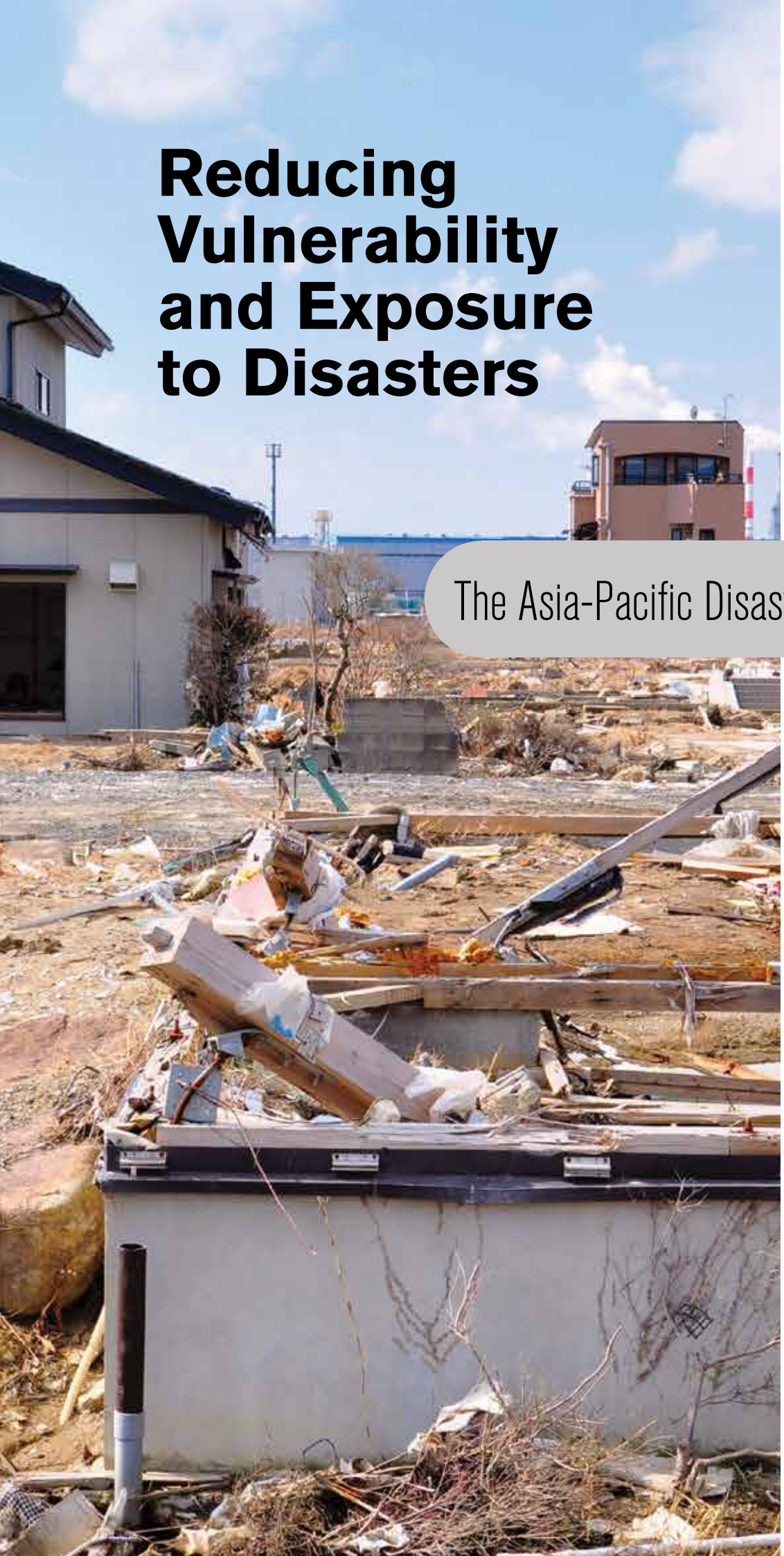
Reducing Vulnerability and Exposure to Disasters



The Asia-Pacific Disaster Report 2012

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

UNISDR
The United Nations Office for Disaster Risk Reduction

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The Economic and Social Commission for Asia and the Pacific (ESCAP) promotes regional cooperation for inclusive and sustainable economic and social development in Asia and the Pacific, a dynamic region characterized by growing wealth, diversity and change, but also challenged with persistent poverty, environmental degradation, inequality and insecurity. ESCAP supports member States with sound strategic analysis, policy options and technical cooperation activities to address key development challenges and to implement innovative solutions for region-wide economic prosperity, social progress and environmental sustainability. ESCAP, through its conference structure, assists member States in forging a stronger, coordinated regional voice on global issues by building capacities to dialogue, negotiate and shape the development agenda in an age of globalization, decentralization and problems that transcend borders. A key modality for this strategy is the promotion of intraregional connectivity and regional integration.

The International Strategy for Disaster Reduction (ISDR) is a strategic framework, adopted by United Nations Member States in 2000, aiming to guide and coordinate the efforts of a wide range of partners to achieve substantive reduction in disaster losses and build resilient nations and communities as an essential condition for sustainable development.

The United Nations Office for Disaster Risk Reduction (UNISDR) is the secretariat of the ISDR system. The ISDR system comprises numerous organizations, States, intergovernmental and non-governmental organizations, financial institutions, technical bodies and civil society, which work together and share information to reduce disaster risk.

UNISDR serves as the focal point for the implementation of the Hyogo Framework for Action (HFA) – a ten year plan of action adopted in 2005 by 168 governments to protect lives and livelihoods against disasters.

