Introduction

There is an increasing trend worldwide in the number of disasters and their total economic impacts. This is very evident in the analysis by Munich Re, a major reinsurance company, of what it terms Great Natural Catastrophes[1] (see Figures 1 and 2). Flooding causes over one-third of the total estimated costs and is responsible for two-thirds of people affected by natural disasters. Over 90% of people affected by natural disasters worldwide live in Asia, as the countries in Asia with large populations are particularly prone to recurrent flooding.

The number of disasters attributed to flooding is on the rise (see Figure 3), while the number of people killed[2] due to flooding remains steady (see Figure 4). However, the overall number of deaths due to all natural disasters is decreasing, and this has been attributed to investing in early warning and preparedness programmes. There is an alarming increasing trend in the number of people affected by natural disasters with an average of 147 million affected per year (1981-1990) rising to 211 million per year (1991-2000), with flooding alone accounting for over two-thirds of those affected. This might well be a result of the increasing growth of urban populations, some portions of which may be in flood-prone areas.

Figure 5 shows the number of people that have been affected by natural disasters from 1975 to 2000 by income and disaster type. More than 95% of all deaths as a result of natural disasters are in the least developed nations, and these same nations have the greatest number of people affected by natural disasters. Typically, disasters impact the elderly, women and children the most. This is a trend that will continue unless concerted actions are taken to mitigate the impacts from natural hazards.

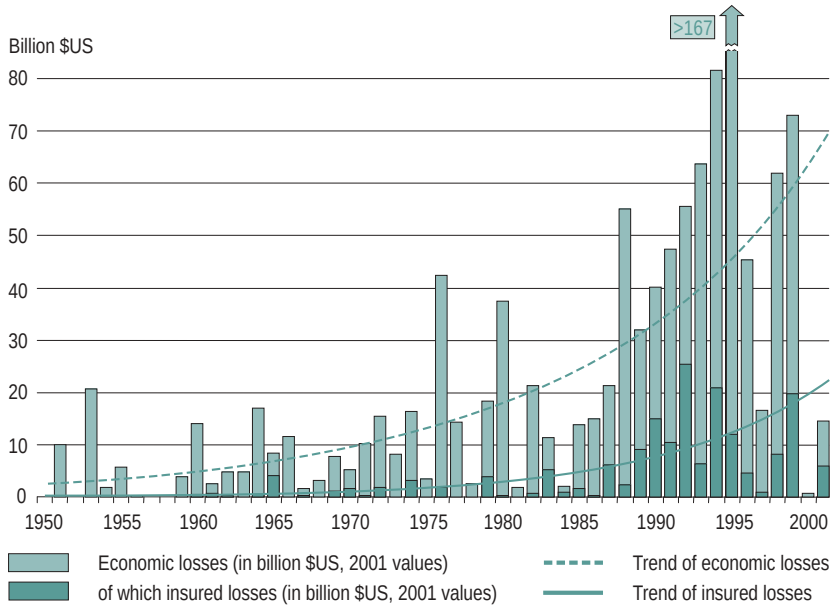
Flooding is the single most destructive type of natural disaster that strikes humans and their livelihoods around the world. In the last decade, there has been catastrophic flooding experienced in China, India, Bangladesh, Germany, Poland, Mozambique, the USA, and elsewhere. Flooding is not restricted to the least developed nations, but also occurs in devastating fashion in the most developed and industrialized countries of the world. However, it is the citizens of the least developed nations that suffer the highest toll from the occurrence of flooding. If we look at Hurricane Mitch as one specific example, it caused massive destruction and loss of life in Central America, affecting the peoples of Honduras, Nicaragua, El Salvador, and Guatemala. Honduras was hardest hit with economic losses estimated as being approximately US$ 3.64 billion (UNDP/ECLAC, 1998) or about 69% of their annual gross domestic product (GDP) in 1998 (IMF, 2002). In comparison, Hurricane Andrew resulted in estimated damages of US$ 30 billion (see http://www.aoml.noaa.gov/hrd/Landsea/Usdmg). These damages represented less than 0.5% of the GDP of the USA (IMF, 2002). When natural disasters such as flooding occur in developing nations, they can effectively wipe out decades of investments in infrastructure and the personal wealth of many of its people, not to mention the countless loss of lives, physical injuries, sickness and psychological trauma that result from the disasters.

