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THE PREPARATION TEAM FOR REDUCING DISASTER RISK: A CHALLENGE FOR DEVELOPMENT A GLOBAL REPORT

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FOREWORD

Natural disasters exert an enormous toll on development. In doing so, they pose a significant threat to prospects for achieving the Millennium Development Goals in particular, the overarching target of halving extreme poverty by 2015. Annual economic losses associated with such disasters averaged US$ 75.5 billion in the 1960s, US$ 138.4 billion in the 1970s, US$ 213.9 billion in the 1980s and US$ 659.9 billion in the 1990s. The majority of these losses are concentrated in the developed world and fail to adequately capture the impact of the disaster on the poor who often bear the greatest cost in terms of lives and livelihoods, and rebuilding their shattered communities and infrastructure. Today, 85 percent of the people exposed to earthquakes, tropical cyclones, floods and droughts live in countries having either medium or low human development.

This Report is premised on the belief that in many countries the process of development itself has a huge impact — both positive and negative — on disaster risk. It shows how countries that face similar patterns of natural hazards — from floods to droughts — often experience widely differing impacts when disasters occur. The impact depends in large part on the kind of development choices they have made previously. As countries become more prosperous, for example, they are often better able to afford the investments needed to build houses more likely to withstand earthquakes. At the same time, the rush for growth can trigger haphazard urban development that increases risks of large-scale fatalities during such a disaster. The same is true in many other areas. While humanitarian action to mitigate the impact of disasters will always be vitally important, the global community is facing a critical challenge:How to better anticipate — and then manage and reduce — disaster risk by integrating the potential threat into its planning and policies.

To help frame such efforts, this Report introduces a pioneering Disaster Risk Index (DRI) that measures the relative vulnerability of countries to three key natural hazards — earthquake, tropical cyclone and flood — identifies development factors that contribute to risk, and shows in quantitative terms, just how the effects of disasters can be either reduced or exacerbated by policy choices. Our hope is that the index will both help generate renewed interest in this critical development issue and help bring together stakeholders around more careful and coherent planning to mitigate the impact of future disasters.

Mark Malloch Brown
Administrator
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UNDP is the UN's global development network, advocating for change and connecting countries to knowledge, experience and resources to help people build a better life.

Today, disaster reduction is a key component of UNDP efforts in crisis prevention and recovery. UNDP first allocated core resources for disaster preparedness in 1989, with an approved policy framework aimed 'to stimulate the interest and actions needed to create comprehensive disaster preparedness plans, strategies and structures and to promote disaster mitigation activities within the context of development planning and implementation'. The United Nations General Assembly has transferred to UNDP, the responsibilities of the Emergency Relief Coordinator for operational activities concerning natural disaster mitigation, prevention and preparedness. Furthermore, the UNDP Bureau for Crisis Prevention and Recovery (BCPR) has made considerable progress in developing an implementation framework that adds value to ongoing activities in disaster reduction.

UNDP plays an active and central role in the implementation of the International Strategy for Disaster Reduction (ISDR).This publication, *Reducing Disaster Risk:A Challenge for Development,* and the global review of disaster risk reduction, *Living with Risk,* published by the ISDR Secretariat,are two complementary and coordinated initiatives.They are aimed at assisting countries and international organisations to enable communities to become resilient to natural hazards and related technological and environmental disasters so economic, environmental, human and social losses can be reduced. UNDP and the ISDR Secretariat are currently working towards a framework of joint reporting on disaster risk reduction.

While much has been achieved, much remains to be done if disaster loss is not to jeopardise the achievement of the Millennium Development Goals. The humanitarian community has made progress in mitigating the losses and suffering associated with disasters through improved response preparedness and early warning. However, humanitarian actions do not address the development processes that are shaping disaster risk in the first place. The development community generally continues to view disasters as exceptional natural events that interrupt *normal* development and that can be managed through humanitarian actions.

The linkages between development and disaster risk are not difficult to visualize. Any development activity has the potential to either increase or reduce disaster risk. When a school or a health centre is destroyed in an earthquake, we have to remember that this same school or health centre was once a development project, whether funded from national budgets or external development assistance.

When we decided to produce a global report on development and disaster risk,we wanted to highlight these *development choices*. Disaster risk is not inevitable, but on the contrary can be managed and reduced through appropriate development actions. This is the message we want to convey in this Report to our programme countries, our donors, our partners in the United Nations system, regional and international organisations, civil society and the private sector. A great deal of support was provided in preparation of this publication,known as the *World Vulnerability Report* when the process began in 2000, and we acknowledge many generous contributions.

Contributors

The technical production of the Report was made by the following team: Mark Pelling (editor), Andrew Maskrey, Pablo Ruiz and Lisa Hall. Yasemin Aysan was responsible for the overall coordination of the Report in its first stages, with critical support from Ben Wisner and Haris Sanahuja.

The preparation of the Disaster Risk Index (DRI) was originally conceived during the meeting of a Group of Experts in 2000 and commissioned to the United Nations Environment Programme (UNEP) Global Resource Information Database (GRID) in Geneva. Main scientific collaborators include Hy Dao, Pascal Peduzzi, Christian Herold and Frédéric Mouton. Maxx Dilley and Haris Sanahuja provided key guidance in concepts and definitions. We would like also to thank those whose work has directly or indirectly contributed to the success of this research, such as Brad Lyon and his colleagues from the International Research Institute (IRI) for Climate Prediction at Columbia University for his methodology on determining physical drought. Regina Below and Debarati Guha-Sapir for EM-DAT databases and Bruce Harper, Greg Holland and Nanette Lombarda for input on tropical cyclones. This work also benefited from the contributions of Stephane Kluser, Antonio Martin-Diaz, Ola Nordbeck, Damien Rochette, Thao Ton-That and Bernard Widmer.

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Advisory Panel and Consultation Process

The Report underwent a long consultation process. An advisory panel made up of international experts and UNDP specialists in disaster reduction provided guidance and advice in the finalization of the Report. The panel included Andrew Maskrey (chair), Angeles Arenas, Mihir Bhatt, Thomas Brennan, Omar Dario Cardona, Maxx Dilley, Ailsa Holloway, Kamal Kishore, Allan Lavell, Kenneth Westgate, Ben Wisner and Jennifer Worrell. Additional inputs were received from Terry Jeggle.

The Report benefited from the discussions of the Working Group on Risk, Vulnerability and Impact Assessment of the International Strategy for Disaster Reduction (ISDR). A large number of consultations around the conception and preparation of the different components of the DRI were realized in 2002.

The Report was shared with a large number of UN organisations involved in disaster reduction: the Food and Agricultural Organization (FAO), International Labour Organization (ILO), the United Nations Centre for Regional Development (UNCRD), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), the United Nations Human Settlements Programme (UN Habitat), the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), the World Food Programme (WFP) and World Meteorological Organization (WMO). The Report was also shared with the Inter-American Development Bank (IDB), the International Federation of Red Cross and Red Crescent Societies (IFRC), the Organization of American States (OAS), the ProVention Consortium and the World Bank (WB). Their comments, suggestions and views have been extremely useful during the drafting of the final version of this Report.

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This Report would not have been possible without the many instrumental contributors. We hope that this common effort towards reducing disaster risk will make an important contribution to our main challenge, the achievement of the Millennium Development Goals.

Julia Taft
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ABBREVIATIONS

ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Center
ADRC	Asian Disaster Reduction Center
AfDB	African Development Bank
AGR_{EMP}	Percentage of labour force in agricultural sector
AOML	Atlantic Oceanographic and Meteorological Laboratory
AUDMP	Asian Urban Disaster Mitigation Program
BCC	Baroda Citizens Council
BCPR	Bureau for Crisis Prevention and Recovery
CDB	Caribbean Development Bank
CDC	Centers for Disease Control and Prevention
CDERA	Caribbean Disaster Emergency Response Agency
CDIAC	Carbon Dioxide Information Analysis Center
CDMP	Caribbean Disaster Mitigation Project
CDMS	Comprehensive Disaster Management Strategy
CEPREDENAC	Coordination Center for the Prevention of Natural Disasters in Central America
CGIAR	Consultative Group on International Agricultural Research
CIESIN	Center for International Earth Science Information Network
CMA	Cape Town Metropolitan Area
CMAP	CPC Merged Analysis of Precipitation
CNSS	Council of the National Seismic System
COPECO	National Commission for Contingencies
CPC	Climate Prediction Center

CPI	Corruption Perceptions Index
CRED	Centre for Research on the Epidemiology of Disasters
DAC	Development Assistance Committee
DFID	Department for International Development of the United Kingdom
DiMP	Disaster Mitigation for Sustainable Livelihoods Programme of the University of Cape Town
DMFC	Disaster Mitigation Facility for the Caribbean
DPC	Direction de la Protection Civile
DRI	Disaster Risk Index
ECHO	European Community Humanitarian Office
ECLAC	Economic Commission for Latin America and the Caribbean
EM-DAT	EM-DAT: The OFDA/CRED International Disaster Database
ENSO	El Niño/Southern Oscillation
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GDP_{AGR}	Percentage of agriculture's dependency for GDP
GDP_{CAP}	Gross Domestic Product per capita
GEO	Global Environment Outlook
GIS	Geographical Information System
GLASOD	Human Induced Soil Degradation
GLIDE	Global Identifier Number
GRAVITY	Global Risk and Vulnerability Index Trend per Year
GRID	Global Resource Information Database
GTZ	German Technical Co-operation
HDI	Human Development Index
HDR	Human Development Report
HIPC	Heavily Indebted Poor Countries
HPI	Human Poverty Index
IDB	Inter-American Development Bank
IDNDR	International Decade for Natural Disaster Reduction
IFI	International financial institution
IFRC	International Federation of the Red Cross and Red Crescent Societies
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority on Development
ILO	International Labour Organization
IMF	International Monetary Fund
IRI	International Research Institute for Climate Prediction
ISDR	International Strategy for Disaster Reduction
IUCN	World Conservation Union
LA RED	Network for Social Studies on Disaster Prevention in Latin America
LDC	Least Developed Country

MANDISA	Monitoring, Mapping and Analysis of Disaster Incidents in South Africa
MDGs	Millennium Development Goals
NCEP	National Center for Environmental Prediction
NCGIA	National Center for Geographic Information and Analysis
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
OAS	Organization of American States
OCHA	Office for the Coordination of Humanitarian Affairs
ODS	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OECS	Organization of Eastern Caribbean States
PADF	Pan American Development Foundation
PAHO	Pan American Health Organization
PhExp	Physical Exposure (if not specified, for drought)
PPP	Purchasing Power Parity
PRSP	Poverty Reduction Strategy Paper
SADC	The Southern African Development Community
SIDS	Small Island Developing States
SNPMAD	Sistema Nacional para la Prevención, Mitigación y Atención de Desastres
SOPAC	South Pacific Applied Geoscience Commission
$U5_{MORT}$	Under five years old mortality rate
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCRD	United Nations Centre for Regional Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP/GRID	United Nations Environment Programme, Global Resource Information Database
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNHABITAT	United Nations Human Settlements Programme
USAID/OFDA	United States Agency for International Development,Office of U.S. Foreign Disaster Assistance
USGS	United States Geological Survey
WAT_{RUR}	Percentage of population having access to improved water supply in rural area
WAT_{TOT}	Percentage of population having access to improved water supply
WAT_{URB}	Percentage of population having access to improved water supply in urban area
WB	World Bank
WFP	World Food Programme
WMO	World Meteorological Organization
WRI	World Resources Institute
WTO	World Trade Organization
ZENEB	Zentrum für Naturrisiken und Entwicklung (Center for Nature Risks and Development)

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EXECUTIVE SUMMARY

Some 75 percent of the world's population live in areas affected at least once by earthquake, tropical cyclone, flood or drought between 1980 and 2000.

The consequences of such widespread exposure to natural hazard for human development is only now beginning to be identified. *Reducing Disaster Risk: A Challenge for Development* plays a role in this learning process.

Natural disaster risk is intimately connected to processes of human development. Disasters put development at risk. At the same time, the development choices made by individuals, communities and nations can generate new disaster risk. But this need not be the case. Human development can also contribute to a serious reduction in disaster risk.

This Report shows that billions of people in more than 100 countries are periodically exposed to at least one event of earthquake, tropical cyclone, flood or drought. As a result of disasters triggered by these natural hazards, more than 184 deaths per day are recorded in different parts of the world.

This Report demonstrates that development processes intervene in the translation of physical exposure into natural disaster events. This is demonstrated by the observation that while only 11 percent of the people exposed to natural hazards live in countries classified as low human development, they account for more than 53 percent of total recorded deaths.

The Report argues that disaster risk is not inevitable and offers examples of good practice in disaster risk reduction that can be built into ongoing development planning policy. These examples are summarised in this Executive Summary.

1 Development at Risk

Meeting the Millennium Development Goals (MDGs) is severely challenged in many countries by losses from disasters. The destruction of infrastructure and the erosion of livelihoods are direct outcomes of disaster. But disaster losses interact with and can also aggravate

other financial, political, health and environmental shocks. Such disaster losses may setback social investments aiming to ameliorate poverty and hunger, provide access to education, health services,safe housing, drinking water and sanitation, or to protect the environment as well as the economic investments that provide employment and income.

A considerable incentive for rethinking disaster risk comes from the goals laid out in the Millennium Declaration.

The MDGs direct development planning towards priority goals. Each of these goals interacts with disaster risk.These goals will potentially contribute to a reduction of human vulnerability to natural hazard. But it is the processes undertaken in meeting each goal that will determine the extent to which disaster risk is reduced. This implies a two-way relationship between the kind of development planning that can lead to the achievement of the MDGs and the development processes that are currently associated with an accumulation of disaster risk.

The primary responsibility for achieving MDGs lies with individual countries. New windows for environmental sustainability have been discussed at the World Summit on Sustainable Development,held in Johannesburg, South Africa in 2002. For example, Poverty Reduction Strategy Papers need to take disaster risk and environmental sustainability into account. Bringing disasters and development together also requires a better integration between the humanitarian and development communities.

How can development increase disaster risk?

There are many examples of the drive for economic growth and social improvement generating new disaster risks. Rapid urbanisation is an example.The growth of informal settlements and inner city slums, whether fuelled by international migration or internal migration from smaller urban settlements or the countryside, has led to the growth of unstable living environments. These settlements are often located in ravines, on steep slopes, along flood plains or adjacent to noxious or dangerous industrial or transport facilities.

Rural livelihoods are put at risk by the local impacts of global climate change or environmental degradation. Coping capacity for some people has been undermined by the need to compete in a globalising economy, which at present rewards productive specialisation and intensification over diversity and sustainability.

Can development planning incorporate disaster risk?

The frequency with which some countries experience natural disaster should certainly place disaster risk at the forefront of development planners' minds. This agenda differentiates between two types of disaster risk management. *Prospective disaster risk management* should be integrated into sustainable development planning. Development programmes and projects need to be reviewed for their potential to reduce or aggravate vulnerability and hazard. *Compensatory disaster risk management* (such as disaster preparedness and response) stands alongside development planning and is focused on the amelioration of existing vulnerability and reduction of natural hazard that has accumulated through past development pathways. Compensatory policy is necessary to reduce contemporary risk, but prospective policy is required for medium- to long-term disaster risk reduction.

Bringing disaster risk reduction and development concerns closer together requires three steps:

a. The collection of basic data on disaster risk and the development of planning tools to track the relationship between development policy and disaster risk.
b. The collection and dissemination of best practice in development planning and policy that reduce disaster risk.
c. The galvanising of political will to reorient both the development and disaster management sectors.

2 International Patterns of Risk

UNDP has begun development of a Disaster Risk Index (DRI) in order to improve understanding of the relationship between development and disaster risk.

The findings of the DRI project, presented in this Report, enable the measurement and comparison of relative levels of physical exposure to hazard, vulnerability and risk between countries and the identification of vulnerability indicators.

Four natural hazard types (earthquake, tropical cyclone, flood and drought), responsible for 94 percent of deaths triggered by natural disaster were examined and the populations exposed and the relative vulnerability of countries to each hazard were calculated.

In the last two decades, more than 1.5 million people have been killed by natural disasters. Human deaths are the most reliable measure of human loss and are the indicator used in this Report. However, as with any economic data, this reveals only the tip of the iceberg in terms of development losses and human suffering. Worldwide, for every person killed, about 3,000 people are exposed to natural hazards.

In global terms and for the four hazard types assessed, disaster risk was found to be considerably lower in high-income countries than in medium- and low-income countries. Countries classified as high human development countries represent 15 percent of the exposed population, but only 1.8 percent of the deaths.

Earthquake: About 130 million people were found to be exposed on average every year to earthquake risk as defined in this Report. High relative vulnerability (people killed/exposed) was found in countries such as the Islamic Republic of Iran, Afghanistan and India. Other medium development countries with sizeable urban populations, such as Turkey and the Russian Federation, were also found to have high relative vulnerability, as well as countries such as Armenia and Guinea that had experienced an exceptional event in the reporting period.

Tropical cyclone: Up to 119 million people were found to be exposed on average every year to tropical cyclone hazard and some people experienced an average of more than four events every year. High relative vulnerability was found in Bangladesh, Honduras and Nicaragua, all of which had experienced a catastrophic disaster during the reporting period. Other countries with substantial populations located on coastal plains were found to be highly vulnerable, for example India, Philippines and Viet Nam. Small Island Developing States (SIDS) represent a high-risk group of countries. But comparing within this group pulls out differences, for example, between the relatively high vulnerability of Haiti and the lower vulnerability of Cuba and Mauritius.