Preface

For many in Asia and the Pacific, 2011 will be remembered as a year of large-scale disasters with devastating impacts on economies, communities and above all the lives of people across our region.

The Great East Japan Earthquake, tsunami and the ensuing nuclear disaster, as well as the Southeast Asian floods, which so severely affected Thailand, were major contributors to the staggering $294 billion in regional economic losses – representing 80 per cent of global losses due to disasters in 2011.

Disasters can affect developed and developing countries in equal measure. Yet risk accumulation, spurred by rapid economic growth, remains only partially understood. We are still working to identify the ways in which different components of risk - hazards, vulnerability and exposure - interact to increase total risk, and trigger damage.

One of the most positive developments, however, is that, despite greater frequency of these events and increased damage to property and livelihoods, the death toll from such disasters as typhoons, floods and landslides in some subregions is decreasing. This is a significant accomplishment, and proves that better disaster risk management - investing in early warning systems, preparedness and social safety nets – saves lives. Economic development creates resilience when invested to reduce the vulnerability of people and communities.

Collective actions can mitigate disasters, and protect our populations, but we are in a race against time. Exposure to disaster risk is growing faster than our ability to build resilience. Economic losses are rising, and communities are continually threatened. Rapid regional economic growth is also partially responsible for the rapid growth of disaster exposure.

In Asia and the Pacific, over the past four decades, the average number of people exposed to annual flooding has increased from 29.5 to 63.8 million, whilst populations in cyclone-prone areas have grown from 71.8 million to 120.7 million. The region also represents more than 85 per cent of global economic exposure to tropical cyclones - pointing to a pattern of economic growth in typhoon prone coastlines and flood plains.

When disasters hit, it is private citizens and communities who pay the highest price. In 2009, when Typhoon Ketsana caused damage of $58 million in the Lao People's Democratic Republic, 50 per cent of the losses were borne by small farmers. In the Philippines, the same typhoon caused damage of $4.3 billion - 90 per cent of which were borne by poor urban households. Seventy per cent of the $9.7 billion in flood damage in Pakistan in 2010 was borne by poor households and small farmers.

These figures highlight the ways in which socio-economic vulnerabilities are interlinked. As economies falter, social spending is threatened. It is the poor, and particularly women, children, the elderly and the disabled, who

are the most vulnerable - first through direct losses and again through subsequent fiscal adjustments. It is therefore crucial that every effort be made to protect development gains which benefit the poorest and most vulnerable. While they are the hardest hit in a disaster, vulnerability can increase for everyone in a community.

Our shared challenge is to control both the growing rate of exposure and rising vulnerability. Exposure to hazards has multiplied as urban centers grow and people and economic activities expand into increasingly exposed and hazard-prone land. It is also a concern that smaller economies, those that have less diversified economic structures, and countries with high fiscal deficits, show greater strains of vulnerability even when faced with relatively small-scale disasters.

Land use and urban planning, ecosystem management and disaster recovery – the very tools devised to deal with exposure to risks - are not yielding the desired results. Globalization of supply chains means that any disruption to a single node of production may lead to a breakdown of the entire production chain, as happened in 2011 Thai floods and the Great East Japan Earthquake. And, in the developed countries of the Asia-Pacific region, where prosperity should be used to address the many downsides of economic growth, disaster losses are growing most rapidly.

There are, however, some outstanding efforts being made to reverse these trends. Bangladesh's investment of more than $10 billion in the past 35 years in disaster risk reduction has resulted in lower disaster losses. It is one of only a handful of countries in the region to have done so. China is another, with its 2011-2015 Comprehensive Disaster Prevention and Reduction Plan which aim to reduce disaster losses annually to less than 1.5 per cent GDP through investment measures across government sectors.

Bangladesh, India, Pakistan, the Philippines and Thailand have shown that well-targeted social protection measures are not only affordable but that they also reduce vulnerability to a great extent. Innovative technologies in information, communication and space-based applications have been put to good use by several countries to fill critical gaps in the information supply chain.

This report demonstrates that countries increasingly embrace the view that minimizing disaster risk is essential for achieving sustainable development. Many have started to take action - building the resilience of people and communities. One of the key Rio+20 outcomes is stronger political commitment and recognition that disaster risk reduction and building resilience need to be addressed with a "renewed sense of urgency in the context of sustainable development and poverty eradication". The disasters of the past two years have defined the consequences of failing to fully apply the combined tenets of disaster risk reduction and sustainable development. - it is now time to act.

We are pleased, therefore, to present the *Asia-Pacific Disaster Report 2012: Reducing Vulnerability and Exposure to Disasters*, to the ministers, policymakers and other participants at the Fifth Asian Ministerial Conference on Disaster Risk Reduction in Yogyakarta, Indonesia. We believe these findings will prove useful in the pursuit of sustainable development and in the implementation of future disaster risk reduction agendas. Our organizations, and those other dedicated partners with whom we work, look forward to joining you in making a safer and continuously prosperous Asia-Pacific region.