[1] Munich Re in their 2001 annual review of natural catastrophes defines these as follows: "Natural catastrophes are classed as great if the ability of the region to help itself is distinctly overtaxed, making interregional or international assistance necessary. This is usually the case when thousands of people are killed, hundreds of thousands are made homeless or when a country suffers substantial economic losses, depending on the economic circumstances generally prevailing in that country."

[2] It should be noted that deaths from storm surge caused by cyclones are not included in these figures on floods, but are classified as resulting from wind storms. For example, in Bangladesh over 300,000 people were killed in tropical cyclones in 1970 and over 138,000 people in 1991.

Figure 1

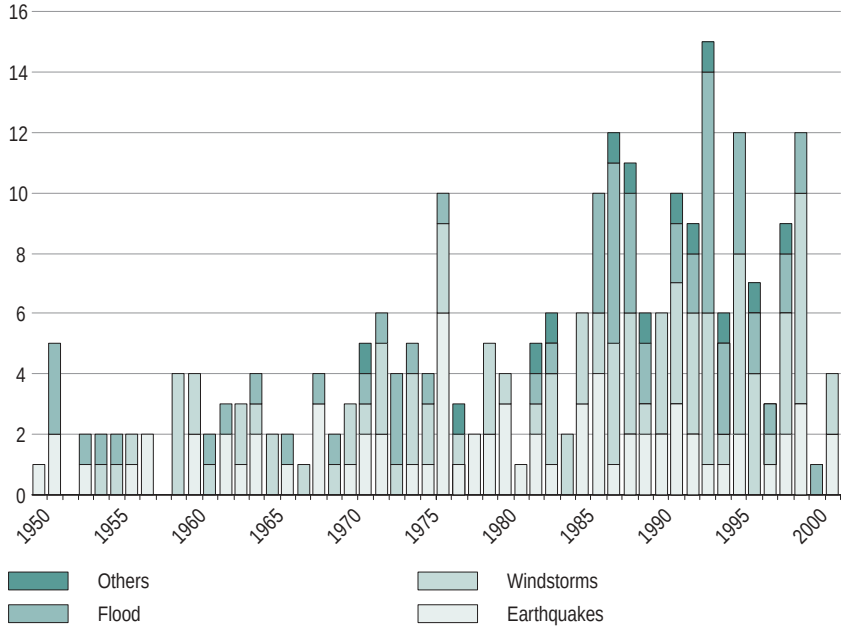
World economic losses from 1950-2002 for great natural catastrophes*



Source: Munich Re, 2002
*Note: Far exeeding 100 deaths and/or $US 100 million in claims

Figure 2

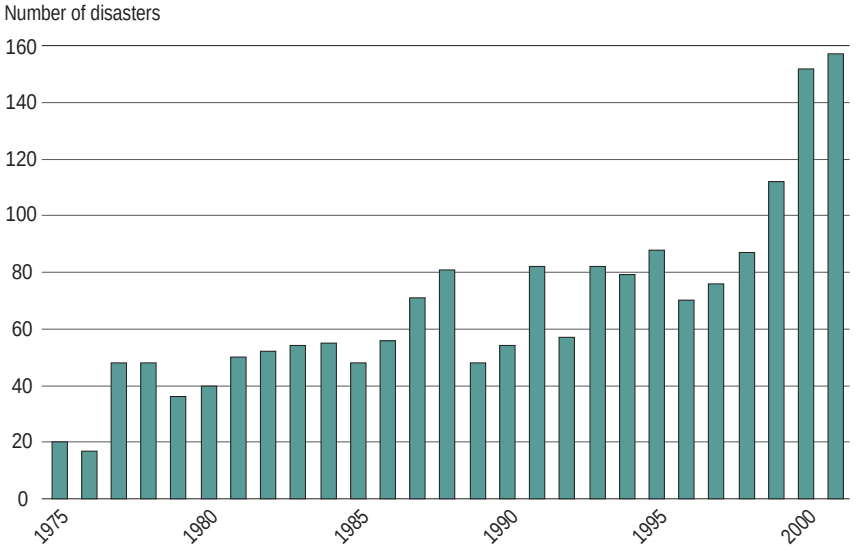
Number of great natural catastrophes from 1950-2001