Flood: About 196 million people in more than 90 countries were found to be exposed on average every year to catastrophic flooding. Many more people are exposed to minor or localised flood hazards that can have a cumulative dampening impact on development, but do not cause major human losses in single events. They were not included in this assessment. High vulnerability was identified in a wide range of countries and is likely to be aggravated by global climate change. In Venezuela, high vulnerability was due to a single catastrophic event. Other countries with high vulnerability to floods included Somalia, Morocco and Yemen.

Drought: Around 220 million people were found to be exposed annually to drought and African states were indicated as having the highest vulnerability to drought. Methodological challenges prevent any firm country-specific findings being presented for this hazard.The assessment strongly reinforced field study evidence that the translation of drought into famine is mediated by armed conflict, internal displacement, HIV/AIDS, poor governance and economic crisis.

For each hazard type, smaller countries had consistently higher relative exposure to hazard and in the case of tropical cyclones, this was translated into high relative vulnerability.

What are the development factors and underlying processes that configure disaster risks?

The analysis of socio-economic variables, available with international coverage, and recorded disaster impacts, enabled some initial associations between specific development conditions and processes with disaster risk. This work was undertaken for earthquake, tropical cyclone and flood hazard.

Earthquake: Countries with high urban growth rates and high physical exposure were associated with high levels of risk.

Tropical cyclone: Countries with a high percentage of arable land and high physical exposure were associated with high levels of risk.

Flood: Countries with low Gross Domestic Product (GDP) per capita, low local density of population and high physical exposure were associated with high levels of risk.

These findings had very high degrees of statistical significance and highlight the importance of urbanisation

and rural livelihoods as development contexts that shape disaster risk. Consequently, further analysis was structured around these two development factors.

If disaster risks are to be managed and reduced, change in development policy and planning is required at the national level.
More effort should be given to the collection of sub-national disaster data. This will help build datasets and indicators with a national level of observation and a local scale of resolution that can enable the visualisation of complex patterns of local risk. For example, the accumulation of risk over time, in specific locations, and when catastrophic hazard events trigger multiple secondary hazards and numerous small-scale disasters. This kind of information is important for factoring disaster risk considerations into development policy at the national level. Locally specific data can also highlight the ways in which natural and man-made hazards (such as house fires) interact, allowing further refinement of policy.

A multi-hazard DRI is an achievable task.
The multi-hazard model is built from the socio-economic variables associated with individual hazards. The multi-hazard DRI is innovative in breaking away from a hazard-centred analysis of risk to one that has integrated analysis of risk that draws on vulnerability factors. There is scope in the model for the better integration of vulnerability variables (such as armed conflict) and hazards (such as volcanoes and landslides) as data becomes available. Future work should also seek to incorporate an assessment of the extent to which national policy has included risk reduction and the impacts of such policy on disaster risk. Finally, it is hoped that the global multi-hazard DRI will pave the way for national level studies that combine disaster and socio-economic information.

3 Development: Working to Reduce Risk?

For many people across the globe, development does not appear to be working. The increasing number and intensity of disasters with a natural trigger are one way in which this crisis is manifest.

Two key variables were associated with disaster risk in the DRI: *urbanisation* and *rural livelihoods*. For each, a critical dynamic pressure likely to shape the future characteristics of these variables was also examined. For urbanisation, we analysed *economic globalisation*, and for rural livelihoods, we analysed *global climate change*. In addition, a number of additional important development pressures — violence and armed conflict, the changing epidemiology of disease (HIV/AIDS), governance and social capital — did not have datasets of the necessary coverage and quality to be included in the DRI at the time of its calculation, and so are included to provide a stronger qualitative analysis.

During this decade, population increase will occur most rapidly in urban areas in the countries of Africa, Asia and Latin America and the Caribbean, with more than half of the world population becoming urban by 2007.
The average size of the world's 100 largest cities increased from 2.1 million in 1950 to 5.1 million in 1990. The complexity and sheer scale of humanity concentrated into large cities creates a new intensity of risk and risk-causing factors, but it is in small- and medium-sized towns that the majority of the urban population live. Smaller cities contribute less pollution to global climate change, but show high levels of internal environmental pollution and risk. Therefore, urbanisation is a real challenge for planning and for the ability of the market to provide basic needs that can allow development without creating preventable disaster risks.

Urbanisation does not necessarily have to lead to increasing disaster risk and can actually, if managed properly, help reduce it.
There are a number of factors that contribute to the configuration of risk in cities. First,history is important. For example; where cities have been founded in or expanded into hazardous locations. Second, the urbanisation process leads to the concentration of populations in risk-prone cities, and risk-prone locations within cities. This is true in megacities and in rapidly expanding small- and medium-sized urban centres. When populations expand faster than the capacity of urban authorities or the private sector to supply housing or basic infrastructure, risk in informal settlements can accumulate quickly. Third, in cities with transient or migrant populations, social and economic networks tend to be loose. Many people, especially minority or groups of low social status, can become socially excluded and politically marginalised,leading to a lack of access to resources and increased vulnerability. The

urban poor are often forced to make difficult decisions about risk. Living in hazardous locations is sometimes 'chosen' if it provides access to work, for example; in the city centre.

Urbanisation can also modify hazard patterns. Through process of urban expansion, cities transform their surrounding environment and generate new risks. The urbanisation of watersheds can modify hydraulic regimes and destabilize slopes, increasing flood and landslide hazard.

As centres of cultural value expressed through the man-made environment, cities are also sites where the collective quality of life can be undermined if historic buildings are lost to disaster.

Urbanisation also has the power to radically shape disaster risks at the regional scale. Major investments in infrastructure and productive facilities, the development of new urban areas and trade corridors, and the unplanned urbanisation of new regions are all examples of modalities through which urbanisation can shape risk in broad territorial areas.

Urbanisation is affected by dynamic pressures, such as economic globalisation.
Globalisation and the growing interconnectedness of global society means that catastrophic events in one place have the potential to affect lives and public policies in distant locations. At the same time, globalisation also has the power to shape new local economic relationships and subsequent geographies of risk. Given that the decisions that generate such conditions (such as free trade agreements) are taken at the international level and without detailed knowledge and data of the territories potentially affected, it is uncommon that existing risk patterns are taken into account.

Economic globalisation can provide opportunities for the enhancement of livelihoods and the quality of life for those people and places benefiting from new investments. To prevent these investments from creating large inequalities and further polarising the world into those who are at risk and those who are not, the opportunities and benefits of globalisation need to be shared much more widely. The introduction of Poverty Reduction Strategy Papers as coherent guidelines for national development planning offers a tool for enhancing the place of equity for poverty and vulnerability reduction in development. Working to reduce inequality and vulnerability within the context of a globalising economy requires strong international, national and local governance.

Rural livelihoods: About 70 percent of the world's poor live in rural areas.
There is great variety in the structure of rural economies and societies and their interaction with the environment. However, there are recurrent themes that characterise how development shapes risk in the countryside. Rural poverty is one of the key factors that shapes risk to hazards such as a flooding or drought. The rural poor, who are most at risk,are often no longer subsistence peasants. Instead, rural dwellers depend on complex livelihood strategies,including seasonal migration or inputs from remittances sent from relatives living in cities or overseas. These new survival strategies are reconfiguring risk in the countryside.

Often the poorest in rural areas occupy the most marginal lands and this forces people to rely on precarious and highly vulnerable livelihoods in areas prone to drought, flooding and other hazards. Local ecological and environmental change as a consequence of agricultural practices can itself create risk. For example, deforestation to make way for agricultural production often leads to soil erosion, loss of nutrients and eventually, the marginality of agriculture. In some circumstances, these processes can lead directly to the generation of new patterns of flood, drought, fire or landslide hazard.

For the majority of rural communities connected to the global economy, livelihoods are vulnerable to fluctuations in world commodity prices. When low commodity prices coincide with natural hazards, rural livelihoods come under high stress. However, those rural communities isolated from the wider market are not necessarily any less at risk. Instead, the pathways through which risk is configured are different. In particular, isolation tends to limit choices for any coping strategy.

Rural livelihoods are affected by dynamic pressures such as global climate change.
Global climate change brings with it long-term shifts in mean weather conditions and the possibility of the increasing frequency and severity of extreme weather events — the latter is perhaps more threatening to

agricultural livelihoods. Taken together, the effects of climate change increase uncertainty and the complexity of risk for everyone, including landless labourers, small-scale farmers, wealthy agriculturists and people whose livelihoods serve the rural economy.

While the developed nations of the world produce the majority of greenhouse gases, the burden of impact will be more severe on developing countries. They have larger vulnerable populations, national economies dependent on agricultural production and are less equipped to deal with extreme weather events.

The lack of capacity to manage and adapt to climate-related risks is already a central development issue in many developing countries, particularly in Small Island Development States. The lack of capacity to manage risks associated with current climate variability will likely also inhibit countries from adapting to the future complexity and uncertainty of global climate change.

Finally, where the dynamics of global climate change and economic globalisation are seen to interact, the shifting nature of hazard and disaster risk becomes even more apparent and hard to predict.

If development is to be advanced in countries affected by climate risks and if development is not to aggravate climate change risk, an integrated approach to local climate risk reduction needs to be promoted. Successful risk reduction approaches already practiced by the disaster risk community should be mainstreamed into national strategies and programmes.

Violence and armed conflict, disease, governance and social capital are also important factors of risk.

These themes have not been included in the analysis of vulnerability factors in the DRI exercise because of statistical constraints, but the themes are no less important.

During the 1990s, a total of 53 major armed conflicts resulted in 3.9 million deaths. The analysis undertaken in the DRI suggests that armed conflict and governance are factors that can turn low rainfall episodes, for example, into famine events. This is particularly the case in complex emergencies. At the turn of the 21st century, some countries suffered episodes of drought, earthquake or volcanic eruption on top of years of armed conflict, causing a particularly acute humanitarian crisis. Little or no attention has been paid to the potential of disaster management as a tool for conflict prevention initiatives, in spite of some encouraging experiences.

Epidemic diseases can be seen as disasters in their own right. They also interact with human vulnerability and natural disasters. There is a great deal of variation in the relationships between disease, disaster and development. Hazard events such as flooding or temperature increase in highland areas can extend the range of vector-born diseases, such as malaria. HIV/AIDS and other diseases can exacerbate the disaster risks brought on by climate change, urbanisation, marginalisation and war. With HIV/AIDS, the able-bodied, adult workforce who would normally engage in disaster-coping activities is too weak from the disease. Or they are already dead, leaving households composed of the elderly and very young, who often lack labour capacity or knowledge.

Governance for disaster risk reduction has economic, political and administrative elements:

- Economic governance includes the decision-making process that affects a country's economic activities and its relationships with other economies.
- Political governance is the process of decision-making to formulate policies including national disaster reduction policy and planning.
- Administrative governance is the system of policy implementation and requires the existence of well functioning organisations at the central and local levels. In the case of disaster risk reduction, it requires functioning enforcement of building codes, land-use planning, environmental risk and human vulnerability monitoring and safety standards.

There is more to good governance than reorganising the public sector or redividing the responsibilities between different tiers of government. While governments bear the primary responsibility with regard to the right to safety and security, they cannot and should not shoulder these tasks alone. At national and international levels, civil society is playing an ever more active role in forming policies to address risk. The private sector also has a role to play in moving towards sustainable development that incorporates an awareness of disaster risk — a role that could be enhanced.

This Report offers a number of case studies for good practice in governance for disaster risk reduction. Over

the last decade, the number of regional organisations addressing risk management issues has grown. In addition to developing their own expertise and policy initiatives, regional organisations can provide continuity to help maintain national level progress in development and disaster risk management.

At the national level, mainstreaming disaster risk reduction with development policy is a key challenge. The need for strong intervention following a disaster is recognised. The challenge now is to increase the focus on disaster risk reduction as a central element of ongoing development policy. A more integrated approach calls for collaboration between government agencies responsible for land-use planning, development planning, agricultural and environmental planning and education as well as those organisations responsible for disaster management.

This approach requires decentralised disaster risk planning strategies that can empower communities and open the window for local participation. The most vulnerable in society are also often those most excluded from community decision-making and in many cases this includes women. Enabling participation in these circumstances requires a long-term commitment to social development as part of vulnerability reduction programmes.

The importance of a gendered perspective on risk and the opportunities raised by risk reduction for a gender-sensitive approach to development can be seen from encouraging experiences of civil society groups active in risk reduction and disaster recovery.

Within reforms, legislation often remains a critical element in ensuring a solid ground for other focal areas, such as institutional systems, sound planning and coordination, local participation and effective policy implementation. But the road of legal reform is not easy and not always sufficient to facilitate change. Legislation can set standards and boundaries for action, for example, by defining building codes or training requirements and basic responsibilities for key actors in risk management. But legislation on its own cannot induce people to follow these rules. Monitoring and enforcement are needed.

In recent years the concept of *social capital* has provided additional insights into the ways in which individuals, communities and groups mobilise to deal with disasters. Social capital refers to those stocks of social trust,norms and networks that people derive from membership in different types of social collectives. Social capital, measured by levels of trust, cooperation and reciprocity in a social group, plays the most important role in shaping actual resilience to disaster shocks and stress. Local level community response remains the most important factor enabling people to reduce and cope with the risks associated with disaster. But community ties can be eroded by long-term or extreme social stress.

The appropriateness of policies for enhancing the positive contribution of civil society depends on developmental context. For many countries in Africa, Latin America and Asia that have undergone structural adjustment and participatory development, the challenge may not be so much the creation of a non-governmental sector as its coordination.

4 Conclusions and Recommendations

This Report supports six emerging agendas within disaster risk reduction. These are summarised here.

1. **Appropriate governance is fundamental if risk considerations are to be factored into development planning and if existing risks are to be successfully mitigated.** Development needs to be regulated in terms of its impact on disaster risk. Perhaps the greatest challenges for mainstreaming disaster risk into development planning are political will and geographical equity. These are problems shared through environmental management and environmental impact assessment. How to attribute responsibility for disaster risk experienced in one location that has been caused by actions in another location? Justifying expenditure in risk reduction will become easier as valuation techniques (including the DRI) that are available for indicating the positive contribution of risk reduction investments in development become more refined.

2. **Factoring risk into disaster recovery and reconstruction.** Development appraisal and decision making tools, and monitoring programmes that incorporate disaster risk management are needed to mainstream prospective disaster risk management. The argument made for mainstreaming disaster

risk management is doubly important during reconstruction following disaster events.

3. **Integrated climate risk management.** Building on capacities that deal with existing disaster risk is an effective way to generate capacity to deal with future climate change risk.

4. **Managing the multifaceted nature of risk.** Natural hazard is one among many potential threats to life and livelihood. Often those people and communities most vulnerable to natural hazards are also vulnerable to other sources of hazard. For many, livelihood strategies are all about the playing off of risks from multiple hazards sources — economic, social, political, environmental. Disaster risk reduction policy has to take this into account and look for opportunities for building generic as well as disaster risk specific capacities.

5. **Compensatory risk management.** In addition to reworking the disaster-development relationship, which this Report hopes to make a contribution towards, a legacy of risk accumulation exists today and there is a need to improve disaster preparedness and response.

6. **Addressing gaps in knowledge for disaster risk assessment.** A first step towards more concerted and coordinated global action on disaster risk reduction must be a clear understanding of the depth and extent of hazard, vulnerability and disaster loss.

Specific recommendations towards this end are to:

a. Enhance global indexing of risk and vulnerability, enabling more and better intercountry and inter-regional comparisons.
b. Support national and subregional risk indexing to enable the production of information for national decision makers.
c. Develop a multi-tiered system of disaster reporting.
d. Support context driven risk assessment.

Chapter 1
DEVELOPMENT AT RISK

1.1 Natural Disaster as a Cause and Product of Failed Development

Natural disaster is intimately connected to the processes of human development. Disasters triggered by natural hazards put development gains at risk. At the same time, the development choices made by individuals, communities and nations can pave the way for unequal distributions of disaster risk.

Meeting the Millennium Development Goals (MDGs) is extremely challenged in many communities and countries by losses from disasters triggered by natural hazards. The destruction of infrastructure, the erosion of livelihoods, damage to the integrity of ecosystems and architectural heritage, injury, illness and death are direct outcomes of disaster. But disaster losses interact with and can also aggravate other stresses and shocks such as a financial crisis, a political or social conflict, disease (especially HIV/AIDS), and environmental degradation. And such disaster losses may set back social investments aiming to ameliorate poverty and hunger, provide access to education, health services,safe housing, drinking water and sanitation, or to protect the environment as well as economic investments that provide employment and income.

At the same time, it has been clearly demonstrated how disaster risk accumulates historically through inappropriate development interventions. Every health centre or school that collapses in an earthquake and every road or bridge that is washed away in a flood began as development activities. Urbanisation and the concentration of people in hazard prone areas and unsafe buildings, increases in poverty that reduce the human capacity to absorb and recover from the impact of a hazard, and environmental degradation that magnifies hazards such as floods and droughts, are only a few examples of how development can lead to disaster risk.