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Abbreviations

ACF	Autocorrelation Function
ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Centre
ADRRN	Asia Disaster Reduction and Response Network
AEL	Annual Expected Loss
AIDS	Acquired immune deficiency syndrome
AIMS	Aid information management systems
ARIMA	Autoregressive integrated moving average model
ASEAN	Association of Southeast Asian Nations
BNPB	Badan Nasional Penanggulangan Bencana
CADRI	United Nations Capacity for Disaster Reduction Initiative
CAPRA	Central American Probabilistic Risk Assessment
CCA	Climate change adaptation
CDO	Cagayan de Oro
CEIC	CEIC Data Company Ltd
CMR	Colombo Metropolitan Region
CODI	Community Organizations Development Institute
CRED	Centre for Research on the Epidemiology of Disasters
CRPD	United Nations Convention on the Rights of Persons with Disabilities
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAD	Development Assistance Database
DM	disaster management
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EIA	Environmental Impact Assessment
EM-DAT	Emergency Events Data Base/The International Disaster Data Base
EIU	Economist Intelligence Unit
EO	Earth observation
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
ESSAF	China Wenchuan Earthquake Recovery Project, Environmental and Social Safeguards Screening and Assessment Framework
FROC	Flood Relief Operation Centre
GAR	Global Assessment Report on Disaster Risk Reduction
GCMs	Global Climate Change Models
GDP	Gross Domestic Product
GEM	Global Earthquake Model
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic information system
GISTDA	Geo-Informatics and Space Technology Development Agency
GIZ	German Agency for Technical Cooperation
GLOF	Glacial Lake Outburst Flood
GPS	Global Positioning System
GTS	Global Telecommunication System
HDD	hard disk drive
HIV	Human Immunodeficiency Virus
HFA	Hyogo Framework for Action
IBP	International Budget Partnership

ICIMOD	International Centre for Integrated Mountain Development
ICT	information and communications technology
IFRC	International Federation of Red Cross and Red Crescent Societies
IP	Internet Protocol
IPCC	Intergovernmental Panel for Climate Change
IPCC-AR4	Intergovernmental Panel for Climate Change Fourth Assessment Report
IPCC-SREX	Intergovernmental Panel for Climate Change Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
ITU	International Telecommunication Union
IUCN	International Union for Conservation of Nature
IULA	International Union of Local Authorities
JAXA	Japan Aerospace Exploration Agency
JCCB	Japanese Chamber of Commerce Bangkok
JETRO	Japan External Trade Organization
LDCs	Least Developed Countries
LLDCs	land-locked developing countries
LECReD	Low Emission Climate Resilient Development
MDGs	Millennium Development Goals
mGNSS	Multi-Global Navigation Satellite Systems
MODIS	Moderate Resolution Imaging Spectroradiometer
MTPIP	Medium Term Philippine Investment Plan
NAP-DRR	National Action Plan for Disaster Risk Reduction
NASA	National Aeronautics and Space Administration
NCMRWF	National Centre for Medium Range Weather Forecasting
NDMA	National Disaster Management Authority
NFPP	National Framework for Physical Planning (Philippines)
NGO	Non-Government Organization
NMHSs	national meteorological and hydrological services
ODP	Ozone-Depleting Substances
OFDA	Office of the United States of America Foreign Disaster Assistance
OOSA	United Nations Office for Outer Space Affairs
PACF	Partial Autocorrelation Function
PCGIAP	Permanent Committee on GIS Infrastructure for Asia and the Pacific
PDNA	Post-disaster Needs Assessments
PNT	positioning, navigation and timing
RESAP	Regional Space Applications Programme for Sustainable Development
R&D	Research and Development
RIMES	Regional Integrated Multi-hazard Early Warning System
RS	Remote Sensing
SAARC	South Asian Association for Regional Cooperation
SARS	Severe Acute Respiratory Syndrome
SDGs	sustainable development goals
SDP	Strategic Development Plan
SEF	Strategic Environmental Framework
SIDS	small island developing States
SME(s)	small and medium-sized enterprises
SNAP	strategic national action plan
SUPARCO	Space and Upper Atmosphere Research Commission
TED	Twitter Earthquake Detection
THB	Thai baht
UN-APCICT	United Nations Asia Pacific Training Centre for Information and Communications Technology for Development
UNCTAD	United Nations Conference on Trade and Development
UNDAF	United Nations Development Assistance Framework
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Organization

UNEP	United Nations Environment Programme
UNEP/GRID	United Nations Environment Programme/Global Resources Information Database
UN-HABITAT	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNITAR	United Nations Institute for Training and Research
UNOCHA	Office for the Coordination of Humanitarian Affairs
UNOSAT	United Nations Operational Satellite Applications Programme
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VoIP	Voice over Internet Protocol
VSAT	very small aperture terminal
WDI	World Development Indicators
WFP	World Food Programme

The symbol "$" stands for United States dollars unless otherwise indicated.

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Executive Summary

The past two years have been challenging ones for the Asia-Pacific region in several respects, but 2011 has been particularly unforgettable for how it has focused the attention of so many people on the crucial matters of life, death and loss. The Great East Japan Earthquake and devastating tsunami, the ensuing nuclear disaster which it provoked, and then the Southeast Asian floods that severely affected South-East Asia, particularly Thailand, were major contributors to the staggering $294 billion in losses from disasters suffered by States in the region during 2011. This amount was 80 per cent of the annual global disaster losses of $366.1 billion; it is even more striking that the region's single year losses were also 80 per cent of its total disaster losses from the decade 2000-2009.

These are stark reminders of the unmitigated growth of accumulated disaster risks that affect the socioeconomic conditions of developing countries, as well as threatening the economic assets of wealthier developed economies. Many leaders and much of the public are still struggling to understand how the various components of risk - hazards, vulnerability and exposure - interact to increase the region's total risk and continue to trigger ever-greater losses. It has also become disturbingly evident that rapid economic growth alone does not result in reducing vulnerabilities sufficiently, but actually creates even greater conditions of public exposure to a growing variety of disaster risks.

Development contributes to reducing vulnerability

The Asia-Pacific region is the most disaster-prone area of the world and it is also the most seriously affected one. Almost 2 million people were killed in disasters between1970 and 2011, representing 75 per cent of all disaster fatalities globally. The most frequent hazards in the region are hydro-meteorological, which also affect the most people. Since 2000, more than 1.2 billion people have been exposed to hydro-meteorological hazards alone, through 1,215 disaster events, compared to the 355 million people exposed to 394 climatological, biological and geophysical disaster events during the same period.