Source: Munich Re, 2002

Figure 3

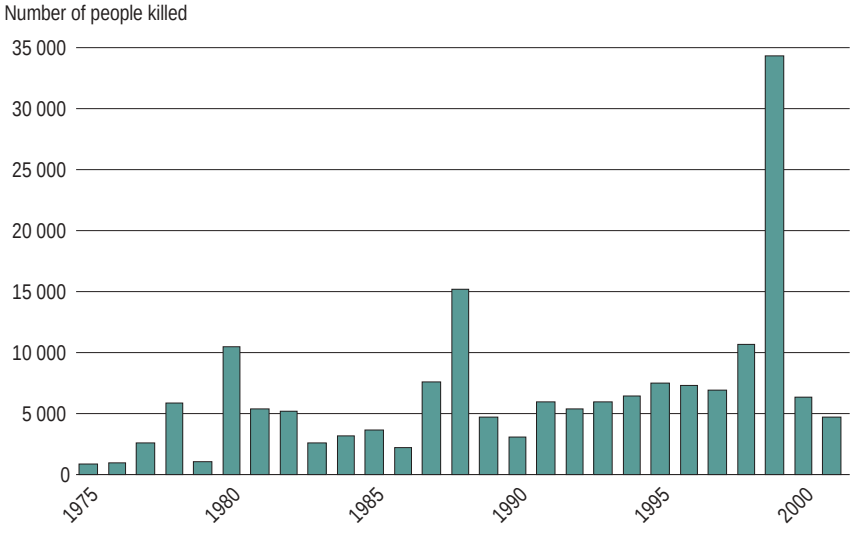
Number of disasters attributed to floods, 1975-2001



Source: EM-DAT, CRED, University of Louvain, Belgium

Figure 4

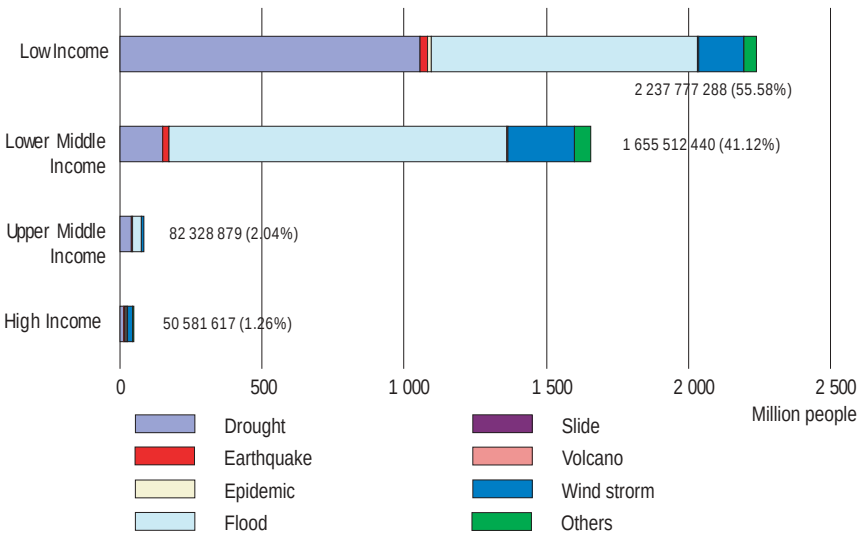
Number of people killed in floods, 1975-2001



Source: EM-DAT, CRED, University of Louvain, Belgium

Figure 5

World overview from 1975-2000 of number of people affected categorized by income class and disaster type



Source: ADRC, EM-DAT, CRED, University of Louvain, Belgium

In recent years, water topics have received great attention on the international agenda. The challenge for disaster and water managers is to bring their communities together and have them raise their combined profile at world and national policy events so as to allow for a greater ability to influence practices. The implementation of integrated water resources management (IWRM) has not been fully achieved in either developing or developed countries; and water continues to be managed in a compartmentalized fashion. The challenge is to recognize the importance of the impacts of natural water-related hazards within the framework of sustainable development.