The relationship of development and disaster risk can be seen by a quick review of data produced by this Report. About 75 percent of the world's

population live in areas affected at least once between 1980 and 2000 by earthquake, tropical cyclones, flood or drought. As a result of disasters triggered by these natural hazards, more than 184 deaths per day were recorded in different parts of the world. Deaths indicate only the tip of the iceberg in terms of losses in the quality of life, livelihoods and economic development, and are unevenly distributed around the world. While only 11 percent of the people exposed to natural hazards live in low human development countries, they account for more than 53 percent of total recorded deaths. Development status and disaster risk are clearly closely linked.

Appropriate development policies that reduce disaster risk can therefore make an important contribution toward the achievement of the MDGs by reducing losses and protecting existing development gains as well as avoiding the generation of new risks. The reduction of disaster risk and sustainable human development are therefore mutually supportive goals that also contribute to the reduction of poverty, the empowerment of marginalised social groups and gender equality. Disaster risk reduction can make a particularly critical difference for highly vulnerable populations, for example those living in small island developing states or societies weakened by armed conflict and HIV/AIDS.

Disasters are still usually perceived as exceptional natural events that interrupt normal human development and require humanitarian actions to mitigate loss. While this Report acknowledges the increasing impact of natural disasters on development, its focus is on how development itself shapes disaster risk. This Report demonstrates that countries with similar patterns of natural hazard have widely varying levels of disaster risk and that these risks have been shaped through development paths and processes. The key message of this Report is that disaster risk is not inevitable, but on the contrary, can be managed and reduced through appropriate development policy and actions.

Through publishing this Report, UNDP thus seeks to demonstrate through quantitative analysis and documented evidence that disaster risk is an *unresolved problem of development* and to identify and promote development policy alternatives that contribute to reducing disaster risk.

The Report addresses four key questions:

- How are disaster risks and human vulnerability to natural hazards distributed globally between countries?
- What are the development factors and underlying processes that configure disaster risks and what are the linkages between disaster risk and development?
- How can appropriate development policy and practice contribute to the reduction of disaster risks?
- How can disaster risk assessment be enhanced in order to inform development policy and practice?

The **Disaster Risk Index** (DRI),which is presented as the centrepiece of this Report, is a first step in addressing these questions.The DRI provides the first global assessment of disaster risk factors through a country-by-country comparison of human vulnerability and exposure to three critical natural hazards:earthquake, tropical cyclones and flooding, and the identification of development factors that contribute to risk. Volcanic eruption is important internationally, but lacks sufficient data for analysis at this time (see Technical Annex). Similarly, the development of a drought DRI revealed a series of unresolved methodological and conceptual challenges, which imply that its results do not yet have the required degree of confidence. Nevertheless, the exploration of these challenges in itself provides important insights into drought risk and vulnerability and is presented in the Report as a work in progress. Reliance on internationally available data and the use of human deaths as a proxy for disaster losses meant that certain types of disasters were excluded from the model. An example of this is fire, which can cause widespread damage with few deaths.

DRI builds on UNDP experience with the Human Development Index (HDI). Just as with the HDI, this first report on DRI should be seen as an initial step towards measuring global disaster risks. Its value is as much in flagging data needs to support decision making at the sub-national, national and international levels, as it is in contributing to the process of mapping international patterns of disaster risk.

1.2 Outline of the Report

Chapter 1 is divided into three sections. The first section presents the objective of the Report in advocating for the importance of disaster risk as a component in meeting the MDGs. The second section contextualises

the Report by offering definitions of terms and commenting on links with similar projects being undertaken by other international agencies. The third section outlines a conceptual framework for the Report and maps out the relationship between disaster risk and human development.

Chapter 2 reviews the findings of the DRI. This is a first step in achieving a worldwide accounting tool for development and disaster risk status. In addition to starting the process of mapping global patterns of risk and vulnerability, this exercise flags key gaps in knowledge and indicates the national mechanisms needed to enhance data collection.

Chapter 3 explores the development processes that contribute to the configuration of disaster risk, as identified in the DRI. It also allows for the examination of pressures known to shape risk that could not be included in the DRI through lack of international data. Perhaps most important of these is the overarching role of governance. The second role of Chapter 3 is to present examples of good practice in disaster risk reduction projects undertaken within a developmental approach. This material supports a growing number of accounts of best practice including recent reviews undertaken by the International Strategy for Disaster Reduction (ISDR), The International Federation of Red Cross and Red Crescent Societies (IFRC) and The Department for International Development (DFID).[1]

Chapter 4 returns to the key needs identified in Chapter 1 for disaster risk reduction to be appropriately mainstreamed into development policy. Building on these arguments and informed by the evidence presented in Chapters 2 and 3, key policy recommendations are advocated.

The Technical Appendix sets out in detail the methodology used to identify vulnerability factors and model national levels of disaster risk in the DRI. Progress made on the modelling of a multi-hazard DRI is also reported.

The conceptual framework of disaster risk used in the Report is outlined in Chapter 2. At the same time, a formal glossary of terms is presented at the end of the Report. However, it is helpful to outline five key terms here.

Natural disaster is understood to be an outcome of natural hazard and human vulnerability coming together, the coping capacity of society influences the extent and severity of damages received.

Natural hazards are natural processes or phenomena occurring in the biosphere that may constitute a damaging event and that in turn may be modified by human activities, such as environmental degradation and urbanisation

Human vulnerability is a condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard. Human vulnerability includes within it the vulnerability of social and economic systems, health status, physical infrastructure and environmental assets. It is possible to look at these subsets of vulnerable systems in isolation, but here we are concerned with the broad picture of human vulnerability.

Coping capacity is the manner in which people and organisations use existing resources reactively, to limit losses during a disaster event. To this can be added *adaptive capacity,* which points to the possibility for society to redirect its activities proactively, to shape development in a way that minimises the production of disaster risk.

1.3 Disaster Losses are Increasing

Over the last quarter century, the number of reported natural disasters and their impact on human and economic development worldwide has been increasing yearly. Existing records, while less reliable before 1980, can be traced back to 1900. This longer time period also shows a relentless upward movement in the number of disasters and their human and economic impacts.[2]

It is troubling that disaster risk and impacts have been increasing during a period of global economic growth.

At best this suggests that a greater proportion of economic surplus could be better distributed to alleviate the growing risk of disaster. At worst is the possibility that development paths are themselves exacerbating the problem; increasing hazards (for example through environmental degradation and global climate change), human vulnerability (through income poverty and political marginalisation) or both.

Measuring disaster loss is itself a major conceptual and methodological challenge. On the one hand, it is necessary to define what losses can really be attributed to disasters, as opposed to other kinds of development loss. On the other hand, a major obstacle to describing and analysing disaster loss and its impact on development is the lack of reliable data and information on all levels. This is perhaps one reason why policymakers have been slow to act on the link between disaster and development.

The question of how many disasters occur and the losses that they represent can only be answered in relation to a given level of observation and resolution. Disaster losses occur on all levels,from individual household losses associated with everyday environmental hazards to losses due to exceptional catastrophic events, such as major earthquakes and cyclones that can affect entire regions. Seen from a local perspective, all these losses would be relevant and important. From a global perspective, most local level disasters are effectively invisible.

Global databases of disaster loss are maintained by reinsurance companies, such as Munich Reinsurance Group and Swiss Reinsurance as well as by the Centre for Research on the Epidemiology of Disasters (CRED), an independent academic institution. Only the latter is in the public domain and therefore accessible for analytical purposes. EM-DAT: The OFDA/CRED International Disaster Database, or EM-DAT as it will be referred to in this Report, reports losses associated with large scale and many medium-scale disaster events, but does not include losses associated with small-scale events or those medium-scale events not reported internationally.

While data on human mortality is relatively robust, data on economic loss and livelihood erosion is generally not considered to be complete or reliable at this stage. While the reinsurance companies give more emphasis to economic loss, given their focus on insured losses, this is unlikely to provide a clear picture of livelihood losses, particularly in developing countries.

Comprehensive economic assessments of disaster loss have been carried out by the Economic Commission for Latin America and the Caribbean (ECLAC), the World Bank and other regional and international bodies following major natural disasters. Such assessments, nonetheless, constitute snapshots in time and do not capture accumulative economic loss at either the national or global levels. At the same time, there is likely an underestimation of the impact of disaster on livelihood sustainability and the erosive pressure disasters can exert on social capital. In particular, the contribution to livelihood failure, household collapse and poverty of slow-onset and small-scale disasters is likely to have been played down through lack of data.

Detailed national databases of disaster loss are available in some countries, but do not provide complete global or even regional coverage at this stage. At the same time, national databases show similar deficiencies as the global databases regarding the reporting of economic loss and livelihood erosion.

BOX 1.1 THE ECONOMIC IMPACT OF DISASTERS

Disaster losses are conventionally categorised as:

- **Direct costs** — physical damage, including that to productive capital and stocks (industrial plants, standing crops, inventories, etc.), economic infrastructure (roads, electricity supplies, etc.) and social infrastructure (homes, schools, etc.).
- **Indirect costs** — downstream disruption to the flow of goods and services — e.g., lower output from damaged or destroyed assets and infrastructure and the loss of earnings as income-generating opportunities are disrupted. Disruption of the provision of basic services, such as telecommunications or water supply, for instance, can have far-reaching implications. Indirect costs also include the costs of both medical expenses and lost productivity arising from the increased incidence of disease, injury and death. However, gross indirect costs are also partly offset by the positive downstream effects of the rehabilitation and reconstruction efforts, such as increased activity in the construction industry.
- **Secondary effects** — short- and long-term impacts of a disaster on the overall economy and socio-economic conditions — e.g. fiscal and monetary performance, levels of household and national indebtedness, the distribution of income and scale and incidence of poverty, the effects of relocating or restructuring elements of the economy or workforce.

Reported data on the cost of disasters relate predominantly to direct costs. Figures on the true cost of indirect and secondary impacts may not be available for several years after a disaster event, if at all. The passage of time is necessary to reveal the actual pace of recovery and precise nature of indirect and secondary effects.

Ongoing research suggests that the secondary effects of disasters can have significant impacts on long-term human and economic development.[3] Most obviously, disasters affect the pace and nature of capital accumulation. The possibility of future disasters can also be a disincentive for investors. In examining the longer-term impact of disasters, it is also important to recognise that a disaster is not a one time event but, rather, one of a series of successive events, with a gradual cumulative impact on long-term development.

Source: Benson (2002)[4]

1.3.1 Economic loss as an indicator of disaster impact

Economic losses are often reported with reference to only the direct losses from infrastructure and assets destroyed during large-scale disasters. They seldom take into account the economic implications of reduced levels of production linked to damage in productive assets or infrastructure that in turn limit access to raw materials, energy, labour or markets (see Box 1.1 on previous page).

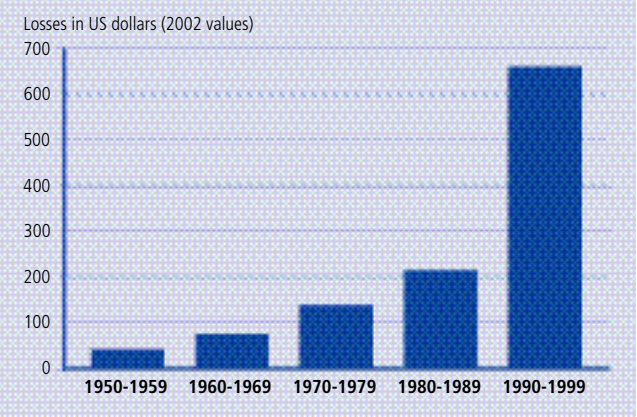
In absolute terms, the recorded economic cost of disasters has been increasing over decades (see Figure 1.1). According to Munich Re, real annual economic losses in 2002 averaged US$ 75.5 billion in the 1960s, US$ 138.4 billion in the 1970s, US$ 213.9 billion in the 1980s and US$ 659.9 billion in the 1990s.[5]

Munich Re estimates that global economic losses for the most recent ten years (1992-2002) were 7.3 times greater than the 1960s. The *World Disasters Report 2002* assesses the annual average estimated damage due to natural disasters at US$ 69 billion. Two-thirds of these losses were reported from high human development countries.

Figure 1.2 shows economic loss by World Region for disaster events triggered by a natural hazard between 1991 and 2000.The unequal distribution of impacts is clear. In Europe and America, losses are shown to be higher than in Africa, but this is a reflection on the value of infrastructure and assets at risk,not impact on development potential. In less developed regions of the world, low losses reflect a deficit of infrastructure and economic assets rather than a low impact on development. And even a small economic loss may be critically important in the case of countries with a very low GDP. What economic loss data cannot show is the variable capacity of people and businesses from different regions to protect themselves from economic loss, for example, through insurance or government aid. Africa's much smaller economic losses may be more significant in terms of slowing progress in human development.

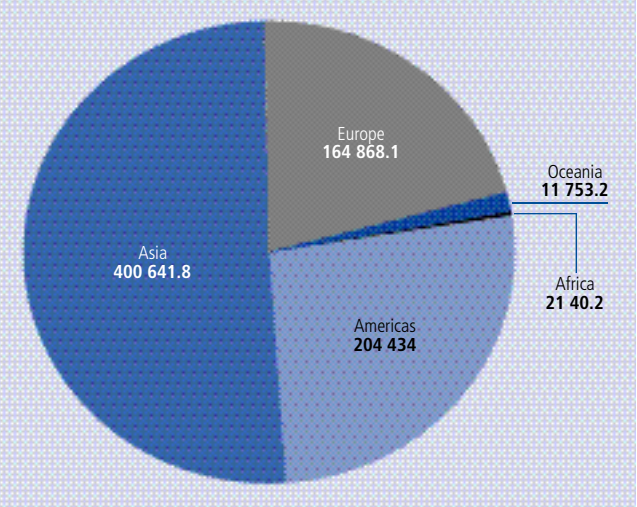
The use of economic loss as an indicator of disaster impact on development varies for different natural hazards. For example, earthquakes often appear to trigger the most expensive disasters, but losses are concentrated. Individual floods may not record large losses, but total human impact may be higher. Asian

FIGURE 1.1 ECONOMIC LOSSES DUE TO NATURAL DISASTERS FROM 1950 TO 2000



Source: Munich Re

FIGURE 1.2 TOTAL AMOUNT OF DISASTER DAMAGE BETWEEN 1991 AND 2000 IN MILLIONS OF US DOLLARS (2000 VALUES)



Source: EM-DAT: The OFDA/CRED International Disaster Database

countries experience the greatest collective economic losses to disaster, with flood being a common hazard in this region and human development may be even more at risk here than these data suggest.

1.3.2 Human loss as an indicator of disaster impact

In the last two decades, more than one and a half million people have been killed by natural disasters. The total number of people affected each year has doubled over the last decade.

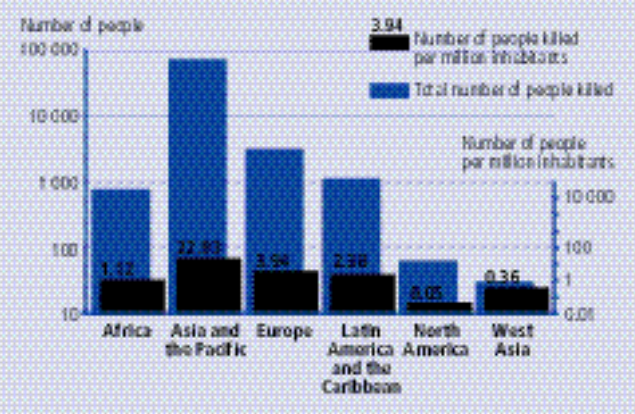
Human deaths are the most reliable measure of human loss and are the indicator used in this Report. However, as with economic data, this reveals only the tip of the iceberg in terms of development losses and human suffering. Worldwide, for every person killed,

around 3,000 people are exposed to natural hazards.[6] This scale of impact fits more intuitively with the order of magnitude one might expect from disaster. But even here the ways in which people are identified as being affected is partial. Estimates are based on assessments of the number of people experiencing damage to livelihoods or to a dwelling, or interruption of basic services. But these are difficult data to collect in a post-disaster period, particularly if there is not an accurate pre-disaster baseline. More difficult still is factoring in longer term impacts, such as the consequences of the death or incapacitation of a primary income earner on a household or extended family, the consequences of migration or resettlement, or the number of people experiencing secondary health and educational impacts.

Data from EM-DAT[7] reveals that in examining human deaths to disasters with a natural trigger by world region (Figures 1.3 – 1.6), a common thread is seen across hazard types. The Asia-Pacific region experiences the greatest impacts both in terms of total lives lost and when lives lost are calculated as a proportion of regional population,due to earthquakes, tropical cyclones and floods. The exception to this comes from the high concentration of deaths associated with drought in Africa. Drought events are often part of a bigger picture that can include armed conflict, extremes of poverty and epidemic disease with death touching only the surface of livelihood disruption and human suffering. The erosion of development gains under such circumstances are clear.