The effects of climate extremes and variation suggest that while the number of tropical cyclones (typhoons in Asia and the Pacific) are not increasing in number, more of them are stronger, making the region more susceptible to greater potential losses. This also becomes more serious because of the human contributing factors involved, with more people being exposed to the risk of tropical cyclones.

The encouraging news is that despite the increases in both physical and economic exposure, the loss of life is decreasing from hydro-meteorological hazards in some subregions, such as in East and North-East Asia. This can be attributed to improved development conditions and shows the impact of investments made in early warning and preparedness. Unfortunately elsewhere, when equivalent development benefits either don't exist or are not sufficiently inclusive, the vulnerabilities of people continue to rise.

People and Governments alike are still struggling to understand how the various components of risk - hazards, vulnerability and exposure - interact to create recurrent disasters. The region has been slow to be concerned by how the growth of disaster risks has

been spurred by rapid economic growth, and the means to minimize those risks while also striving for sustained economic prosperity.

For example, from 1970 to 2009, the mortality due to small-scale disasters in the Lao People's Democratic Republic and Indonesia has continued to rise. In other countries with less preventive capacity, small and medium-scale disasters are equally destructive because of their cumulative effects, which can even exceed damage from single large-scale disaster events. This suggests that the intended developmental benefits from early warning and preparedness realized in some countries are not as evident in areas where capacities are more limited or without sufficient resources.

Development contributes to expanding exposure

Recent observations and a growing body of analysis are now recognizing that when combined with the demographic characteristics of the region, the main driver of risk is the growing socio-economic exposure to natural hazards. The population of the region has increased from 2.2 billion to 4.2 billion people between 1970 and 2010, but the average number of people exposed to annual flooding has more than doubled from 29.5 to 63.8 million; the number of people residing in cyclone-prone areas has grown from 71.8 million to 120.7 million.

In addition to this absolute increase in human exposure to natural hazards, economic losses resulting from disasters also continue to rise. Global GDP has more than tripled from 12.4 to 40.2 trillion dollars (in constant 2000 US dollars), while the Asia-Pacific GDP has grown by four and a half times during the same period. Trends in economic exposure are increasing for nearly all subregions and for all hazards.

While this rising economic exposure is even greater in the relative terms cited, disaster losses also grew. Relative to growth, disaster losses increased by 16 times since 1980 while GDP per capita grew 13 times over the same period. Most of the largest losses have occurred in middle-income countries and well-developed economies, which indicates that a larger proportion of the growing economies remain at risk despite the availability of more capital assets. This confirms that while rapid economic growth in the region has increased so has the prevailing exposure to disasters. The region has yet to commit adequate resources to reduce disaster risks and protect the development gains made possible by sustained growth.

Economic exposure is particularly alarming for the frequently occurring hydro-meteorological hazards. The Asia-Pacific region experiences more than 85 per cent of global economic exposure to tropical cyclones. The economic exposure to floods in East and North-East Asia has increased ten-fold within the past 40 years, while East and North-East Asia represents 85 per cent of global economic exposure to rain-triggered landslides. These facts point to a pattern of recent growth where most new development in the region has been along coastlines and in floodplains, locations highly exposed to natural hazards.

The damage and loss assessment figures of the 2011 Thailand floods reveal that almost 90 per cent of the losses were located in floodplains along the Chao Phraya River. That river basin covers 30 per cent of Thailand's land area where 40 per cent of the population lives. As the river approaches Bangkok, it also concentrates much of the 66 per cent of the national GDP and includes the locations where 78 per cent of the people work.

The exposure and vulnerability to hydro-meteorological hazards also continue to rise for urban settlements in developing countries of the region. This has been accentuated as the population living in Asian urban areas has increased from 17 per cent of the total population to 44 per cent between 1950 and 2010. The percentage of urban population will likely reach 64 per cent by 2050. Among the 305 urban agglomerations presently in the Asia-Pacific region 119 are situated in coastal areas. Not surprisingly, the primary urban agglomerations with the highest concentrations of people mostly overlap with the areas of extreme or high mortality risk related to disasters.

Unless sustained efforts are pursued and corresponding investments made, urban growth will continue to increase disaster exposure. As an example, even though the number of reported household fires has decreased in the Odisha state of India between the periods of 1980-1990 and 2000-2010, the extent of the distribution of the fires has spread following urban growth. Although many people seek the benefits that urban life brings to them in terms of various services, the type of growth pursued by a city often creates vulnerabilities and expands exposure to disaster risks.

Investing in disaster risk reduction can reduce vulnerability

Economic vulnerability to disaster depends significantly on a country's economic structure and fiscal dynamics as well as on the overall size of the economy. Generally speaking, smaller and less diversified economies are more vulnerable to disaster risks. For example, Maldives lost more than 60 per cent of its GDP because of the Indian Ocean Tsunami in 2004, postponing its emergence from being categorized as a Least Developed Country for five years. In Pakistan, the estimated damage resulting from the 2010 floods was close to $10 billion representing 5.8 per cent of the country's 2009/2010 GDP. The damage was particularly debilitating as at the time the country was already struggling to regain fiscal stability following multiple shocks it endured in 2007 and 2008.