Communities, nations, and regions can no longer afford to simply respond to and recover from these disasters. An integrated approach to flood disaster management will reduce the losses and break the cycle of event-disaster. A paradigm shift is required in perceptions, attitudes and practices in order to move from the current model of post disaster response and recovery to one of investing in the holistic disaster management process. The long tried approach of providing aid after a disaster needs to be altered to increasing investments in disaster mitigation management approaches before the occurrence of the next extreme event.

Flood disaster management is an end-to-end process for recognizing and effectively combating the risk associated with floods through a suite of planned actions. The process involves a number of activities that occur throughout the cycle:

- Pre-disaster - preventative measures and preparedness;
- During the flood - disaster relief, response and mitigative actions; and
- Post disaster - rehabilitation, reconstruction, economic recovery, and efforts to assess and fine-tune preventative measures.

Effective planning measures require an understanding of the factors that contribute to losses due to flooding. Typically, multiple actions must be taken to proactively manage the risk. A multiple mitigation approach would consider measures such as: preventing or restricting new or inappropriate development or activities in the flood plain; removal of certain structures from the floodway; flood proofing of structures in the flood plain; introduction of structural measures such as levees, dams and constructed channels; controlling land use practices within the basin; and applying flood forecasting and warning systems linked with response mechanisms. There is seldom a single approach to reduce and manage risk, but rather an array of measures that run from the development and enforcement of policies to the construction of works to the development of the forecasts, warnings, and response programme. Emphasis should be placed on arriving at solutions that are practical, appropriate and sustainable for the community at risk.

Establishing a flood forecasting programme enhances all other flood mitigation measures. Forecasts provide the necessary lead-time for a wide variety of

Hurricane Mitch Devastation

Hurricane Mitch, a category five hurricane, devastated Central America in 1998, causing widespread flood, storm surge, landslide and mudslide damages. Hurricane Mitch had wind speeds in excess of 240 kilometres per hour (150 miles per hour), and rainfall over a four-day period that exceeded 1,500 mm (59 inches) for several areas near the Pacific coast. Over 3.5 million people were affected, an estimated 9,214 were killed and 12,845 were injured. Damages have been reported to have exceeded $US 4.5 billion (UNDP/ECLAC, 1998) to $US 7 billion[3], primarily in Honduras, Costa Rica and Nicaragua. In Honduras the damages represented over 69% of GDP and about 73% of the total external debt. Major infrastructure such as bridges and roads were severely damaged and will take many years to be replaced.

Photo: J. Valdés

On 3 November, residents of Tegucigalapa, Honduras look at homes destroyed by a mudslide on Cerro El Berrinche. Triggered by torrential rains from the tropical depression that had been Hurricane Mitch, floods and earth slides devastated the region. Honduran officials put the death toll at 5,000 people, and climbing, with half a million left homeless.

[3]Source: Der Weltamanach, http://www.weltalmanach.de/archiv/00_338.html

actions to be taken by the community. Actions can reduce loss of life and economic losses by evacuating families, personal effects, produce, livestock and machinery, and by taking short-term efforts to increase the capacity of structural measures such as sandbagging operations and flood control operations at dams. Even in what are considered areas with low possibilities of flooding, complacency can set in and investments in forecasting and other mitigation efforts may be curtailed. Long-term investments and policies are needed so that the community will be prepared to respond to the relatively rare event when, not if, it happens.

Social and economic aspects are also very important and must be considered to effectively mitigate the impacts resulting from floods. Disasters in developing countries can literally wipe out the investments made in infrastructure of the previous 50 years, emphasizing the importance of sustainable practices in the design of the fabric of society and its economy. There is a need to build resilience to floods within the society. This is, in part, achieved through the recognition that the level of risk to society is highly linked to indifference and poverty, with this association being mutually reinforcing. Factors such as low income, inadequate housing, issues of land tenure, and lack of public services and social security force the poor to take actions that expose them to greater on-going risk. There is a need for governments to include the impacts of disasters in their financial planning scenarios and economic growth rate projections. This would trigger an awareness that inadequate measures lead to enormous economic and social shocks associated with disasters. Possibly through effective long-term fiscal planning, governments would better recognize the linkages between investments in flood disaster management and long-term social and economic stability.