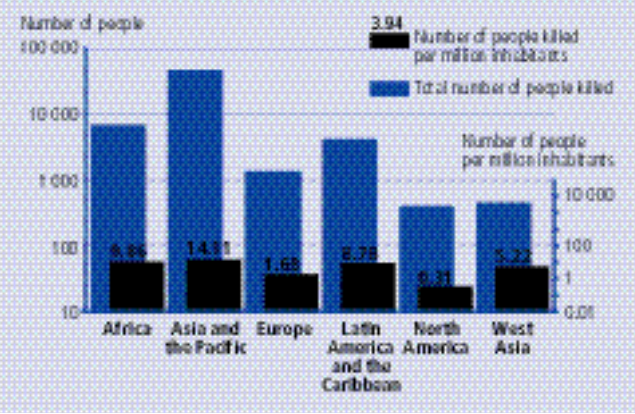
The concept that humanitarian emergencies associated with drought can only be fully understood by considering the role played by armed conflict, extreme poverty and epidemic disease is a useful entry point for rethinking the disaster-development relationship. If disasters apparently triggered by drought are often more

FIGURE 1.3 TOTAL REGIONAL MORTALITY, EARTHQUAKES, 1990–1999



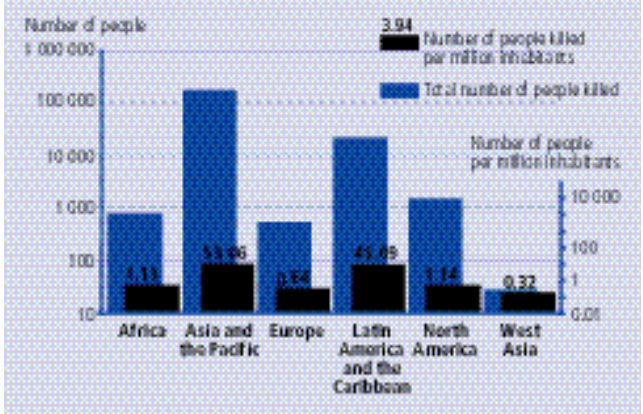
Source: EM-DAT: The OFDA/CRED International Disaster Database

FIGURE 1.4 TOTAL REGIONAL MORTALITY, FLOODS, 1990–1999



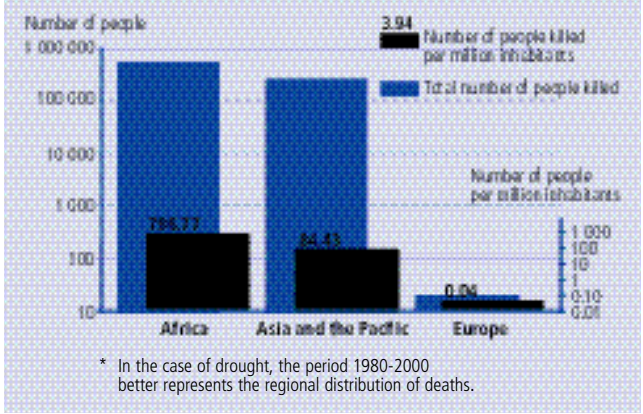
Source: EM-DAT: The OFDA/CRED International Disaster Database

FIGURE 1.5 TOTAL REGIONAL MORTALITY, TROPICAL CYCLONES, 1990–1999



Source: EM-DAT: The OFDA/CRED International Disaster Database

FIGURE 1.6 TOTAL REGIONAL MORTALITY, DROUGHTS, 1980–2000*



* In the case of drought, the period 1980-2000 better represents the regional distribution of deaths.

Source: EM-DAT: The OFDA/CRED International Disaster Database

properly thought of as complex emergencies, as much to do with human as environmental processes, why not other disasters associated with tropical cyclones, earthquakes or floods?

Regional losses in Latin America and the Caribbean are dominated by disasters triggered by tropical cyclones and flooding. Africa and West Asia also suffer from high losses from flooding. Europe and North America show lower absolute and relative numbers of deaths to all hazard types, with the highest impact for these regions being registered by Europe's relative losses to earthquakes.

The severe famines associated with drought that unfolded in sub-Saharan Africa in the 1980s are shown by extending drought losses to a time period of 1980-2000.

1.4 Disaster Risk and the Millennium Development Goals: A Framework for Action

A considerable incentive for rethinking disaster risk as an integral part of the development process comes from the aim of achieving the goals laid out in the Millennium Declaration.The Declaration sets forth a road map for human development supported by 191 nations. Eight Millennium Development Goals were agreed upon in 2000, which in turn have been broken down into 18 targets with 48 indicators for progress. Most goals are set for achievement by 2015.[8]

The MDGs contain cross-cutting themes in development and disaster risk policy, each tied to specific targets and indicators for progress. They require international collaboration to be met. All signatory countries now claim to be working toward these goals and donors are providing sharply focused aid packages to support their endeavours.

The risk to development stemming from natural disaster is recognised in the Millennium Declaration in Section IV, entitled "Protecting Our Common Future". Within this section is stated the objective:"to intensify our collective efforts to reduce the number and effects of natural and man-made disasters".[9]

Natural disasters occur when societies or communities are exposed to potentially hazardous events, such as extremes of rainfall, temperature or wind speed or tectonic movements, and when people are unable to absorb the impact or recover from the hazardous impact. While it is commonplace to talk about natural disasters, both vulnerability and hazard are conditioned by human activities. Reducing the number and effects of natural disasters means tackling the development challenges that lead to the accumulation of hazard and human vulnerability that prefigure disaster.

The accumulation of disaster risk and the unequal distribution of disaster impacts prompt a questioning of the development paths that have been taken by countries more or less at risk from disaster. Natural disasters destroy development gains, but development processes themselves play a role in driving disaster risk. To follow the example quoted earlier, when a school built without earthquake resistance collapses during a tremor, is this an example of disaster risk undoing development, or of inappropriate development prefiguring disaster risk?

The MDGs direct development planning towards priority goals. Each of these goals will interact with disaster risk. On the surface, these goals will contribute to a reduction of human vulnerability to natural hazard. But it is the processes undertaken in meeting each goal that will determine the extent to which disaster risk is reduced. Building schools is not enough for a sustainable and long-term development gain, schools exposed to natural hazard must be disaster resistant, and people using them need to prepare for disaster.

This implies a two-way relationship between the kind of development planning that can lead to the achievement of the MDGs and the development processes that are currently associated with an accumulation of disaster risk. Unless disaster risk considerations are factored into all development related to the MDGs, well-meaning efforts to increase social and economic development might inadvertently increase disaster risk. At the same time, the realisation of existing (let alone future) levels of risk will slow down and undermine efforts to achieve the MDGs.

The primary responsibility for achieving MDGs lies with individual countries. To date, 29 countries have published Millennium Development Goal Reports.[10]

BOX 1.2 THE MILLENNIUM DEVELOPMENT GOALS AND DISASTER RISK REDUCTION

The Millennium Declaration contains a statement of values and objectives for the international agenda for the XXI century. Eight Millennium Development Goals, based on the Millennium Declaration, have been approved by the General Assembly as part of a road map for the implementation of the Declaration. These are set out below and each one's relationship with disaster risk is highlighted.

1. Eradicating extreme poverty and hunger

i) To halve the proportion of people whose income is less than one dollar a day
ii) To halve the number of people who suffer from hunger

The DRI proves through statistical analysis a long-held theoretical position that human vulnerability to natural hazards and income poverty are largely co-dependent. At the national level, reducing disaster risk is often contingent upon alleviating poverty and vice versa. Exposure to hazards can play a critical role in places where poverty expresses itself as a lack of entitlement to acquire basic nutritional needs. Hunger reduces individual capacity to cope with disaster stress and shock and disasters can destroy assets leading to hunger. The economic and political underpinnings of hunger, particularly within complex political emergencies, are well documented.[11]

2.Achieving universal primary education

i) To ensure that children everywhere — boys and girls alike — complete a full course of primary education

Educational attainment is a fundamental determinant of human vulnerability and marginalisation. Basic literacy and numeric skills enable individuals to become more engaged in their society. Broadening participation in development decision-making is a central tenet of disaster risk reduction.

The destruction of schools is one very direct way in which disasters can inhibit educational attainment, but perhaps more important is the drain on household resources that slow and sudden-onset disasters inflict. Households frequently have to make difficult decisions on expending resources on survival and coping with poverty, or on investments (such as education and health care) to alleviate human vulnerability and enhance longer-term development prospects. Unfortunately, for the poorest, there is no choice and human vulnerability deepens as resources are targeted towards survival.

3. Promoting gender equality and empowering women

i) Eliminate gender disparities in primary and secondary education, preferably by 2005, and in all levels by 2015.

Facilitating the participation of women and girls in the development process, including efforts to reduce disaster risk, is a key priority. Women across the world play critical roles in the shaping of risks in development. In some contexts, women may be more exposed to and vulnerable to hazards. For example, those with responsibilities in the household may be more exposed to risk due to unsafe building and from local hazards stemming from inadequate basic services or exposure to smoke from cooking fuel. At the same time, women are often more likely than men to participate in communal actions to reduce risk and enhance development. Orienting disaster risk policy so that it builds on the social capital represented by women can enable a more informed development policy. As criticisms of participatory development indicate, achieving such a model will not be easy, but best practice does exist to point the way.

When women face barriers in participating at higher levels of decision-making, this severely limits the skills and knowledge available for sustainable development and risk reduction. Overcoming disparities in access to education is a fundamental component of the disaster risk reduction agenda.

4.Reducing child mortality

i) Reduce infant and under-five mortality rates by two-thirds

Children under five years of age are particularly vulnerable to the impacts of environmental hazards ranging from the everyday risks of inadequate sanitation and drinking water to death and injury following catastrophic events and their aftermath. The loss of care givers and household income earners and the stress of displacement can have especially heavy tolls on the psychological and physical health of children under five years of age. Policies aiming to support sustainable development paths by reducing child mortality need to build in strategies to limit or reduce disaster risk.

5. Improving maternal health

i) Reduce maternal mortality ratios by three-quarters

As environmental hazard stress or shock erodes the savings and capacities of households and families, marginal people within these social groups are most at risk. In many cases it is women and girls or the aged who have least entitlement to household or family assets. Maternal health is a strategic indicator of intra- and inter-household equality. Reducing drains on household assets through risk reduction will contribute to enhancing maternal health. More direct measures through investment in education and health will similarly contribute to household resilience as maternal health indicators improve. Children have already been identified as a high-risk group and maternal health plays a part in shaping the care received by young children.

6. Combating HIV/AIDS, malaria and other diseases

i) Halt and begin to reverse the spread of HIV/AIDS
ii) Halt and begin to reverse the incidence of malaria and other major diseases

The interactions between epidemiological status and human vulnerability to subsequent stresses and shocks are well documented. For example, rural populations affected by HIV/AIDS are less able to cope with the stress of drought because of a shortage of labour. Individuals living with chronic terminal diseases are more susceptible to the physiological stress of hunger. For diseases transmitted through vectors, there is a risk of epidemic following floods or drought, similarly the destruction of drinking water, sanitation and health care infrastructure in catastrophic events can increase the risk of disease.

7.Ensuring environmental sustainability

i) Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources
ii) Halve the proportion of people without sustainable safe drinking water
iii) By 2020, achieve a significant improvement in the lives of at least 100 million slum dwellers

Major disasters, or the accumulation of risk from regular and persistent but smaller events, can wipe out any hope of sustainable urban or rural environments. Again, the equation works both ways. Increasing destruction due to landslides, floods and other disasters related to environmental and land-use patterns are a clear signal that massive challenges remain in achieving this MDG. The target of achieving a significant improvement in the lives of at least 100 million slum dwellers by the year 2020 will be impossible without developing policies to confront their currently high risk from earthquake, tropical cyclones, flooding and drought.

8. Developing a global partnership for development

i) Address the least developed countries' special needs and the special needs of landlocked and small island developing states
ii) Deal comprehensively with developing countries' debt problems
iii) Develop decent and productive work for youth
iv) In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries
v) In cooperation with the private sector, make available the benefits of new technologies — especially information and communications technologies

Efforts to enhance sustainable development and reduce human vulnerability to natural hazard are hampered by national debt burdens, terms of international trade, the high price of key drugs, lack of access to new technology and new hazards associated with global climate change.

Difficulties in reaching international agreement on a range of issues, for example at the World Summit on Sustainable Development in Johannesburg in 2002 and the World Trade Organisation meeting at Cancun in 2003, highlight the efforts needed to build a global partnership for development that might contribute to disaster risk reduction.

Examples of progress at the international level include cooperation between states at high risk from natural disaster that has increased their negotiating power. In the case of small island developing states, the Association of Small Island States has been active in climate change talks. Within the machinery of international organisations, the ISDR Task-Force constitutes a good example of global partnership for development and disaster risk reduction.

Source: www.un.org/millenniumgoals

While the MDGs have galvanised international development efforts,progress has been slow and this has direct implications for global levels of disaster risk.[12] The most far-reaching opportunities for disaster risk reduction within the MDGs relate to MDG8 — developing a global partnership for development. This requires that developed countries meet their commitments to trade reform, debt relief and aid.The lack of consensus on international trade, particularly in agriculture that brought the World Trade Organization talks in Cancun in 2003 to a halt, shows the amount of work that still needs to be undertaken in building an international agenda for trade reform. Without such reform, developing countries will have little chance of generating higher economic growth. At the same time, however, because trade reform has such far-reaching implications for patterns of economic, social and territorial development, by definition it will change the distribution of disaster risk. Once again, the two-way relationship between disaster risk and development becomes apparent. Trade reform may stimulate more *risk generating* development, unless disaster risk reduction becomes an integral part of development planning.

Issues of environmental sustainability were discussed in the World Summit on Sustainable Development, held in Johannesburg, South Africa in 2002. The Johannesburg Plan of Implementation encourages public-private sector partnerships in managing environment and development challenges. The ways in which partnerships operate in terms of wealth generation and distribution, stakeholder participation and the environmental impacts of development, will also potentially contribute to the shaping of disaster risk. These need to be critically reviewed in the face of disaster risk, stemming from the ongoing degradation of the natural environment from deforestation, natural resource extraction (including oil), soil loss, biodiversity loss and growing concerns for access to water for drinking and agricultural use.

Alongside the use of the MDGs in focusing development aims, the international community is also changing its way of delivering development support. This too has implications for the shaping of disaster risk and the way in which strategies for enhancing security will need to be framed.[13] In particular, the use of national Poverty Reduction Strategy Papers (PRSPs) to better define priorities for public expenditure and the role of aid within these priorities. This rethinking of aid applies not only to governments, but also to civil society and the private sector.

With disaster risk increasingly recognised as one way in which economic poverty is felt or expressed,[14] PRSPs need to take this into account. They also provide an opportunity to bridge the ministerial and bureaucratic divides that have in the past so often resulted in disaster risk reduction falling in the cracks between development planning and disaster response.

1.5 A Changing Debate:Bringing Disasters and Development Together

A developmentally informed perspective on disasters lies at the intersection of work normally undertaken by two different communities: development planners and disaster risk reduction practitioners. This Report hopes to contribute by catalysing both communities to rethink their responsibilities. It follows previous initiatives that have paved the way for this argument. Important in this regard has been the United Nations International Decade for Natural Disaster Reduction, 1990-1999 (IDNDR).

A number of very large-scale disasters occurred at the end of the IDNDR. The 1997-1998 El Niño led to flooding in East Africa, Latin America,the Caribbean and South and Southeast Asia. It was followed by hurricanes Georges and Mitch hitting Central America and the Caribbean. These events were succeeded by mudslides and debris flows in Venezuela, a cyclone in Orissa, India, and earthquakes in Turkey, El Salvador and Gujarat, India. All this occurred in the four years between 1997 and 2001 and all contributed to a more articulated and serious consideration of the disaster-development relationship.[15]

The declaration of the IDNDR helped raise the profile of discussions surrounding the social and economic causes of disaster risk. In acknowledging this came the realisation that mitigating losses through technological and engineering solutions dealt with the symptoms rather than with the causes of the problem and that reducing disaster risk required a long-term engagement with processes of international development. The major disasters occurring at the end of the 1990s helped to galvanise support for this view.

As the successor to IDNDR in 2000, the UN International Strategy for Disaster Reduction (ISDR) was initiated to foster this agenda by focussing on the processes involved in the awareness, assessment and management of disaster risks. An important tool in the development of this agenda has been the ISDR Secretariat's publication *Living with Risk: A Global Review of Disaster Reduction Initiatives.*[16] The UN commitment to promoting sustainable development and mitigating disaster losses is brought together in this document.

BOX 1.3 THE EVOLUTION OF NATURAL DISASTER AS A DEVELOPMENT CONCERN

Both researchers and practitioners have been providing compelling evidence for many years that natural disasters are something more than just acts of God. While this is a broad generalisation of a very complex and heterogeneous process, one can say that until the 1970s a dominant view prevailed that natural disasters were synonymous with natural events such as earthquakes, volcanic eruptions and cyclones. In other words, an earthquake was a disaster per se. The magnitude of a disaster was considered to be a function of the magnitude of the hazard. As earthquakes and volcanic eruptions are not avoidable, the emphasis of national governments and the international community was on responding to the events and in the best of cases, preparing for them.

From the 1970s onwards, technical professionals, such as engineers and architects, began to focus on the fact that the same natural hazard had a varying impact on different kinds of structures, such as buildings. The characteristics of a disaster became more associated with its physical impact than with the natural hazard. Interest grew in the design and implementation of ways to mitigate losses through physical and structural measures to reduce hazards (for example, through building levees and flood defences) or to increase the resistance of structures. Unfortunately, the cost of physical mitigation meant that in many countries efforts to reduce risks by these means have been minimal.