A crucial question that all concerned decision makers in the region need to ask is, "Who pays for these disaster losses?" Assuming that disaster relief, reconstruction and recovery expenditures are much less than the losses incurred, it is evident that it is the private sector, and particularly marginal farmers, small-scale entrepreneurs and poor urban households, who largely shoulder the greatest losses. After Typhoon Ketsana struck the Lao People's Democratic Republic in 2009 causing $58 million in damage, 55 per cent of the losses were borne by small and marginal farmers. In the Philippines, the same typhoon caused $4.3 billion in damage with 90 per cent of the losses sustained by poor urban households. In Pakistan, the 2010 floods caused $9.7 billion in losses, with 70 per cent absorbed by poor households, small and marginal farmers.

This matter of the inequitable distribution of losses from disasters highlights how closely economic and social vulnerabilities are linked. As economies falter, it is the poor and the most vulnerable segments which are further threatened, as countries are forced to balance budgets and to reduce fiscal expenditures.

Specific segments of the population are especially vulnerable to disasters. Women and children, people with disabilities and elderly members of a community are all affected to a greater degree by disasters. They have different needs, but also some unique abilities, too, which actually could be employed better to reduce disaster risks than most countries have contemplated. Typically, little concerted effort has yet been made to address the particular needs of populations that are highly vulnerable to disasters. While some initiatives are in place to serve the needs of vulnerable people, there is much more that can be accomplished.

There are some examples in the region that demonstrate efforts to provide better social protection measures can also contribute to reducing disaster risk. They are effective, and they can also be affordable, but they are not widespread. Considering the sound macroeconomic fundamentals that are the hallmark of policy management in the region, many countries may be able to afford a minimum level of universal social protection coverage that ranges from 1 to 3 per cent of gross national income. Targeted social protection measures such as supplementary incomes, in-kind transfer programmes at times of crisis, subsidies for urgent needs or recovery efforts and labor-intensive public works programmes have shown merits for Asian and Pacific populations. Examples of these types of programmes have been implemented in Bangladesh, India, Indonesia, the Philippines and Thailand among others, but they still remain greatly under-utilized.

Rapid urbanization expands exposure to hazards, and it also increases people's vulnerability, especially among the poor. In 2011, 10 of the world's 20 megacities were located in the Asia-Pacific region. The most rapid urbanization is proceeding in some of the poorest countries with the least public urban infrastructure like drainage, disaster-resilient housing or even access for effective firefighting that are needed to minimize disaster risks. When combined with the dense spatial concentration of the poor in the region's megacities, a marked increase in vulnerability results. Case studies of the Thailand floods and the flash floods in Cagayan de Oro, Philippines found that the urban poor were overwhelmingly more affected by these urban floods, compared to the overall population.

Disasters can impede and even roll-back achievement of the Millennium Development Goals (MDGs). The years of implementing MDGs and the Hyogo Framework for Action (HFA) have resulted in considerable progress in reducing development disparities and the risk of disasters, respectively. As each agenda has matured and become more widely accepted throughout countries and across development sectors, a greater appreciation of their synergy has emerged among many policymakers. Notwithstanding this progress, there is growing evidence that disaster costs are increasing. The impacts are more direct in lower- and middle-income

countries that are affected by large-scale disasters, where disaster risks are high and progress towards MDGs is slow.

Targets can stimulate investments in disaster risk reduction

Evidence exists that investing in disaster risk reduction (DRR) can reduce vulnerability to disasters, but means to ensure that those investments are made within the development portfolios of Governments across the region remain more problematic.

Government investments in DRR actually are increasing, but the trends in the continuous growth of exposure and vulnerabilities to disasters indicate that more needs to be done. There have been some positive efforts to reconsider previous approaches with good effect. The amount of DRR investments by the Government of Indonesia have grown from less than 0.6 of the Government's total budget in 2006 to more than 1 per cent by 2012. Bangladesh has invested more than $10 billion during the past 35 years, resulting in a current decline in disaster losses. China's Comprehensive Disaster Prevention and Reduction Plan (2011-2015) envisages increased investments to reduce disaster losses to a level of less than 1.5 per cent of GDP annually by implementing comprehensive measures across government sectors.

By setting targets, as China and Bangladesh have done to motivate measurable decreases in economic losses or reductions in vulnerability indicators, there is promise for fostering future Government investments in DRR. Measurable outcomes can assist decision makers in determining needed resources and the mix of investments to achieve particular objectives. They also allow wider latitude in considering a combination of risk mitigation, risk reduction, and risk transfer measures over a targeted period of time.

Ecosystem management, land-use planning, supply chain management, and disaster recovery have the potential to reduce exposure

The increasing disaster risks in Asia-Pacific are driven by the increasing exposure of its people and economic assets. There are many contributing factors to these developments, but five primary conditions have been considered because of significant opportunities to manage them for multiple benefits. They address particularly the communities of practice involved with ecosystem management, spatial and land-use planning, financial investment in disaster risk management, global supply chain management and post-disaster recovery.

Ecosystem services support human life and provide the basic materials for economies, such as food, fuel and clean water. Demand for ecosystem services from rapidly growing economies and populations, and the perceived low economic value attributed to these services, have led to the increased, and often wasteful use of natural resources. For example, despite an estimated 668 million people affected by drought, the water intensity for most Asia-Pacific sub-regions far exceeds the global average.

Experience from the region shows that when resource-intensive development issues are addressed, such as by integrating ecological costs in water pricing in Singapore, the outcome is the assured availability and quality of water while effectively addressing the problem of water scarcity. Recognizing the value of ecosystem services, improving the efficiency of use of natural resources, and good land-use management and planning are mechanisms that can be used to foster the interrelated benefits of linking DRR with other development needs.

