve these resources for future use. To the best of their ability, they help keep water clean, soil fertile, forests sustainable, and livestock healthy.
- Older women especially will remember how people coped with past hazards and disasters and are more likely than men to still speak the native language. They can help others like them to learn how to minimise risk .
- Women are more likely than men to share information, ideas, and resources because they are more organised at the grassroots. They build lively networks of friends at work, in schools, in their neighbourhood and through their religion. Often in a disaster, it is women's groups that take the lead in helping rebuild community solidarity after a disaster.

(IHRC 2001)

Characteristics of roles of women:
- Manage and use natural resources on a daily basis.
- Organise locally to address immediate family and community needs such as lack of clean water.
- Have limited economic resources to anticipate, prepare for, and recover from a major disaster.
- Respond to people's on-going needs in the extended recovery period following a major disaster.
- Under-represented politically, but strong informal leaders.
- Connected with school systems and children's education.
- Have influence over others through strong social networks.
- Effective communicators, especially on family and children related matters.
- Attentive to emergency warnings and preparedness.
- Safety-conscious or "risk averse".

Checklist for gender:
- Have you identified the different roles of men and women in the society and made projects and plans suitable for this?
- Have you considered the potential leadership role women could play within the family and community during a flood disaster?

- Have you explored the links between gender and culture, particularly in a traditional society, and the way that relates to flood risk management policy and programmes?
- Have you also considered children together with women because of the often vital connection between them?

Participation

People have coped with floods for centuries, and as mentioned in previous chapters, they have developed their own coping mechanisms to deal with the complexities of flood risk. Community participation in decision-making for flood risk reduction measures is essential for project planners to understand the dynamic interactions between people and their natural and built environment.

Multi-stakeholder participation in programming enables a host of people with vested interests to discuss and review strategies, and explore new methods for reducing flood risk. Although the community is bound by commonalities such as location or interest, their views and opinions will differ, so also will their options and choices. Platforms for dialogue and discussion between members of civil society must be created, to air grievances and concerns. People have a right to actively participate in the decision-making process that will ultimately affect their lives.

Participatory approaches in disaster management:

- They enable people to explain their vulnerabilities and priorities, allowing problems to be defined correctly and responsive measures to be designed and implemented.
- The principle resource available for mitigating or responding to disasters is people themselves and their knowledge and expertise.
- Participatory work requires a multi-task approach combining different activities, hazards and disaster phases. It is therefore well-placed for dealing with the complexity of disaster and the diversity of factors affecting people's vulnerability to them.
- The process of working and achieving things together can strengthen communities. It reinforces local organisations, building up confidence, skills, capacity to cooperate, awareness and critical appraisal. In this way it increases people's potential for reducing their vulnerability, it empowers people more generally by enabling them to tackle other challenges, individually and collectively.
- Participatory risk reduction initiatives are likely to be sustainable because they build on local capacities, the participants have 'ownership' of them and they are more likely to be compatible with long-term development plans.
- Community participation in planning and implementing projects accords with people's right to participate in decisions that affect their lives. It is therefore an important part of democratisation in society and is increasingly demanded by the public.

- Participatory approaches may be more cost-effective in the long-term than extremely top-down driven initiatives, partly because they are more likely to be sustainable and because the process allows the ideas to be tested and refined before adoption.
- External agents cannot cope alone with the enormous risks facing vulnerable populations. Local people can bring a wealth of resources, especially knowledge and skills, to help reduce risks.
- Working closely with local people can help professionals to gain a greater insight into the communities they seek to serve, enabling them to work more effectively and produce better results.

(Twigg, 2004)

Checklist to consider for participation:
☑ Do you have mechanisms in place that encourage participation of various stakeholders and the community?
☑ Is there a genuine interest to involve the community in plans?
☑ What are the hindrances to community participation?

Disasters, Development and Sustainability

Reducing disaster risk requires long-term commitment and engagement with the process of development planning. Years of development achievements and gains can be wiped out in a relatively short span of time by a severe natural hazard. We have seen many areas in Asia destroyed or damaged by the impacts of floods. Bangladesh, Vietnam, Cambodia, India, Nepal, Sri Lanka, Thailand, Indonesia, Philippines and China have all experienced great losses due to floods.

Flood disasters have economic, social, political and environmental ramifications. Weighing up the costs and benefits of addressing flood risk, particularly in flood-prone low-lying areas such as floodplains, deltas, urban and coastal areas will have greater long-term benefits for the well-being of people living in these areas. Box 12.4 illustrates the link between disasters and development.

see Box 12.4

Over the past 15 years, the paradigm shift from relief to preparedness and mitigation, and most recently, the emphasis on integrating disaster risk management practices into development planning has become more accepted. Yet, there is a long way to go. The need to consider risk management issues that may adversely impact development planning is still not common practice.