Also since the 1970s, but with increasing emphasis in the 1980s and 1990s, researchers from the social sciences and humanities have argued that the impact of a natural hazard depends not only on the physical resistance of a structure, but on the capacity of people to absorb the impact and recover from loss or damage. The focus of attention moved to social and economic vulnerability, with mounting evidence that natural hazards had widely varying impacts on different social groups and on different countries. The causal factors of disaster thus shifted from the natural event towards the development processes that generated different levels of vulnerability. Vulnerability reduction began to be advanced as a key strategy for reducing disaster impact, though this proved elusive to implement.

By the end of the 1990s, it was clear that development processes were not only generating different patterns of vulnerability, but were also altering and magnifying patterns of hazard — an argument that has gained increasing currency as evidence mounts regarding the impact of global climate change. Risk management and reduction has been advanced as an integral paradigm that builds on and incorporates all the previous strategies from the perspective that all development activities have the potential to increase or reduce risks.

In 1997, under the United Nations Programme for Reform, the General Assembly transferred the responsibility for operational activities on natural disaster mitigation, prevention and preparedness to UNDP. Since then, UNDP has made considerable progress in developing capacity building programmes in disaster reduction and recovery. In doing this, UNDP supports the implementation of the ISDR agenda at the national and regional levels. This work is reinforced by partnerships with the Office for Co-ordination of Humanitarian Affairs (OCHA) and other UN agencies and international organisations.

International Financial Institutions (IFIs) such as the World Bank and the regional development banks have also began to engage with issues surrounding the relationship between disaster risk and economic development. Many considerations compelled IFIs to incorporate disaster reduction as a major part of their portfolio of activities. For example, the massive destruction of infrastructure that had been built with international loans from the IFIs, the setbacks to national economies and the mounting evidence that unless disaster reduction was factored into reconstruction, new loans following disasters might simply lead to the *rebuilding* of risk. The ProVention Consortium, launched by the World Bank as a global partnership of governments, international organisations, academic institutions, the private sector and civil society, has been active in promoting research and disseminating best practices in many aspects of disaster risk management.

Members of international civil society also have been instrumental in moving the agenda of managing disasters on from mitigation and preparedness, towards a deeper integration with development processes. Since 1992, IFRC has published an annual *World Disaster Report.*[17] The two most recent editions focused on disaster risk reduction and recovery. This new focus on the links between disaster and development shows the increasing awareness in major international development and humanitarian agencies about the importance of disaster risk reduction. As with *Reducing Disaster Risk: A Challenge for Development,* the IFRC argument for a greater emphasis on disaster risk reduction building on established response mechanisms, is tied into the context of achieving the Millennium Development Goals.[18]

At the same time in recognising the growing international interest and commitment to reducing disaster risk,it is

important to recognise that this has been stimulated by the emergence of national and regional institutions dedicated to research, training and application in disaster prone countries. Many of the contemporary approaches to risk management and reduction, now being discussed and advocated at the international level, have grown out of disaster reduction research and application by developing country researchers and institutions. Since the early 1990s, a growing literature has emerged in Latin America and the Caribbean, Asia and Africa.[19]

The creation of regional organisations and networks manifests the growing maturity of this process. These organisations and networks now have an important influence on international policy.

1.6 Is Sustainable Human Development Achievable Under Natural Disaster Risk?

The UNDP emphasis on human development has informed the way in which development is conceived of in this Report. Human development is about more than the rise or fall of national incomes. It is about having space in which people can develop their full potential and lead productive, creative lives in accordance with their needs and interests. People are the real wealth of nations.

Fundamental to human development is building human capabilities: the range of things that people can do or be in life. The most basic capabilities for human development are to lead long and healthy lives, to be knowledgeable, to have access to the resources needed for a decent standard of living and to be able to participate in the life of the community. Without these, many choices are simply not available and many opportunities in life remain inaccessible. The stress and shock felt by those vulnerable and exposed to natural hazards will impact in myriad ways on the capacity of people to achieve and enjoy human development gains. Levels of human development will also shape people's capacity to be resilient in the face of hazard stress and shock.

UNDP Human Development Reports (HDR) recognise the role played by disaster risk in shaping human development. Disaster risk has been a concern of regional thematic works including: *El Estado de la Region* published in 1999 and covering Central America, *Building Competitiveness in the Face of Vulnerability,* published in 2002 by the Organisation of Eastern Caribbean Sates, and *El Impacto de un Huracán,* published in 1999 in Honduras. More generally, given the close relationship between disaster risk and human development, the HDR series often discusses concerns relevant to disaster risk reduction though in a less systematic manner.[21]

BOX 1.4 MAHBUB UL HAQ ON THE MEANING OF HUMAN DEVELOPMENT

The basic purpose of development is to enlarge people's choices. In principle, these choices can be infinite and can change over time. People often value achievements that do not show up at all, or not immediately, in income or growth figures: greater access to knowledge, better nutrition and health services, more secure livelihoods, security against crime and physical violence, satisfying leisure hours, political and cultural freedoms and a sense of participation in community activities. The objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives.

Source: Mahbub ul Haq [20]

1.6.1 Disaster-development linkages

The primary focus of *Reducing Disaster Risk: A Challenge for Development* is on the relationship between human development and disaster.[22] In order to clarify the ways in which disaster and development interact, it is helpful to distinguish between the economic and social elements of human development. These components are interdependent and overlapping. Nevertheless, it is useful to think of the ways that these two elements, and their constituent institutional and political components, are shaped, retarded and sometimes accelerated by disaster. Similarly, one can analyse the ways in which economic and social

BOX 1.5 DISASTER RISK, HUMAN DEVELOPMENT AND THE MDGs

The interaction of **economic development** with disaster risk has direct consequences for the meeting of MDG 1 (eradicate extreme poverty and hunger), 6 (combat HIV/AIDS, malaria and other diseases) and 7 (ensure environmental sustainability).

The interaction of **social development** and disaster risk has direct consequences for the meeting of MDG 3 (promote gender equality and empower women) and 8 (develop a global partnership for development).

TABLE 1.1 DISASTER-DEVELOPMENT

	Economic Development	Social Development
Disaster limits development	Destruction of fixed assets. Loss of production capacity, market access or material inputs. Damage to transport, communications or 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 an 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 resiliency. 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 resiliency.

development (and their constituent processes) work directly or indirectly to decrease or increase disaster risk.

Table 1.1 sets out these complex interactions schematically, which are discussed below and form the context for the following chapters. Social development includes social assets such as inclusive governance, but also the health and educational infrastructure that enables participation.Economic development concerns economic production and its supporting infrastructure, for example transport networks to enable market access and the integrity of natural resources for the sustainability of resource-dependent livelihoods.

Disasters limit economic development?

Disasters can wipe out the gains of economic development. In 1982, Hurricane Isaac destroyed 22 percent of the housing stock in the Tongan archipelago.[23] Reconstruction costs to correct damage to water, sanitation, energy, telecommunication, roads and railway infrastructure from flooding in Mozambique in 2000 will cost US$ 165.3 million.[24] These accounts are dramatic, but the constant drain on resources from everyday disasters similarly limits the development potential of millions of people around the world. In Viet Nam, in "normal" years, flooding destroys an average of 300,000 tonnes of food.[25]

Catastrophic disasters result in the destruction of fixed assets and physical capital, interruption of production and trade, diversion and depletion of savings and public and private investment. While absolute levels of economic loss are greater in developed countries due to the far higher density and cost of infrastructure and production levels, less-developed countries suffer higher levels of relative loss when seen as a proportion of Gross Domestic Product (GDP).

The 2001 earthquakes in El Salvador and Seattle in the United States resulted in losses of around US$ 2 billion each. While this scale of loss was easily absorbed by the U.S. economy, it represented 15 percent of El Salvador's GDP for that year.

Larger countries, with a greater geographical spread of economic assets relative to the spatial impact of disasters, are more able to avoid direct loss and minimise downstream, indirect or secondary losses. In 1995, Hurricane Luis caused US$ 330 million in direct damages to Antigua, equivalent to 66 percent of GDP. This can be contrasted with the larger economy of Turkey that lost between US$ 9 billion and US$ 13 billion in direct impacts from the Marmara earthquake in 1999, but whose national economy remained largely on track.[26]

Not only the size of a nation's economy, but also the proportion of its land area exposed to hazard will determine disaster risk. This partly accounts for the high vulnerability of small island developing states. Almost three-quarters of the island of Montserrat was made uninhabitable by a volcanic eruption in 2001. Today only 36 percent of the pre-disaster population remain, supported by the United Kingdom.

A lack of diversity in the economy can also undermine security, whether it be of a household or nation. The importance of diversification for rural livelihood

sustainability has long been recognised as a mechanism to cope with changing market conditions and climatic fluctuations. There is a tension here between the dictates of global trade, which pushes countries towards specialisation,and the insecurity that a lack of diversity brings. This is particularly so for countries "specialising" in primary commodity exports that may also be at risk from drought, flooding or tropical cyclones. This is exemplified by reduced agricultural production in Africa in the 1997 El Niño year. The most significant declines were in Botswana, Lesotho, Malawi, South Africa, Swaziland and Zambia.[27]

But the relationship between economic size, diversity and risk is not simple. The lowest income countries are not necessarily the most vulnerable from an economic perspective. This group, including Burkina Faso, Ethiopia, Malawi and Swaziland, typically have agrarian economies. Although vulnerable to drought, once rains return recovery can be fast and attracts high levels of donor support. A study of drought impacts showed that intermediate economies with some diversification (such as Senegal and Zimbabwe) have been more vulnerable as economic impacts cross into manufacturing sectors. Impacts also linger, as recovery of the manufacturing sector is slower than in agriculture and may not attract so much donor attention.[28]

At the local level, disasters can seriously impact household livelihoods and push already vulnerable groups further into poverty. The loss of income earners, through death or injury, the interruption of production or access to markets and the destruction of productive assets,such as home-based workshops, are all examples of ways in which disasters affect local and household economies. Often such impacts are accumulative as the impact of everyday and frequently occurring small-scale hazards erodes livelihoods over a period of time. The capacity of a household or local community to absorb the impact and recover from a major natural hazard will be seriously limited if already weakened over time by a series of smaller-scale losses.

Disasters limit social development?

A population that has been weakened and depleted by natural disaster, particularly when this coincides with losses from HIV/AIDS, malnutrition or armed conflict, will be less likely to have the organisational capacity to maintain irrigation works, bunds in fields for water harvesting, hillslope terraces, community wood lots or shelter belts. Without these social assets, communities become more vulnerable.

In addition to the loss of social assets themselves, there are many examples of disaster events destroying the gains of the health, sanitation, drinking water, housing and education sectors that underpin social development. Examples include the El Salvador earthquake in 2001, which badly damaged 23 hospitals, 121 health care units and 1,566 schools;or the cyclone that hit Orissa, India in 1999, which led to the contamination of drinking water wells and damaged many schools in the direct impacts of a single event.[29]

Potentially negative consequences for social development do not stop with direct impacts. In the aftermath of a disaster or during the escalation of a slow-onset disaster, such as a drought or complex political emergency, problems with governance mean that aid budgets can be skewed towards the recovery of one group or sector as opposed to another. The result is a reduction in social equality.

A review of livelihoods and governance conditions that led to high losses in the Orissa cyclone in 1999 has pointed to corruption at all levels, unnecessary bureaucracy, political rivalry and an apathetic civil society as pressures that contributed to vulnerability.[30]

Disaster response may also be a time when democratic institutions come under pressure. After the 1985 earthquake in Chile, a traditional civilian response threatened to undermine a dictatorial government.[31] The response was demobilised through repression and the state took over.

Women suffer additional stresses in disaster situations and also bear a disproportionate burden of the additional domestic and income-generating work necessary for survival following a disaster event. When women are exposed to these additional stresses, the level of social development is reduced. However, over the long run, it is also possible that the net result is an increase in their economic and political participation — generating an increase in social development.

The exclusion of women from local decision-making circles in Bangladesh led to women and girls being unwilling to use hurricane shelters. Current, inclusive decision-making bodies have improved the social

position of women and the management of hurricane shelters has been reformed — encouraging greater use among women.

Economic development increases disaster risk?

There are many examples of the drive for economic growth generating disaster risk. This is as true for individuals as it is for international business. The massive forest fires in Indonesia in 1997 that caused air pollution in neighbouring Malaysia were partly caused by the uncontrolled use of fire by farmers wishing to expand production of a major export crop, palm oil. Tourist developments that fringe Barbados may inadvertently be adding to their own risk as waste water and recreational sports contribute to the denudation of coral reefs, which act as a first line of sea defence against storm surges.

Hurricane Mitch in 1998 generated a wide-ranging reflection on the relationships between poverty and environmental degradation. The notion of "Reconstruction with Transformation" was coined by governments in negotiations with external aid donors. In aiming to build a changed development path into the reconstruction effort, this carried with it an explicit recognition that pre-disaster development priorities had led to high levels of risk and human vulnerability, eventually culminating in a humanitarian disaster triggered by a tropical cyclone.

It is the rules of governance that promote particular development paths that also shape patterns of risk and disaster loss. In Izmit, Turkey, systemic corruption played an important role in contributing to the failure of building regulation, sub-standard construction and high rates of building failure during the 1999 earthquake.

Contemporary disaster risk can be linked to historical development decisions and to development decisions taken by actors in distant places. Disaster risks associated with global climate change, or the pollution of rivers by industrial and household effluent that increases the vulnerability of downstream rural communities,exemplify these relationships operating at different scales.[32]

The gaps of time and place between development gain and disaster risk accumulation and the ability of some people to shift their risk onto others while enjoying the benefits of development, are not fully understood and need further examination to assist policy formation. Globalisation will undoubtedly lead to new risk factors and modify or build on previously existing risk.

Economic development does not need to contribute to the conditions that undermine human and environmental sustainability and increase disaster risk. To move forward, there must be a clear understanding of the interaction of development plans with disaster risk.

Social development increases disaster risk?

It is hard to imagine that increases in social development (improved health, sanitation,education, the participation of women in society, etc.) can increase the risk of disasters. The only possible situation that would actually place social development as a causal factor in disaster risk is one where people are forced to expose themselves or others to risk in order to fulfil their (or others) needs or desires.

Rapid urbanisation is a case in point. The growth of informal settlements and inner city slums when fuelled by international migration (for example, from East Africa to Johannesburg or from Central America to cities in the United States) or internal migration from smaller urban settlements or the countryside to large cities, has led to the burgeoning of unstable living environments. These settlements are often located in ravines, on steep slopes, along flood plains or adjacent to noxious or dangerous industrial or transport infrastructure sites. Some 600 million urban dwellers in Africa, Asia, Latin America and the Caribbean live in life- and health-threatening homes and neighbourhoods as a result of poor quality housing and inadequate provision of basic needs.[33]

In many cases, individuals will be seeking opportunities not only to improve their own quality of life, but also to enhance the health and educational attainment of their children and be prepared (or forced) to accept enhanced disaster risk today, for greater prospects for their children tomorrow. However, even this example needs consideration, as it is not increases in social development *per se* that accounts for growing risk, but the unassisted efforts of the economically marginal and politically excluded to gain access to basic human needs that has forced them to accept environmental risk.

Economic development reduces disaster risk?

For economic development to proceed without increasing disaster risk, development planning needs

to reconcile three potentially conflicting drivers for development. First, the generation of wealth, which can raise the basic level of human development. Second, the distribution of wealth, which can enable even the poorest to overcome human vulnerability. Third, the externalities of wealth creation (waste, pollution, destruction of environments or human culture), which need to be controlled to prevent the loss of the fundamental assets on which human life depends and gains meaning.

The mainstreaming of disaster risk assessment into existing development instruments is critical in achieving economic development without generating new risks.This includes opportunities for building on existing risk impact assessment tools and examining opportunities for integration into activities such as housing and infrastructure development, industrial and agricultural development and the introduction of new technologies. This requires a two-pronged strategy. On the one hand, risk information can be used through instruments such as land-use planning and building regulations to increase the resistance, safety and sustainability of development interventions. On the other hand, it is necessary to evaluate the possible impacts of economic development in terms of risks in other locations and for other social groups.

The Klang River Basin Flood Mitigation and Environmental Management Project in Malaysia is a good example of development oriented towards risk reduction. The Klang River Basin is rapidly urbanising and its population is more than 3.6 million, with major portions of agricultural land being converted for urban use. Frequent flooding and degradation of the riparian environment have been escalating as urbanisation continues. An Environmental Master Plan is planned to direct environmental management. The plan aims to improve river water quality and provide flood warning and protection.[34]

Operating during the reconstruction phase of a disaster event, the Market Incentives for Mitigation aims to mobilise the resources of the World Bank and the insurance and reinsurance community and to apply the tools of commercial loss management to the design and maintenance of critical development investments. The goal is to let governments shift funding from emergency relief and reconstruction activities to more effective and sustainable disaster mitigation investment.[35]

An additional component to this agenda is to identify mechanisms for promoting the use of such tools in low- and middle-income countries experiencing rapid growth in populations-at-risk and the import of new and potentially hazardous technologies or waste.

At the local level, one possibility for building resilience comes from microfinance programmes. Microfinance has been shown to enhance development opportunities by providing individuals with access to credit. The Grameen Bank in Bangladesh has a long-standing commitment to supporting small-scale enterprise in this way. During the periodic floods that caused widespread destruction in Bangladesh in 1988 and 1998, losses were reduced amongst high-risk groups like agricultural communities by providing a mechanism for families to diversify income-earning activities across seasons.[36]

Social development reduces disaster risk?