Countries in Asia and the Pacific demonstrate a high level of sensitivity to different types of risk, and there are varying degrees to which individual countries are sufficiently attentive when it comes to land use and spatial planning processes. Considering how much of an impact this has on exposing people and economic assets to risks, the actual investments in risk reduction in this area are not routinely correlated or proportionate to the relative exposure of communities. One issue that highlights this situation is the finding that in the Asia-Pacific region, most countries have not established national spatial or land-use plans; instead, countries have merely adopted a national land-use policy, legislation or only local land-use plans.

Most land-use plans are risk-sensitive with elements of hazard identification, exposure and vulnerability assessments incorporated in the planning processes. Although these plans are strong on intent, they frequently lack means to enable their implementation. For example, none of the planning documents reviewed in preparation of this report has integrated capacity assessment information as a basis for policy formulation; none of the national spatial plans has used disaster damage and loss estimation as a basis for planning.

Another driver of disaster exposure in the region is the increasing risks of supply chain disruptions caused by disasters. Driven by trade and investment liberalization and continued cost reduction pressures from customers, businesses have been extending their activities worldwide; in the process of doing so, they are also expanding their exposure to disaster risks. Disasters caused by natural hazards are one cause of disruptions to supply chains, even when the disaster may occur in another part of the world from where its impact is eventually felt. This is now understood as having the potential for serious economic impacts on another country's economy.

The Great East Japan Earthquake and following tsunami in March 2011 disrupted automobile production of neighbouring countries. As the economy of Japan is highly integrated into the world economy, both direct and indirect supply disruptions caused by the disaster were experienced elsewhere. Japanese automobile production and electrical component production declined by 47.7 per cent and 8.25 per cent respectively, and repercussions were felt in other Asian countries. The 2011 Thailand floods tripled the global cost of computer hard drives, as the reduced production capacity in Thailand caused significant impacts in other countries through global supply chains.

Other features that can reduce exposure to the risks of future disasters are various post-disaster recovery measures. Experience shows that most post-disaster needs assessments have difficulty translating risk reduction intentions into firm decisions and expedient action by individuals, businesses and various levels of government. Turning proposed agendas into practice requires that Governments and development partners maintain the commitments and sense of urgency, more typically reserved for emergency response, and apply them to recovery strategies that internalize risk reduction principles.

It is now widely recognized that disaster recovery planning can reduce exposure to future hazards. In one recent example, following the Great East Japan Earthquake, the national Government issued the Basic Act for Reconstruction and Basic Guidelines for Reconstruction. Part of these guidelines at the municipal level involves land-use planning to relocate communities, and communities rebuilt residential housing in safer areas to protect residents from future tsunamis.

Disaster recovery can stimulate efforts to revisit laws and policies, which can improve resilience. An increasing number of recovery frameworks and strategies focus on re-evaluating and strengthening existing laws and procedural arrangements. This allows recovery efforts to address weaknesses in development processes to reduce risk for future disasters. It also encourages recovery planning to draw on changed attitudes in local government and the community itself to seize opportunities to make changes a reality. In New Zealand following a series of destructive earthquakes in the Canterbury region, the Canterbury Earthquake Recovery Authority developed a recovery strategy designed to guide the rebuilding and recovery of the city and the area of greater Christchurch with the explicit intention to reduce the risk consequences of future earthquakes.

The process to reduce disaster risks is non-linear, with explicit actions

The present report emphasizes the need to move from informed intentions to sustained actions in reducing risks from disasters. However, it is process with many specific objectives, multiple starting points and various directions depending upon the combination of actors engaged and resources that are available. In different working and implementing environments this can result in uncertainty about how actions can be facilitated and what enables them to proceed to effective conclusion. Given initial commitments, there may even be issues regarding "how to do" DRR. While the HFA provides basic foundation guidance, some of the important elements have been reviewed in this report. Primary features such as legislative and policy frameworks, decentralization of authorities and capacities, assignment and engagement with recognized accountabilities reflect the contexts and implementation particularities of countries in the region.

For legal frameworks specifically addressing DRR it is clear that so far, intentions and generalized assent has been more evident than explicit and firmly institutionalized action. For example, countries report that the first HFA priority area for action, "making disaster risk reduction a policy priority, institutional strengthening," has progressed the most. However, dealing with underlying risk factors is the weakest element of DRR laws in the region. This means that the gap between "intended policies and actual practice" may be more a matter of insufficient focus on the knowledgeable implementation of practical and local action, than being the result of a more common explanation of "administrative or bureaucratic delay".

Both policies seeking to reduce risks and adapting to climate change are becoming more integrated or "mainstreamed" into long-term development plans in

the region. Although more than a third of the countries surveyed have explicitly considered both DRR and climate change adaptation (CCA) in their respective long-term development strategies, frequently these professional domains have been treated separately. One noteworthy exception is Bangladesh's Outline Perspective Plan, which distinguishes itself by effectively integrating DRR and CCA into national development strategies as complementary and related concerns.

There is no straight or specifically patterned "direct line" in the development of DRR legislation or policy or the subject's subsequent integration into strategic national planning. Countries develop and adopt instruments that fit their specific needs without necessarily going through a sequential and comprehensive process. However, among the 47 countries and areas analyzed, only 10 countries have available laws and policies on DRR and development plans that cover both DRR and CCA. Only one of the countries reviewed, Viet Nam, has DRR legislation, a DRR plan projected over a long term, and DRR and CCA issues fully integrated into the national development plan.

Similarly, there are different approaches to risk governance in the Asia-Pacific region. In several countries, there is an evident effort to apply the benefits derived from decentralized activities into managing disaster risks. However, the intended reforms and tangible arrangements for decentralization have not yet proven to be as effective as planned. Work continues to expand the still partial reforms in policies, frameworks, legislation, institutions and financing. In some instances, this includes the lack of predictable budgetary allocations corresponding with the extent of assigned responsibilities, and gaps in knowledge and information management. Individual efforts to undertake DRR decentralization in isolation or as single projects have not proven to be effective without a more comprehensive reform agenda.