Many countries in Asia still do not see the limitations to development efforts caused by disastrous floods. More funds are still poured into relief and emergency assistance with the belief that planned development will simply halt during disaster times and resume during normal times with little impact. There needs to be greater emphasis on flood risk mitigation measures to reduce the damage

Box 12.4
Links between development and disasters

	Economic Development	Social Development
Disaster limits development	Destruction of fixed assets. Loss of production capacity, market access or material inputs. Damage to transport, communications and energy infrastructure. Erosion of livelihoods, savings and physical capital.	Destruction of health or education infrastructure and personnel. Death, disablement or migration of key social actors leading to erosion of social capital.
Development causes disaster risk	Unsustainable development practices that create wealth for some at the expense of unsafe working or living conditions for others or degrade the environment.	Development paths generating cultural norms that promote social isolation or political exclusion.
Development reduces disaster risk	Access to adequate drinking water, food, waste management and a secure dwelling increases people's resilience. Trade and technology can reduce poverty. Investing in financial mechanisms and social security can cushion against vulnerability.	Building community cohesion, recognising excluded individuals or social groups (such as women), and providing opportunities for greater involvement in decision-making, enhanced educational and health capacity increases resilience.

(Source: UNDP 2004)

and destructive impacts of flood disasters. There also needs to be an emphasis on flood preparedness planning, which has proven to reduce damages and loss of life in flood-prone areas. Without political will and commitment driving the formulation of policies and legislation aimed at reducing floods and other disaster risks, national development efforts will be threatened.

see Chapter 3

The goal now is to address not only floods, but other disasters in relation to development planning. Disaster risk management is not a stand-alone sector, but an essential concern that operates across sectors. Mainstreaming or integrating disaster risk management into development policy, planning and implementation requires clarifying the roles and placing the responsibilities of disaster management and risk reduction, not only onto the decision-makers and planners at the national level, but also different ministries, donors and the development community.

Flood risk management must be considered in relation to a multi-hazard risk management framework, within a multi-sector environment. The role of the National Disaster Management Office (NDMO) (or other such bureaus) is crucial to advocate for integration and mainstreaming. Capacities need to be built in order to ensure that all sectors understand their cross-sector influences and how risks can be managed within development planning accordingly.

The goal of pursuing sustainable development drives the practice of risk management integration or mainstreaming into development planning. The objective of managing risks works towards ensuring that the achievements of development can continue to expand rather than be limited by disaster events. In terms of integrated flood risk management, critical issues such as the impact of human activities, population growth, increased settlement in floodplains, overuse of river systems, altering the flood environment, deforestation, and increasing the area of the built environment, all need to be considered. It is through the consolidated and concerted efforts of all stakeholders that safer and sustainable communities can be attained.

Checklist to consider for development and sustainable development:

☑ Do institutional arrangements enable a link between development planning and disaster risk reduction?
☑ Are you involved in national / international efforts for sustainable development such as Agenda 21, Kyoto Protocol and UN Millennium Goals?
☑ What are the limitations to sustainable development and how can they be addressed at your level?

Future Challenges

Recognising these cross-cutting issues and their place within the integrated approach helps to focus the ways in which flood risk can be managed. All agencies involved in programming for flood risk management need to be aware not only of possible risk reduction measures, but also how to differentiate the most suitable options for the situation and people. These issues such as culture, tradition, gender and governance can all significantly affect the success of risk reduction initiatives.

This primer has highlighted the complexities of the flood risk environment. It has drawn from the Asian experience and noted some of the successes and limitations in flood risk management. Much has been achieved in recent years concerning the ways in which flood risks are addressed in Asia, but there is clearly scope for improvement and the adoption of better practices.

The integrated approach is not simple, nor easy, it requires commitment and dedication from all stakeholders united with a common goal of reducing flood risks, which plays such a significant role in contributing towards long-term sustainable development. The implications are not only regional, but relevant to the entire global community.

Resources

Population displacement

The Global Survey of the Norwegian Refugee Council (1998) *Internally Displaced People: A Global Survey*. Ed. Hampton, J. Oxford, Earthscan Publications Ltd.

Governance

What is Good Governance?
http://www.unescap.org/huset/gg/governance.htm
Accessed March 2005

Participation

Twigg (2004) *Disaster Risk Reduction, Mitigation and Preparedness in Development and Emergency Planning*. Humanitarian Practice Network Good Practice Review 9. London, ODI.