Social development goals are key in shaping governance regimes for disaster risk management set within a developmental agenda. To reduce disaster risk, governance must be sensitive to the needs of those at risk from disaster with a natural trigger, and able to facilitate timely, equitable and strategically coherent decisions in resource mobilisation and disbursement.

The physical infrastructure underpinning social development includes health and education. Improved health and educational status help reduce vulnerability and can limit human losses in a disaster. Following the direct impact of a disaster event, a better-nourished, healthier population in which children have all been vaccinated will do much better in homes, shelters and camps set up for those displaced by disasters.

A literate and better-educated population — including girls and women — is better able to partner with experts in designing ways of protecting urban neighbourhoods and rural communities. Such an educated population also responds better to warnings and other public service announcements. The importance of extending educational opportunities to girls and women is noted in the MDGs and has been shown to improve the delivery of disaster risk reduction.

Gram Vikas, a rural development organisation, has been working in Orissa, India since 1979. In 1994, officials met resistance from women while implementing a

project designed to provide drinking water to the village of Samantrapur. The women's attitude was understandable. They had been excluded from the local decision-making process. Integrating women into local decision-making was a precursor to project success. To enable this, women were offered training in basic literacy, health care and income generation. Women are now included in maintaining water supply and toilet blocks in the village and have a greater stake in the politics of the village more generally.[37]

Social development points to the importance of social cohesion, inclusiveness and open participation in decision-making. Achieving such objectives is a major challenge in many communities at risk from disaster. Social capital is often used to refer to the type and thickness of bonds in a community. Projects that can enable people to build social capital for collective good can reduce vulnerability. Though some forms of social capital can be more ambiguous — as in clientelistic relationships — or negative — as in drug gangs.

A community's quality and quantity of social capital may change over time. The impact of disaster with a natural trigger on social capital is uncertain. Comparative work on armed conflict has identified a vicious circle where the loss of interaction between social groups inhibits the flow of information, further undermining trust and restricting future collective action. This has been identified as a weakness in reaching resolution in post-conflict societies,[38] and in building democracy and economic development more generally.[39]

The Dominican Disaster Mitigation Institute has facilitated the building of social capital in vulnerable communities in the Dominican Republic. A long-term strategy has been adopted where training sessions on leadership are interwoven with meetings on disaster preparedness. A number of communities have established women's and neighbouthood associations as a result. Community leaders have learned how to organise the community, establish a goal, and accomplish it.[40]

Can disaster risk enhance social or economic development?

The possibility of disasters having a positive outcome is not considered in Figure 1.2.

Notwithstanding this view, the recovery process can be an opportunity for building disaster risk reduction mechanisms into post-disaster development planning. Disaster-development relationships can be reconsidered and development priorities can be rethought.Importantly, it is not just local actors, but national and international actors who should be involved in these reflections.

Disruptions caused by disasters can open political space for alternative forms of social organisation. Often this is a negative experience, as with looting, but there is the possibility for more egalitarian forms of organisation to manifest. Support for such organisations is one way in which new development priorities might be carried forward beyond the immediate response period.

An example of a positive response to disaster is the Citizens' Disaster Response Network in Manila, which campaigns for greater transparency in government and grassroots participation in development decision-making. Its origin is in an ad hoc coalition of organisations that came together under the umbrella of the Support Disaster Victims Campaign after the eruption of Mount Mayon in 1984.[41]

During the disaster recovery and reconstruction periods, flows of foreign currency into a disaster-affected country from aid, debt relief, insurance, private transfers and remittances can produce an apparent improvement in national balance-of-payments, and provide the financial means for enacting new development priorities.

BOX 1.6 GOVERNANCE AND DISASTER RISK

Governance is a critical area for innovation and reform in achieving disaster risk reduction within human development. It is important to identify those governance tools that will be likely to simultaneously benefit disaster risk reduction and human development. This would include a presumption for equality in participation in decision-making across genders, religious and ethnic groups, casts and economic classes. An awareness of the need to engage with the local knowledge of at-risk individuals and groups as well as respect for scientifically informed knowledge will improve risk management and development planning efforts.

It is also important to identify governance reform that might inadvertently contribute to the generating of human vulnerability. Social networks are often in competition with one another and though this is not a bad thing in itself, when disaster or development aid is fed through and strengthens clientelistic networks this can foster corruption and inequality, further entrenching disaster risk.

The theme of governance is not followed up in Chapter 2 and the analysis of the DRI through a lack of internationally available data. However, it is returned to in discussion in Chapter 3.

However, positive macroeconomic and livelihood effects tend to be limited to a short period of reconstruction. Following Hurricane Gilbert in 1988, Jamaica experienced a boom that reduced a potential external current account deficit of US$ 253 million to only US$ 38.3 million. The two main contributors to this were reinsurance flows of US$ 413 million and foreign grant aid of US$ 104 million. But the boom was short-lived and as reinsurance and grant aid sources of finance dried up, the impact of the disaster on Jamaica's productive capacity was felt. The following year, Jamaica recorded a current account deficit of US$ 297 million.[42]

These examples show the importance of using the disaster response and recovery periods as opportunities for reflecting on the root causes of disaster, and recasting development priorities to reduce human vulnerability and natural hazard. Simply reinventing pre-disaster conditions is a wasted opportunity. This is as true for the institutions of governance as it is for physical infrastructure.

1.7 How Can Development Planning Incorporate Disaster Risk?

The frequency with which some countries experience natural disaster should certainly place disaster risk at the forefront of development planners' minds. For example, Mozambique faces a regular cycle of droughts and floods: 1976-1978 (floods), 1981-1984 (drought), 1991-1993 (drought), 1996-1998 (floods), 1999-2000 (floods).[43]

In acknowledging the importance of disaster as a development constraint,there is a danger of seeing some countries as being by their very nature more disaster prone than others. Sub-Saharan Africa is popularly associated with drought, Central America with earthquakes and the Pacific and Caribbean islands with tropical cyclones. In each case, it is not geography alone that generates disaster risk. Rather, development processes have shaped human vulnerability and hazards paving the way for disaster.

In this section, several conceptual tools are presented that help to outline the ways in which inappropriate development can lead to disaster risk.

The history of international development underlies the disaster risk of today

The roots of much disaster risk can be traced to historical development decisions.[44] Many of the world's largest cities have sprawled from sites chosen in the pre-colonial or colonial eras to cover areas exposed to earthquake, flooding and tropical cyclones. Such cities with coastal locations include Dhaka, Bangladesh; Mombassa,Kenya; and Manila, the Philippines. In Latin America, a desire to control indigenous populations or locate close to mineral resources led to a colonial preference for interior sites. Post-colonial population growth has led to a rapid expansion in populations-at-risk from earthquakes. Mexico City, Mexico and San Salvador, El Salvador are examples and the latter city remains despite being destroyed by earthquake nine times between 1575 and 1986.

Decisions taken today will configure disaster risk in the future

The influence of past development on present disaster risk underlines the significance of contemporary decision-making for the disaster risk that might be experienced by future generations. This reinforces the importance of international cooperation to manage development. For example, in the need for the international community to negotiate to mitigate global climate change, and to support the adaptation strategies of those communities and countries most adversely affected by the impacts of global climate change. The rise of sea levels is placing great strain on coastal communities and climate change enhances the difficulty of planning development. In Fiji during the 1997-1998 drought, US$ 18 million in food and water rations had to be distributed.[45]

Population movements are changing the context of disaster risk

Mass migration from rural to urban settlements has resulted in the growth of city slums, many located on unsafe land and built with environmentally inadequate construction techniques. The marginalisation of poor rural families has led to their relocation on increasingly insecure agricultural lands. Poverty levels, or the absolute number of poor and destitute persons, have increased continually with dramatic effects in terms of increases in social risk and disaster vulnerability.

Development processes modify natural hazard

Hazards are being reshaped and new hazards introduced by contemporary development trends. For example,

the conversion of mangrove coasts into intensive shrimp farming pools in many low-lying tropical coastlines in Southeast Asia and South America has increased the level of local hazard through coastal erosion and the loss of the coastal defence provided by the mangrove stands. The introduction of new technology such as chemicals into local agriculture, rising energy demands of urban centres and the international trade in hazardous waste, are all processes that have increased the complexity of hazard. Disaster risk reduction needs to be seen in the context of a wider interacting array of natural and technological hazards.

Everyday life is made up of everyday hazards

Everyday hazard can build cultures of resistance to danger. This is seen in the many coping strategies adopted by agriculturalists. But more common, particularly in rapidly growing urban settlements, is an association of everyday hazard with poverty and vulnerability. Typical everyday hazards include inadequate sanitation and drainage, health insecurity, malnutrition, unemployment and lack of stable and sufficient incomes, drug abuse and social and domestic violence. Exposure to everyday hazard in such cases can erode development potential and increase vulnerability to future hazard.

Risk accumulates before being released in a disaster

Everyday hazards and vulnerability form patterns of accumulating risk that can culminate in disaster triggered by an extreme natural hazard event. Achieving MDG 1 (to eradicate extreme poverty and hunger) and MDG 7 (to ensure environmental sustainability) will have a direct impact on reducing human vulnerability to everyday hazards and the accumulation of risk that prepares the way for disaster.

Large disasters are made up of many smaller disasters

The nested relationship between small and large disasters is called the concatenation of risk. Typically, an apparently simple, large-scale disaster will be composed of an array of smaller, contrasting hazard types. Hurricanes, for example, can trigger local floods and landslides. Building disaster risk reduction into development planning means taking into account large and small hazards.

This analysis leads one to ask some fundamental questions…

Do risk and disaster necessarily have to increase in incidence and effect in the future?

Is it possible to maintain economic growth while introducing policies to reduce disaster risk?

Is it necessary to change the overall parameters of future development models in order to reduce the possibility of future risk variables, or might significant improvements be made with more marginal changes?

This Report starts to address these issues by arguing for a reorientation in disaster reduction — to shift from an approach that focuses exclusively on reducing the impact of disasters on development towards an integrated risk management approach that *in addition* promotes forms of development that help reduce, rather than increase, disaster risk.

This does not mean that the elements of established disaster management (preparedness, emergency response, rehabilitation and reconstruction) are less important. But they should be complimented by an awareness of the role that poorly planned development can play in making momentary development gains at the expense of increased disaster risk.

Escalating human and economic costs of disaster point towards the need for policy responses that begin to identify and then tackle the root causes of risk that are embedded within contemporary development practices — as an integrated part of development policy. If lowering the base level of risk in society is possible while maintaining sustainable development goals, then investments in disaster risk reduction would reduce required expenditure on emergency and reconstruction and lessen the immeasurable human losses experienced by those that suffer disaster.

This agenda differentiates between two types of disaster risk management. **Prospective disaster risk management** should be integrated into sustainable development planning. Development programmes and projects need to be seen in the context of the disaster-development relationship and reviewed for potential future impacts on the reduction or aggravation of vulnerability and hazard. **Compensatory disaster risk management** (also termed corrective disaster risk management) stands alongside development planning and is focussed on the amelioration of existing vulnerability and reduction of natural hazard. Compensatory policy is necessary to reduce contemporary risk, but prospective policy is required for medium- to long-term disaster risk reduction.

Work is underway on developing methods for identifying the impact of individual development projects on disaster risk. The Caribbean Disaster Mitigation Project, Investing in Mitigation: Costs and Benefits,[46] has identified three opportunities to incorporate disaster mitigation in infrastructure investment decision-making. The first is to integrate the assessment of disaster risk into existing environmental impact assessment procedures. The second is to fully integrate natural hazard risk into the economic and financial analysis of investment projects. The third is to promote hazard mitigation when the insurance industry is called upon to underwrite catastrophic protection for the investment project.[47]

It is unlikely that prospective risk management will completely eliminate all vulnerability, so compensatory risk management is set to play a long-term role in managing disaster risk. However, even here there are opportunities for planning to build resilience into vulnerable groups or investments.

1.8 Final Discussion

Achieving a more sustainable development, and one that moves towards the meeting of the MDGs, will not be possible while disaster risk management is left outside of development. The challenge for integration lies in devising the tools required for policy makers to transparently justify the closer operation of disaster and development policy.

Bringing disaster risk reduction and development concerns closer together requires three steps:

- The collection of basic data on disaster risk and the development of planning tools to track the changing relationship between development policy and disaster risk levels.
- The collation and dissemination of best practice in development planning and policy that reduce disaster risk.
- The galvanising of political will to reorient both the development and disaster management sectors.

The first two steps are perhaps the most challenging. Once the human welfare gains to be made from mainstreaming disaster risk reduction within development policy are carried out, and transparent inventories of best practice are made available, advocating for policy change becomes more achievable.

For this to be done, information gaps must be filled. As we have already emphasised, there is a dearth of basic data on disaster impacts and risks at all levels from the local to the global. Problems of mapping data are made more difficult by the dynamic nature of risk. Flux in global processes, tied in particular to economic globalisation and global climate change, and changing local conditions, including rapid urbanisation, the spread of HIV/AIDS or civil conflict, mean that disaster risk is not a static condition.

In Reducing Disaster Risk: A Challenge for Development, UNDP seeks to move this agenda forward by presenting a review of state-of-the-art information on the distribution of disaster risk at the international level and an account of key development pressures and best practice in disaster risk reduction tied to development policy.

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4. Benson 2002 expert contribution.
5. Source: Munich RE 2002. Topics: annual review, natural catastrophes 2002, Munich, p. 15.
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16. Living with Risk: A Global Review of Disaster Reduction Initiatives is a major output of ISDR Secretariat published in 2003. The document represents a global review of and resource on disaster reduction initiatives. Disaster risk reduction is seen in the broader context of sustainable development. The escalation of severe disasters is seen to be imposing an increasing threat to both sustainable development and poverty reduction initiatives. It is argued that the post-disaster reconstruction period provides the most opportune time to introduce disaster reduction into sustainable development planning. Therefore, political commitment and social acceptance of the value of risk reduction are necessary for forward-looking developers who want to increase the sustainability of communities.
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18. http://www.ifrc.org/publicat/wdr/
19. See references in the bibliography from institutions in Latin America and the Caribbean, Asia and Africa.
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Chapter 2
INTERNATIONAL PATTERNS OF RISK

In order to improve understanding of the relationship between development and disaster risk at the global level, UNDP has begun development of a Disaster Risk Index (DRI).

The pilot DRI, presented in this Report, enables the measurement and comparison of relative levels of physical exposure to hazard, vulnerability and risk between countries. It also enables the identification of vulnerability indicators that point to development processes contributing to the configuration of disaster risk.

One objective of the DRI is to demonstrate the ways in which development contributes to the configuration of risk and vulnerability. Another objective is to provide quantitative evidence to advocate for the reorientation of development policy and planning in a way that contributes to the management and reduction of disaster risk.

In its present form, the DRI has been developed with a global level of observation and a national level of resolution, allowing comparison between countries with respect to three hazard types (earthquakes, tropical cyclones and floods).

These three hazards are together associated with approximately 39 percent of deaths in large- and medium-scale natural disasters at the global level. A DRI covering droughts and famines, which account for 55 percent of global deaths in large- and medium-scale natural disasters, was also developed. However, the development of the drought DRI revealed a series of unresolved methodological and conceptual challenges, which imply that its results do not yet have the required degree of confidence. Nevertheless, the exploration of these challenges in itself provides important insights into drought risk and vulnerability.

Work was also undertaken to develop a multi-hazard DRI that combined the results of the individual indices on earthquakes, tropical cyclones, floods and droughts. Given the challenges in modelling drought risk mentioned above, and taking into account the fact that drought and famine contribute more than half of global disaster deaths, we have considered it prudent not to present the multi-hazard DRI at this stage.

The DRI is a mortality-calibrated index. In other words, it measures the risk of death in disaster. Disaster mortality is only one facet of overall disaster loss and often is not the most significant. The choice of mortality was guided principally by global data availability and it is recognised that as such, the DRI provides only a partial picture of risk. Mortality is the most accurate type of data available for making international comparisons of disaster loss. It serves to open an agenda of analysis on the links between disaster and development.There is much potential for future work to investigate other indicators of impact, such as livelihood sustainability.

The development of the DRI has been guided both by the use of a conceptual model that seeks to explain physical exposure, vulnerability and risk as well as by the availability of global datasets of a suitable quality. This first version of the DRI represents only a first approximation towards applying the conceptual model on the basis of available global data. It is expected that through continually reviewing the process based on greater data availability and further refinements to the conceptual model, it will be possible to improve the DRI in the future.

This chapter is split into three main sections.

Section One presents the Disaster Risk Index (DRI). This section first presents a methodological overview and then DRI findings for the three hazard types included in this first index: earthquakes, tropical cyclones and floods.

Section Two drills down into the geography of risk and illustrates — with examples from Central America, South Asia and Africa — the complexity of hazard, vulnerability and risk patterns at the sub-national level.

Section Three discusses four recommendations for the future development of the DRI. Firstly, the need to improve data collection on disaster impact at all levels, but particularly at the sub-national level. Secondly, the need to progressively incorporate new variables into the index, through a learning process that will gradually improve its accuracy and usefulness. Thirdly, the need to measure the progress of policies targeted at disaster risk reduction, allowing the consideration of efforts made to reduce disaster risks as an indicator in the index. Fourthly, the need for the development of national level DRI — key to mainstreaming the overall recommendations of this Report into national development policy, planning and practice.