The non-linearity of how to reduce risks is also addressed in the growing practice of adaptive governance, which reflects the ability of governance systems to recover from shocks, making transformative change possible following a disaster. Adaptive governance approaches include procedural mechanisms and institutional capacities to monitor early warning indicators and the impacts of specific interventions, and to promote learning by drawing upon knowledge from different types of sources, such as those from indigenous communities and satellite systems. The growing examples from the region focus on learning to manage new climate risks in agriculture, building sustainable human settlements, managing critical ecosystems and sharing scarce water resources.

Innovative technologies offer new possibilities to reduce disaster risks

Among a wide range of innovative technologies, information and communications technology (ICT) and space applications represent particular potential to advance DRR capabilities. These technologies reveal what is at risk within local areas as well as nationally or wider geographical areas such as river basins. Their many possible applications can address the exposure of physical economic, social, cultural and environmental assets. These techniques were used with considerable effect during floods in Pakistan and Thailand. The technology also demonstrates a unique ability to detect, evaluate and monitor hazards and localized risks in isolated or high risk areas, such as in mountainous terrain.

Innovative technology is also being used to save lives and property through early warning, crowdsourcing, and supply chain management applications. Decision makers can use satellite imagery for assessing and monitoring impending hazards and then use the information to save lives and property as the crisis escalates.

Social and networking media, and the rapidly evolving phenomenon of crowdsourcing, offer yet-unrealized opportunities for wider applications related to disaster risks and especially at times of disasters. Internet, Facebook and Twitter have all assumed extensive and previously unconsidered roles for exchanging essential information across many domains and subject interests, from the personal to the technical, in both official governmental and civil society capacities.

Access to the products and services emanating from these innovative technologies assumes increasing importance, especially in the areas of disaster preparedness, response, relief and recovery, which are all dependent on assured information access. With numerous global and regional cooperation mechanisms in place, all the major disasters that have affected the region in recent years have been monitored using near real time satellite imagery. Although the lack of resources in many low-income countries is a continuing constraint in making better use of advanced technologies, an intensified focus on developing human and technical capacities promises

more opportunities to harness innovative technologies for bridging the existing gaps between DRR planning and implementation responsibilities.

While responding to the historic floods 2011, Thailand Government and the affected communities demonstrated the effective use of innovative technologies. These ranged from applying the near real-time satellite imagery, crowd sourcing, social media, to the use of indigenous knowledge and coping capacity of the vulnerable people. As such, Thailand sets a new standard for responding to disasters in the region. The water management strategies of the Government and business continuity planning of the Private sectors, which have been taken up for reducing future flood risks, are commendable efforts.

Building regional cooperation for the effective use of technology and strengthening national capacities will improve regional capacities for DRR. The growing demand for ICT services, combined with technological innovation, growing infrastructure and falling prices allows more people to participate in the information society regardless of their physical location. Almost 90 per cent of the world's seven billion people are now connected in one way or another by information and communication technologies. As such, advances in these technologies are an easy way to improve disaster resilience of communities and people, and thus contribute to sustainable and inclusive development.

The way forward to reducing vulnerability and exposure to disasters

The primary conviction of this report is driven by a concern that people's exposure and vulnerability, experienced individually and collectively, continue to be twin challenges for the region. Faced with growing economic losses and increasingly vulnerable populations, this report has analyzed the drivers of risks and the strategies that are in place to deal with the growing risks. The report has pursued three primary questions that all dedicated collaborators in the region need to join, "How do they and the people with whom they work understand the disaster risks in the region better?", "How can all concerned stakeholders intensify their own work on vulnerability reduction in a truly concerted, consistent and sustained way?", and "What strategies are needed and can be applied to reduce socioeconomic exposure to hazards?"

Disasters are dynamic and need to be re-evaluated constantly. Socioeconomic evidence needs to become a firm foundation from which to proceed in the continuing re-evaluation of risks in the region, and the first step in building this socioeconomic foundation of evidence is the systematic recording of disaster impacts and losses through the institutionalization of national disaster inventory systems. The recording of comprehensive disaster losses and consequential impacts will enable governments to measure and quantify the socioeconomic costs of recurrent disasters. Only then can a strong case be made to justify significant and sustained investments in DRR from fiscal budgets and long-term public investment plans.

The lessons from countries and communities which have successfully reduced human vulnerability to disasters and therefore potentially mortality, need to be learned and exchanged. Experience in some high-risk developing countries demonstrates that setting definitive targets to reduce disaster losses stimulates Government decisions to make investments in DRR. Targets with specifically identified economic and social measures to reduce vulnerabilities ensure that investment attains visible and measurable results. Expanding social protection initiatives and creating targeted safety nets in times of crisis are particularly effective, with added political dividends.

Disaster risk reduction and development can support common objectives and common frameworks, with MDGs and DRR assisting countries to prioritize capacity development. The improvement of risk governance in the context of sustainable development and the need to promote more integrated approaches to environmental, economic and social aspects of development are needed to reduce disaster risks. This is consistent with key outcomes of the Rio+20 Summit on Sustainable Development held in June 2012.