Climate change

Kyoto Protocol, United Nations Framework Convention on Climate Change.
http://unfccc.int/essential_background/kyoto_protocol/items/2830.php
Accessed March 2005

Gender

IHRC (2001) *Working with Women at Risk: Practical Guidelines for Assessing Local Disaster Risk.* Ed. Enarson, E., et al. International Hurricane Center USA, Florida International University.

Environmental governance

Global Environmental Governance, Options and Opportunities (2002) Ed. Esty, D. and Ivanova, M. Global Environmental Governance Project. USA, Yale School of Forestry and Environmental Studies.
http://www.yale.edu/gegdialogue/
Accessed March 2005

Agenda 21, United Nations Department of Social and Economic Affairs, Division for Sustainable Development.
http://www.un.org/esa/sustdev/documents/agenda21/index.htm
Accessed March 2005

Kelly, C. (2003) *Quick Guide: Rapid Response Environmental Impact Assessment in Disaster.* Benfield Hazards Research Centre, University College London and Care International.

Planitz, A. (1999) *A Guide to Successful Damage and Needs Assessment.* South Pacific Disaster Reduction Programme.

References

ADPC (2004) *Building Disaster Risk Reduction in Asia: A Way Forward ADPC Looks Ahead to 2015.* Bangkok, ADPC.

Agence France-Presse (AFP) (2003)
www.reliefweb.int
Accessed: March 2005

Cadribo, R. (2004) *Disaster Risk Reduction and Governance ''African Regional Consultation.''*
http://www.unisdr.org/wcdr/meetings/African-regional-consultation-2-3-jun-04/Disaster-Risk-Reduction-and-Governance.ppt.
Accessed: February 2005

Canadian Red Cross (2003)
http://www.redcross.ca/article.asp?id=005571&tid=001

Daily Times Pakistan (2005) *Too Many Sikh Cooks Spoil the Tsunami Broth.*
http://www.dailytimes.com.pk/default.asp?page=story_15-1-2005_pg4_22
Accessed March 2005

Earth Observatory (2003)
http://earthobservatory.nasa.gov/NaturalHazards/natural_hazards_v2.php3?img_id=10782
Accessed March 2005

Global IDP Project (1998) *Guiding Principles on Internal Displacement.* Norwegian Refugee Council.
http://www.idpproject.org/guiding_principles.htm

IATF/DR (2004) *Climate and Disaster Risk Reduction*. A briefing document on the issues of climate and disaster risk, prepared by UNISDR, Geneva.

IHRC (2001) *Working with Women at Risk: Practical Guidelines for Assessing Local Disaster Risk.* Ed. Enarson, E. et al. USA, International Hurricane Center, Florida International University.

IHRC (2002) *Women and Disasters: What's the Connection?* USA, International Hurricane Center, Florida International University.

MRC (2002) *Component #3 Mediation of Transboundary Flood Issues.* Phnom Penh, MRC.

Rashid, S.F. (2000) *The Urban Poor in Dhaka City: Their Struggles and Coping Strategies during the Floods of 1998.* Disasters. Volume 24, No.3.

Sarker, H. et al (2003) *River, Chars and Char Dwellers of Bangladesh.*
International Journal of River Basin Management, Volume 1, Number 1.

Slocum, R. et al (1995) *Power, Process and Participation: Tools for Change.*
London, IT Publications.

Spector, B. (2001) *Borders Matter: Trans-frontier Regions in Contemporary Europe Border Studies.* 'Implementation of Polices for Management of Transboundary Waters on the Eastern European Border in a Perspective of the "New" EU Water Policy.'

Twigg (2004) *Disaster Risk Reduction, Mitigation and Preparedness in Development and Emergency Planning*. Humanitarian Practice Network Good Practice Review 9. London, ODI.

UNDP (2004) *Reducing Disaster Risk: A Challenge for Development*. New York, United Nations Development Program (UNDP).

UNEP and UNFCCC (2002) *Climate Change Information Kit*, based on IPCC's Climate Change: 2001 Assessment Report and Current Activities under the UNFCCC, UNEP and UNFCCC.

UNESCAP
http://www.unescap.org/huset/gg/governance.htm
Accessed March 2005

UNISDR (2002) *Natural Disasters and Sustainable Development: Understanding the Link between Development, Environment and Natural Disasters.* Background Paper No.5. Geneva, UNISDR.

Westgate, K. (2005) *Governance, Institutional and Policy Frameworks for Risk Reduction.* Japan, World Conference on Disaster Risk Reduction, Kobe Report.

Safer Communities and Sustainable Development through Disaster Reduction