2.1 Global Risk Factors: The Disaster Risk Index

2.1.1 What is the DRI ?

The DRI enables the calculation of the average risk of death per country in large- and medium-scale disasters associated with earthquakes, tropical cyclones and floods, based on data from 1980 to 2000. It also enables the identification of a number of socio-economic and environmental variables that are correlated with risk to death and which may point to causal processes of disaster risk.

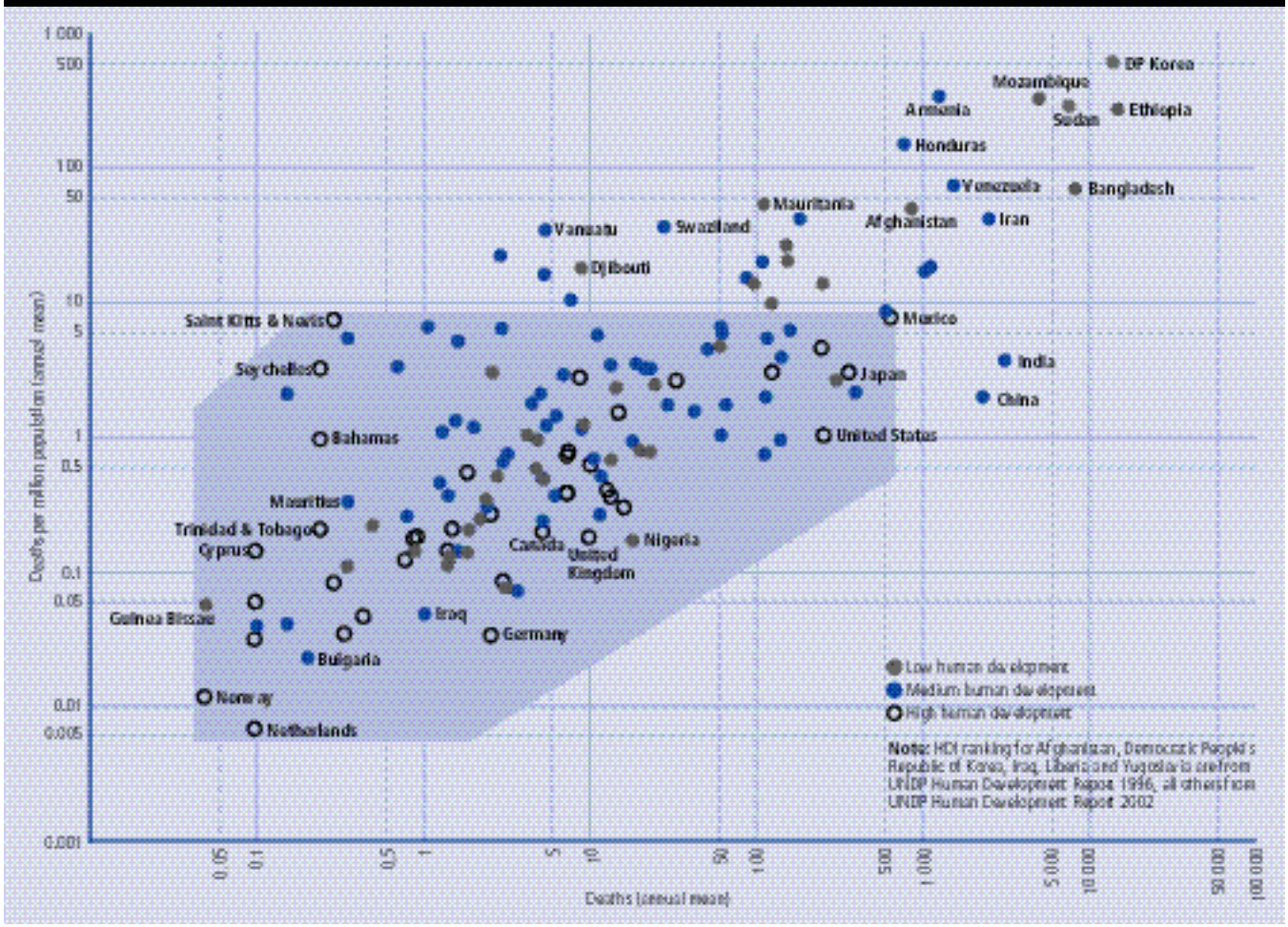
In the DRI,countries are indexed for each hazard type according to their degree of physical exposure, their degree of relative vulnerability and their degree of risk.

2.1.2 The conceptual model

Underlying the DRI is the concept that disaster risk is not caused by hazardous events per se, but rather is historically constructed through human activities and processes. As such the risk of death in a disaster is only partially dependent on the presence of physical phenomenon such as earthquakes, tropical cyclones and floods. In the DRI, risk refers exclusively to the risk of loss of life and excludes other facets of risk, such as risk to livelihood and to the economy. This is because of a lack of datasets available at the global scale with national resolution.

For an extreme physical event to be hazardous, by definition there has to be a subject to experience the hazard or the threat. For example, people, infrastructure and economic activities have to be located in an area where earthquakes occur. In the DRI, this relationship

FIGURE 2.1 DEVELOPMENT STATUS AND DISASTER DEATHS



Source: EM-DAT OFDA/CRED International Disaster Database

is expressed through the concept of *physical exposure,* referring to the number of people located in areas where hazardous events occur combined with the frequency of hazard events. Physical exposure is not an indicator of vulnerability, but is a condition *sine qua non* for disaster risk to exist. Without people exposed to hazardous events, there is no risk to human life.

Clearly however, greater physical exposure leads to greater loss of life. Assuming no change in other developmental conditions, a fivefold increase in the population living in a given flood plain would lead to a fivefold increase in mortality due to floods. Very high physical exposure in many countries reflects the concentration of population in hazard prone areas, itself a characteristic of the development process.

Physical exposure, however, is insufficient to explain risk. Countries with similar levels of physical exposure to a given hazard experience have widely differing levels of risk.

BOX 2.1 DEVELOPMENT STATUS AND DISASTER IMPACT

Figure 2.1 reveals that losses from natural disaster are tied to national development status.

While low and medium human development countries have similar loss patterns, some high human development countries occupy the bottom left-hand part of the graph. This indicates low numbers of deaths associated with natural disaster. No high human development country has recorded more than 10 deaths per million population as an annual average using data collected from 1980-2000, nor more than 600 deaths as an average in any one year. Both figures are exceeded by numerous medium and low human development countries.

This observation reinforces intuitive views about the disaster-development relationship, as discussed in Chapter 1. The aim of the DRI as presented in this chapter is to move beyond the surface view and begin a systematic examination of available data on disaster risk.

Vulnerability is the concept that explains why, with a given level of physical exposure, people are more or less at risk. In theory, vulnerability is modified by coping capacity and adaptive capacity. In the DRI,

coping and adaptation are assumed to have been active in shaping recorded risk. Vulnerability brings together all these elements of human process in a single concept.

In the DRI,vulnerability refers to the different variables that make people less able to absorb the impact and recover from a hazard event. These may be economic (such as lack of reserves or low asset levels); social (such as the absence of social support mechanisms or weak social organisation); technical (such as poorly constructed, unsafe housing); and environmental (such as the fragility of ecosystems).[1]

The way vulnerability is used in the DRI means that it *also* includes variables that may increase the severity, frequency, extension and unpredictability of a hazard. For example, deforestation may increase flood and landslide hazard in some contexts and destruction of coastal mangroves may increase cyclone hazard.Thus, those development activities that influence hazard as well as those that influence human vulnerability are represented in the DRI as vulnerability.[2]

Included in the *vulnerability* index of the DRI are also those factors that may decrease vulnerability, such as appropriate development and urban planning, and specific actions to mitigate disaster losses, such as disaster preparedness and early warning systems.

In the DRI, it is assumed that the factors that make people vulnerable to earthquakes are not necessarily the same as those that make people vulnerable to floods or cyclones. Each corresponds to particular configurations of development activities. Due to the hazard specificity of people's vulnerability, it is not conceptually possible to arrive at a global multi-hazard indicator of vulnerability. Rather the vulnerability indicators suggested by the DRI are always hazard specific.

2.1.3 The development of the DRI

The key steps involved in producing the DRI were:

Calculation of physical exposure

The DRI identified the areas exposed to each of the four hazard types (earthquakes, tropical cyclones, floods and droughts) and the population living in these areas to arrive at a calculation of *physical exposure* for each country. This is the average number of people exposed to a hazard event in a given year. Physical exposure for each hazard was mapped in a Geographical Information System. Physical exposure varies both according to the number of people as well as to the frequency of hazard events. In the DRI, physical exposure is expressed both in absolute terms (the number of people exposed in a country) and in relative terms (the number exposed per million people).

Calculation of relative vulnerability

The risk of death in a natural disaster is a function of physical exposure to a hazardous event and vulnerability to the hazard. People are more or less vulnerable to a given hazard depending on a range of social, economic, cultural, political and physical variables. The DRI has used the number of people actually killed by each hazard type in each country as a proxy for *manifest risk.* In other words, the occurrence of past disasters manifests, by definition, the existence of conditions of physical exposure and vulnerability.

The DRI, therefore, was able to calculate the relative vulnerability of a country to a given hazard by dividing the number of people killed by the number exposed. When more people are killed with respect to the number exposed, the relative vulnerability to the hazard in question is higher.

Calculation of vulnerability indicators

The DRI then examined the manifest risk for each hazard type against a bundle of social, economic and environmental indicators through a statistical analysis using a multiple logarithmic regression model. A total of 26 variables selected through expert opinion were available as global datasets and analysed for each hazard type. This enabled the selection of those vulnerability indicators that were most associated with risk for each hazard type.

A detailed description of the data sets used and the operations performed on the data is provided in the Technical Annex.

2.1.4 Limitations to the DRI

In order to understand the results of the DRI, identify the possible uses of these results and above all to avoid the very real risk of misrepresentation and misuse of the results, it is important to critically and explicitly discuss a number of key limits with respect to the data used and the analysis presented.

The DRI represents the risk of death

Disasters affect people's lives and livelihoods in many ways. Depending on the type of hazard, houses may

be damaged or destroyed, crops may be lost and land may be eroded or washed away. Social infrastructure such as schools, hospitals and community centres may be destroyed, economic activities may be directly or indirectly affected, family members may suffer from illness or injury and be unable to work or study, and lives may be lost. Therefore, the risk of mortality is only one aspect of disaster risk. Many disasters cause enormous social and economic impact without serious mortality. This is particularly so for slow-onset disasters associated with drought.

The use of deaths as a proxy for manifest risk, therefore, strictly limits the analysis of disaster risk to human development. Deaths do not capture human development losses and can only point to comparative orders of magnitude in vulnerability and loss. An economic outcome of disaster risk should complement the current approach based on human losses. Not only are disaster risk trends in industrialised countries not addressed when using mortality calibrated models, but the different economic impacts among different types of hazards skew disaster risk trends within least developed countries.

In the DRI, mortality was chosen as a proxy indicator for disaster risk because reliable data on other aspects of disaster risk (people affected, economic impact) is not available in global level disaster databases. The DRI used the EM-DAT database (see Technical Annex), the only global disaster database in the public domain. While mortality is an indicator of broader risk to human development, the DRI only represents risk to loss of life and cannot be inferred to represent other physical, social and economic aspects of risk.

The DRI examines risks associated with large- and medium-scale disasters

Disaster risk can be represented as a continuum from, at one extreme, the risk from everyday hazards (such as contaminated water supplies, poor sanitation, house fires and dangerous working and living environments) to, at the other extreme, the risk associated with infrequent catastrophic hazard events, such as major earthquakes or cyclones that devastate entire countries and regions. In between these two extremes lie the risks associated with frequently occurring small-scale hazard events (such as highly localised landslides, flash floods and debris flows) and periodic medium-scale hazard events.

Publicly available global data on disaster impact is currently only available for large- and medium-scale disaster events, defined as those involving more than 10 deaths, 100 affected and/or a call for international assistance. As the DRI is based on this data, it does not represent risk associated with small-scale and everyday disasters. At the same time, a recent study undertaken for the ISDR Working Group 3 on Risk, Vulnerability and Impact Assessment, indicates that international reporting may not be capturing all the medium- scale disaster events that occur. Nevertheless, and taking into account these data limitations, we consider that for the purposes of an Index constructed with a global level of observation and a national level of resolution, the large- and medium-scale disasters captured in international databases represent a very good sample of overall disaster risk.

The DRI represents risks associated with earthquakes, tropical cyclones and floods

At the global level, and with respect to large- and medium-scale disasters, the three hazard types analysed in the DRI (plus drought, presented here as a work in progress) account for approximately 94 percent of total mortality. Nevertheless, in individual countries, other hazards may have an important local impact and are not considered in the DRI. For example: landslides, debris flows and fires.

At the same time, primary hazards may trigger a range of secondary hazard events. Earthquakes, for example, often provoke landslides and fires and tropical cyclones cause sea surges and flooding. The DRI only represents the *primary* hazard events as recorded in global disaster databases, even when in some cases the majority of loss may be associated with a range of different hazard types triggered by the primary event.

The DRI represents disaster risk in the period 1980-2000

The DRI has been calibrated using data from the period 1980-2000 because it was considered that access to information before that period was less reliable. This, however, weights the work in favour of countries that suffered catastrophic disaster events with large loss of life in the two decades under analysis and against countries that suffered such events in the 1970s, for example, but not since then.

At an early stage, volcanic eruptions were excluded from the DRI analysis because of the need to differentiate

locally between different types of volcanic hazard. Data for such a task exists and could be compiled into an international database.

The DRI tests vulnerability indicators from available global datasets

The DRI has run statistical regression analysis comparing some 26 socio-economic and environmental variables with risk levels in order to identify possible indicators of vulnerability.

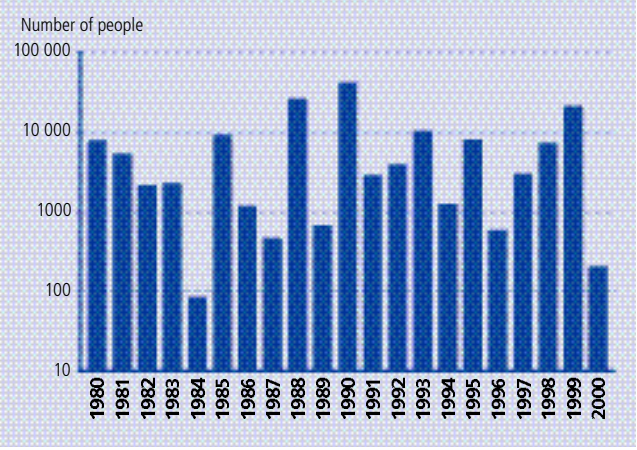
Clearly the variables that could be tested are those that were available in global datasets. This implies that there may be other variables that potentially might help build a better correlation with risk, but for which no global datasets were available at the time of production of the DRI. The choice of vulnerability indicators presented in the DRI, therefore, is limited by available data. It is hoped that in the future more direct indicators of national vulnerability might be available, for example, soil types or the proportion of earthquake resistant buildings per country for earthquake hazard.

The logarithmic base of the model can highlight long-term trends, but does not allow predictive casualties to be made. Small differences in the vulnerability indicator figures can mask major changes in disaster risk.

The DRI does not include indicators on disaster risk management and reduction

In terms of assisting the advocacy purposes of the DRI, an ongoing aim is to generate a disaster risk reduction component. National change over time or comparison between countries operating alternative risk management strategies can be used as an initial level of analysis of the comparative effectiveness of competing risk reduction strategies (including a do-nothing option). But a dedicated comparative index built up of components found to indicate risk reduction would be a clearer tool. Unfortunately, conceptual work remains to be done in identifying key indicators for multiple hazard types operating in a range of socio-political contexts.

FIGURE 2.2 PEOPLE KILLED BY EARTHQUAKES, 1980-2000



Source: The EM-DAT OFDA/CRED International Disaster Database

2.2 Hazard Specific Risk Profiles

2.2.1 Earthquake hazard

A total of 158,551 deaths were associated with earthquakes around the world between 1980-2000 (see Figure 2.2).

Iran has the highest toll of death for this period, with 47,267 people killed in earthquakes.

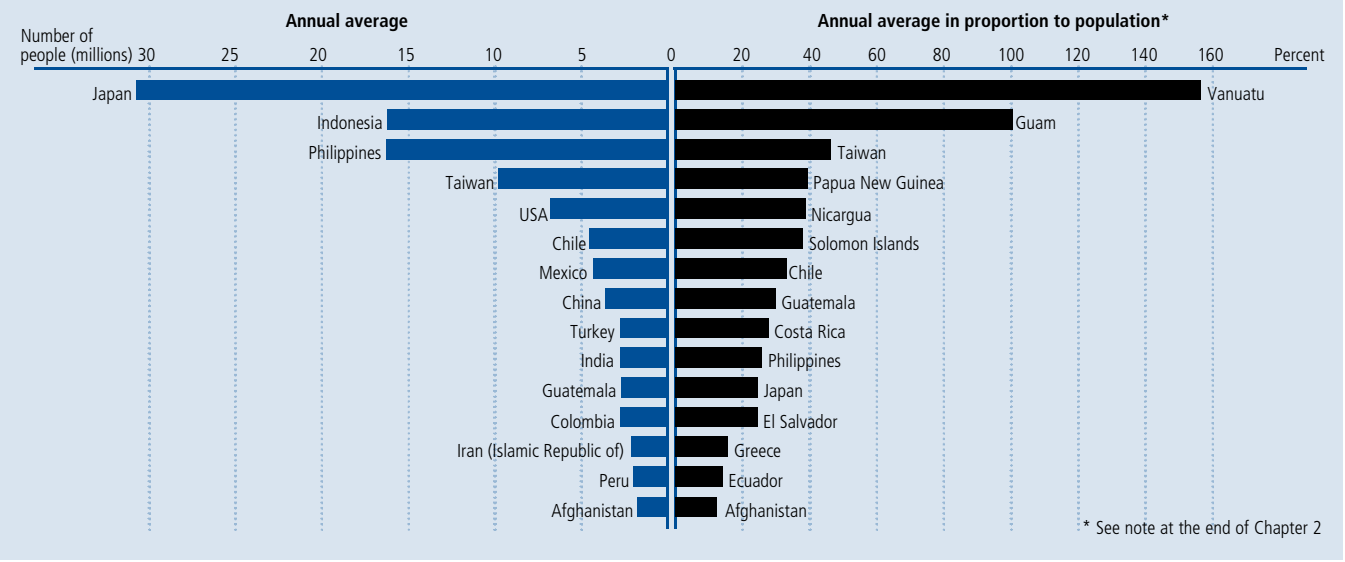
About 130 million people were found to be exposed on average every year to earthquake risk as the defined in this Report.