There are many types of water-related disasters besides floods. Heavy rains can also produce mudslides, landslides, and releases of pollution. On the other extreme, there is also the possibility of drought. The negative impacts of drought in some countries can equal or even exceed the socio-economic damages of floods. Drought also reinforces the persistence of poverty, especially in rural areas that have a low adaptive capacity by the local population and weak institutions managing flood and drought-related disasters. The principles of integrated water resources management are being advocated to lead to sustainable practices for the benefit of society and the environment. There is a need for multi-hazard management systems within the framework of integrated water resources management. This report addresses only the flood aspects. From this holistic perspective, there is also a need to develop a similar approach for drought - the silent killer of the rural poor. The treatment of drought is different from flood, due to its slow onset and the absence of precise or standardized definitions.

This document is intended for the political decision maker, such as a mayor or minister, who wants to take positive steps to reduce flood losses but does not know how to proceed. The information outlined in this report provides guidance on a variety of measures. Some of these include identifying and mapping of areas prone to land/mud slide and flooding, preventing development in such hazard prone areas, enforcing controls on land use, and in implementing flood forecasting and warnings and emergency response programmes. These actions can significantly reduce the loss of life, socio-economic damages and disruptions to the communities. Additional benefits are also realizable in that a flood forecasting and warning programme can also provide much needed information on water availability for integrated water

management leading to reduced water conflict and optimal water usage. This report stresses that one of the biggest challenges facing the decision-maker is to develop the appropriate linkages between the agencies involved at all levels and overcoming the rigidity of operational mandates.

The report is divided into seven major sections. The first section is the introduction to the report, while the second introduces social and economic aspects within flood disaster management, and highlights response strategies at various governmental levels. This section also addresses aspects of public awareness and communications within flood disaster management. The third major section provides an overview of various mitigation measures and technical aspects pertaining to flood management. These concepts span a brief introduction to risk management concepts, flood plain delineation, and watershed management practices. The need for development of policies, plans, and programmes is also addressed, as are climate variability and change and how these might impact upon flood hazards. The fourth major section provides an in-depth description of the components for consideration within a flood forecasting, warning and response system. This section provides the reader with an overview of what constitutes an integrated system, its individual components, and how these should be brought together to provide timely and reliable forecasts and warnings during critical periods. The fifth major section provides an overview of how to develop an integrated flood forecast, warning and response system. A bibliography is provided to facilitate the interested reader in obtaining a host of related material for more detailed study. The Annex contains four case studies outlining pragmatic examples of implementing concepts that are advocated within this document.

Integrated Water Resources Management

Integrated water resources management (IWRM) is an alternative to the dominant sector-by-sector, top-down management style of the past. IWRM aims at: integrating management of water resources at the basin or watershed scale; integrating both supply-side and demand-side approaches; taking an intersectoral approach to decision making; improving and integrating policy, regulatory and institutional frameworks; and promoting equitable access to water resources through participatory and transparent governance.

IWRM looks outside the narrow "water sector" for policies and activities to achieve sustainable water resources development. Focus areas for IWRM are water resources assessments, socio-economic assessments, water resources planning, implementation of action plans, day-to-day water resources management (adjustments of the plans) and water resources protection and conservation. Flood and water-related disaster management is a cross cutting issue that touches upon all of these aspects. Given the holistic approach, IWRM takes into consideration several aspects besides water governance. These include:

- Water supply and health, e.g., sanitation systems and water-borne diseases
- Water and agriculture, e.g., water productivity and agricultural practices degrading water sources
- Water and biodiversity, e.g., wetland loss and the need of water for ecosystems
- Water and energy, e.g., hydropower potential
- Water-related disaster reduction and response, e.g., floods and droughts

Sources: USAID Water Team: Integrated Water Resources Management - A Framework for Action in Freshwater and Coastal Systems, April 2002 and Global Water Partnership, GWP: ToolBox Integrated Water Resources Management, Stockholm 2001.