The left hand axis of Figure 2.3 shows the fifteen countries with the largest absolute populations exposed to earthquake hazard. Populous Asian states (Japan, Indonesia and the Philippines) top the list with the Americas (USA, Chile, Mexico), Turkey and India also included. The right hand axis displays the fifteen countries with the highest proportion of their populations exposed to earthquake hazard. Smaller island states (Vanuatu, Guam, Papua New Guinea) and Central American states (Nicaragua, Guatemala) top the list.

Comparing the size of exposed populations with the number of recorded deaths to earthquake hazard is used as a measure of relative vulnerability in Figure 2.4. Those states closest to the top left-hand corner of the graph show highest relative vulnerability.

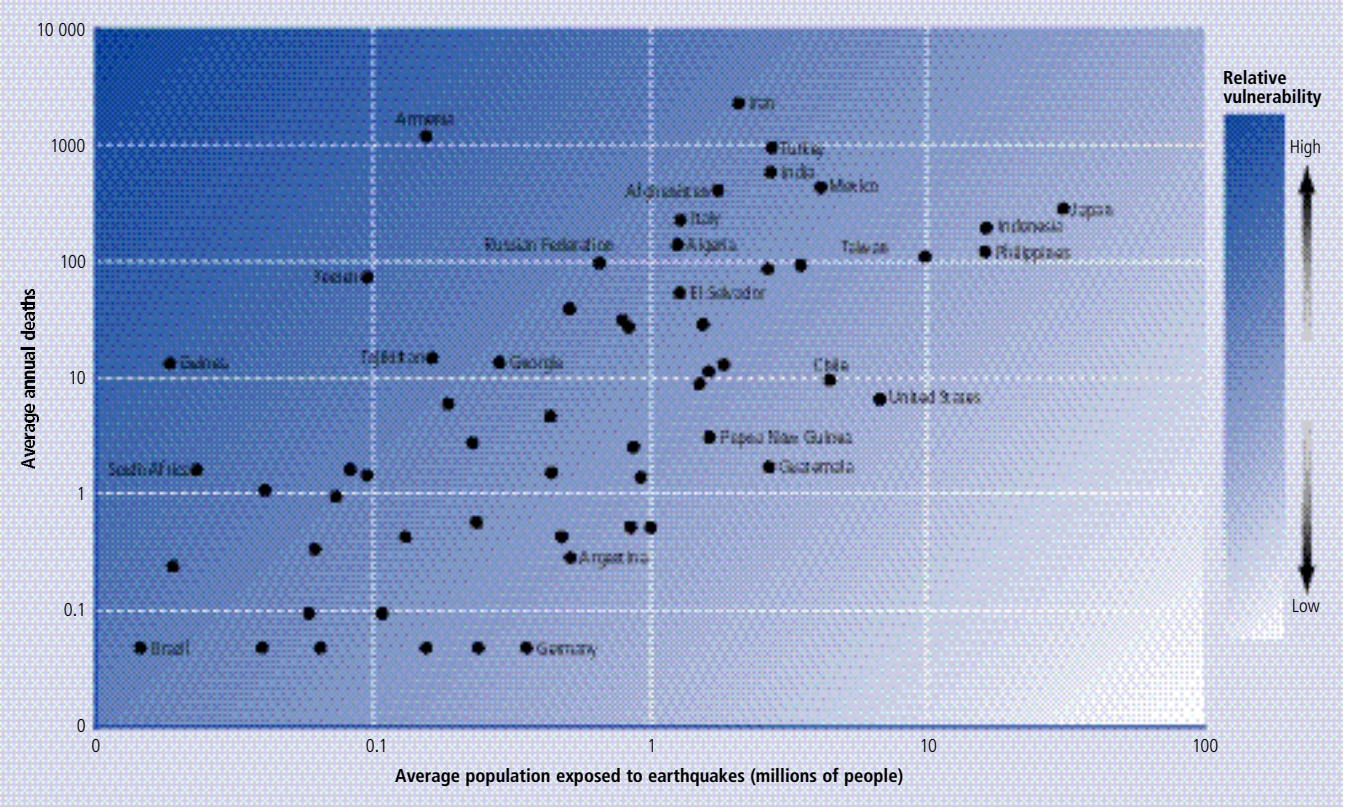
The graph represents relative earthquake vulnerability between 1980 and 2000 only. Armenia stands out as being particularly vulnerable to earthquakes due to a single major catastrophic event that occurred during the reporting period. Similarly, earthquakes are rare in Guinea, however a significant event occurred in the reporting period. In contrast, Guatemala appears far less vulnerable because the catastrophic earthquake of

FIGURE 2.3 PHYSICAL EXPOSURE TO EARTHQUAKES, 1980–2000



Source: UNDP/BCPR; UNEP/GRID-Geneva

FIGURE 2.4 RELATIVE VULNERABILITY FOR EARTHQUAKES, 1980–2000

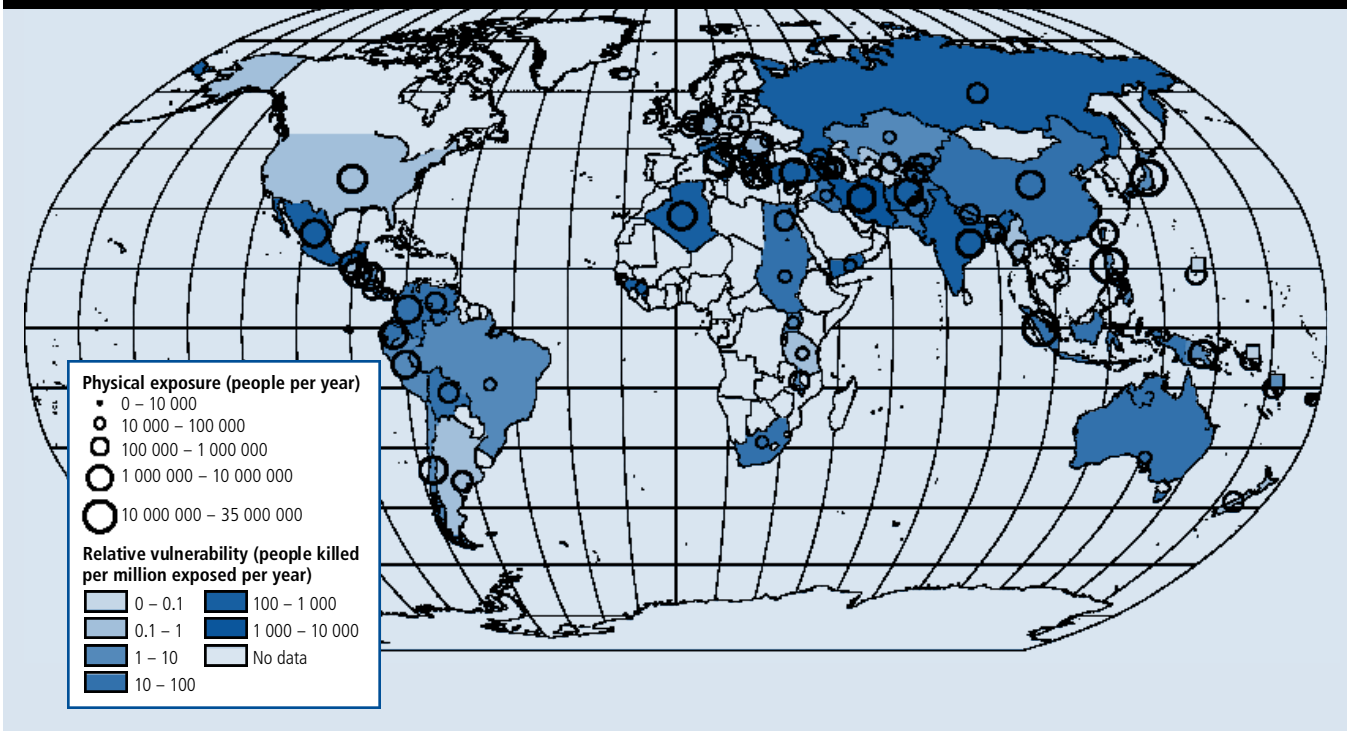


Source: The EM-DAT OFDA/CRED International Disaster Database and UNEP/GRID-Geneva

1976 occurred outside of the reporting period. China and Peru are other countries that experienced very high mortality in catastrophic earthquakes during the 1970s and therefore outside of the reporting period. The analysis, however, does show countries, such as the Islamic Republic of Iran, Afghanistan and India, which do experience frequent earthquakes suffering proportionally far higher loss of life than others, such as Chile or the United States of America.

The tight fit of countries in Figure 2.4 along an axis from the bottom left to the top right-hand corner indicates intuitively a strong correlation between the number of deaths and physical exposure. In other words,

FIGURE 2.5 PHYSICAL EXPOSURE AND RELATIVE VULNERABILITY TO EARTHQUAKES, 1980–2000



Source: Université Catholique de Louvain: The EM-DAT The OFDA/CRED International Disaster Database (victims); Council of the National Seismic System (CNSS): Earthquake Catalog (earthquakes extent); CIESIN, IFPRI, WRI: Gridded Population of the World (GPW), Version 2 (population); Compilation and computation by UNEP/GRID-Geneva

the more people living in areas exposed to earthquake events, the higher the risk of death.

Regression analysis of vulnerability indicators showed that statistically, physical exposure and the rate of urban growth acted together in being associated with the risk of death to earthquake. In other words, the risk of dying in an earthquake was greater in countries with rapid urban growth.

Urban growth does not *explain* human vulnerability to earthquakes *per se.* Rather it is particular processes and factors of urban change that characterise rapidly urbanising countries that increase human vulnerability to earthquakes. These processes and factors will vary considerably from context to context. The earthquake disasters of Turkey in 1999 and Algeria in 2003 highlighted the lack of enforcement of building regulations as a key factor in generating physical vulnerability (see Box 3.1).A study of earthquake vulnerability in Lima, Peru showed that a process of deterioration and overcrowding of inner city rental housing was the key process associated with urban growth that was generating earthquake vulnerability.[3] In the 2001 Gujarat earthquake in India, it was non-earthquake resistant structures in both rural and urban housing that proved to be a key vulnerability factor. In urban areas, the high density of dwellings increased fatalities.[4]

The fact that some countries with high urban growth rates have low relative vulnerability means that it is impossible to generalise. However, common to all the examples above is the fact that in many rapidly growing cities, earthquake risk considerations have not been factored into the building and planning process. In general, city governments have not been capable of regulating either building or settlement in a way that reduces risks. This is a key issue that will be explored in greater depth in Chapter 3.

A final representation of earthquake risk is shown in the World Map in Figure 2.5. Again, urban countries appear most at risk. (See the Appendix for data on individual countries.)

2.2.2 Tropical cyclone hazard

The term tropical cyclone used in this report includes tropical storms, hurricanes (alternatively termed typhoons, tropical cyclones or severe cyclonic storms), and super typhoons. Up to 119 million people were found to be exposed on average every year to tropical cyclone hazard and some people experienced an average

of more than four events every year. As a result,a total of 251,384 deaths have been associated with tropical cyclones worldwide, 1980-2000 (Figure 2.6). Bangladesh accounts for more than 60 percent of the registered deaths in this period while the Philippines show the highest frequency of tropical cyclones with reported deaths.

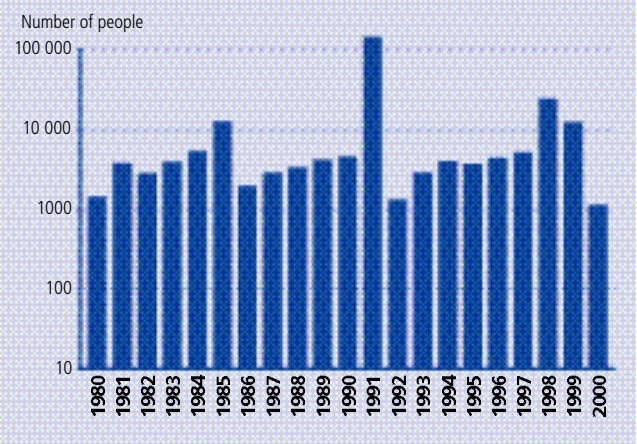
Hazard zones for tropical cyclones were based on data from the Carbon Dioxide Information Analysis (CDIAC) of the US government.

A total of 84 countries distributed over the tropics presented different levels of physical exposure to tropical cyclones (Figure 2.7). Those countries with the largest exposed populations have highly populated coastal areas and especially densely populated deltas (China, India, the Philippines, Japan, Bangladesh). Expressing exposure as a proportion of national population flagged island states and territories (Guam, the British Virgin Islands, Vanuatu, Mauritius) and the Philippines (a collection of islands).

Comparing the size of exposed populations with the number of recorded deaths to tropical cyclones is used as a measure of relative vulnerability to tropical cyclone death in Figure 2.8.Those states closest to the top left-hand corner of the graph show highest relative vulnerability.

A very large proportion of the population of Bangladesh is exposed to tropical cyclones, particularly the heavily

FIGURE 2.6 PEOPLE KILLED BY TROPICAL CYCLONES, 1980-2000



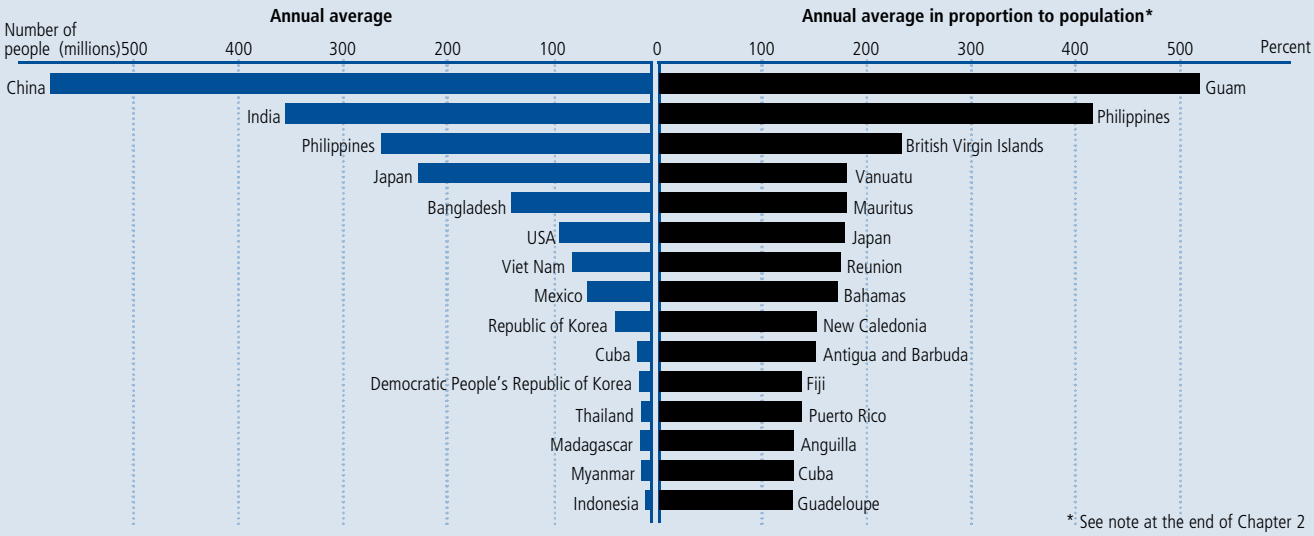
Source: The EM-DAT OFDA/CRED International Disaster Database

populated rural communities along the fertile delta at the confined head of the Bay of Bengal. The large number of recorded deaths shows that in this case high vulnerability accompanies high physical exposure.

Honduras and Nicaragua, while not among the countries with the highest physical exposure, appear as the most vulnerable countries in the period 1980-2000. This reflects the extraordinary magnitude and duration and the devastating human impact of Hurricane Mitch, which occurred in 1998.

The complexity of the hazard events associated with tropical cyclones illustrates another of the limitations of the DRI model mentioned in section 2.1.2. Much

FIGURE 2.7 PHYSICAL EXPOSURE TO TROPICAL CYCLONES, 1980–2000



Source: UNDP/BCPR; UNEP/GRID-Geneva