Many of the approaches, which proceed to reduce vulnerability, are derived from development experience. Nonetheless, much more also needs to be done to arrest the growing exposure of people and assets to hazards throughout the region. Strategies such as land-use planning, ecosystems management, post-disaster recovery and supply chain management have the potential to reduce exposure to future disasters. Most of these strategies are already risk-sensitive, but barriers continue to exist in translating these strategies into actual investments that reduce risks. Research has disclosed that although existing

strategies are clear about their intentions for reducing disaster risks, many of them would benefit from being more explicit about their means of accomplishing DRR. There is a need to engage new stakeholders, particularly those involved in decision-making, planning and investment. There are also additional associated needs to develop requisite social demand and more government ownership for realizing DRR. It is also essential that Governments assume full ownership and responsibility for DRR as part of an inclusive and sustainable development strategy.

In acknowledging the increasing risks in the region, it is necessary to promote a more direct approach to DRR if the promise of development is not to be lost. Shortcuts do not reduce risks, but informed approaches, innovative technologies and wider popular engagement can ensure that their joint activities can be both effective and affordable. Innovative technologies have significant impact because they surmount previous limitations and offer many new directions and opportunities to communicate, plan, analyze, and learn. They fill critical information gaps in DRR.

Experience tells us that peer learning works. When it crosses either geographical or subject boundaries, it can become even more stimulating and engaging. Therefore, for national stakeholders, the best venues for inspirational and impactful learning are regional. To accomplish this wider value, regional organization and international development agencies should facilitate and provide multi-dimensional capacity development and promote an enabling policy environment for building disaster resilience grounded within both DRR and development practices.

1 Disaster risks in the Asia-Pacific region

A farmer and a survivor of cyclone "Nargis" surveys his flooded farmland, located in the Ayeyarwady delta region, along the shores of the Andaman Sea (2008).
Credits: UN Photo/Evan Schneider

The increasing exposure of populations and economic assets in Asian and Pacific countries is having a profound effect on the growing disaster risks of the region. In addition to large-scale disasters, the impacts of smaller but equally destructive disasters are also increasing. The negative consequences of development, including unplanned urban growth and a combination of concentrated and marginalized populations are primary drivers of greater disaster exposure. Increasingly complex socioeconomic infrastructure further creates the potential for more complex risks in the future. The far-reaching implications and complex nature of these disasters will demand more sophisticated and multidimensional capacities to be developed and supported to reduce the impacts of future disasters.

1.1 Introduction

Major disaster events in 2011, such as the Great East Japan Earthquake and the following tsunami, as well as the severe floods in Thailand, provided stark evidence of the concentrated disaster risks that affect human well-being and future development in Asia and the Pacific. Global disaster economic losses of $366 billion were reported during this single year, with fully 80 per cent of those losses occurring in the Asia-Pacific region (CRED, 2012). The trends of increasing exposure and greater losses associated with disasters demand a better understanding of their complex natures and the interaction of their foundation hazards, exposure, vulnerability and resulting risks.

The related terms and concepts used in disaster risk reduction have been evolving over the past 50 years. Disaster risk can be explained most simply as the function of a specific hazard, physical exposure of elements at risk and human vulnerability. This concept has been widely accepted among the professionals who work with the subject, even as it remains challenging for public authorities to anticipate and manage disaster risks in practice.

Exposure refers to the location of people or economic and social assets in hazard-prone areas subject to potential losses. They are also commonly referred to as "elements at risk". Vulnerability characterizes the circumstances of a community, system or tangible assets that make the subject susceptible to damage and losses from a hazard. The definitions of these terms used in the present report are widely accepted by disaster risk reduction practitioners globally and they are adapted primarily from the United Nations International Strategy for Disaster Reduction's standard terminology (UNISDR, 2011b). Key terms and contexts related to risk are explained more fully in Annex I.1.

A fundamental principle of strategic disaster risk management is recognizing that risk is dynamic and needs to be reviewed and evaluated continuously. Hazards, elements at risk and conditions of vulnerability all vary and are subject to change over time. Population densities change, most often increasing in places of greater opportunity, but also often in conditions of greater exposure. The region's economic growth, many of its most valuable assets, the majority of its people and increasingly sophisticated infrastructure are concentrated along coastlines and floodways. When confronted by hazards, these factors and the locations they occupy all contribute to increasing people's exposure to risk. The intensive use of resources, inequitable access to natural and other productive resources and uncontrolled environmental degradation within societies further threaten people's well-being and can easily compromise their future opportunities. The very likely disruptive consequences of a changing climate magnify these conditions of risk in vulnerable areas.

The organization of societies is evolving rapidly throughout Asia and the Pacific with advanced technologies and greater capacities which may decrease people's vulnerability, but they can also expose potentially dangerous conditions that lead to additional or secondary hazards. The Fukushima nuclear incident following the Great East Japan Earthquake and tsunami in March 2011 is only one example of how disasters can spawn multiple and devastating consequences in modern societies.

High levels of vulnerability and exposure often result from poorly conceived development planning or practices. Poorly considered actions, and often official inaction, can result in settlements growing in hazard-prone areas. The construction of unsafe dwellings, poorly served informal settlements and outlying districts on the periphery of dense urban environments only perpetuate poverty conditions and the lack of awareness about risks.

The previous *Asia Pacific Disaster Report 2010* (ESCAP and ISDR, 2010) reviewed the linkages between increasing disaster risk and climate change. It suggested that a direct contribution of climate change to disaster risk was difficult to quantify. However, given the research that has been accomplished and concerns expressed globally about the considerable potential impacts of climate change, the report also indicated the significant influence it will exert on future disaster risks.

The Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4) concludes that the future will bring likely (> 66 per cent) to virtually certain (> 99 per cent) probability of further changes to the global climate, including the occurrence of increased warm spells, heat waves, heavy precipitation events, increased area affected by droughts and tropical cyclone activity, among other possible phenomenon (IPCC, 2007).

The more recent *Special Report of the IPCC on disaster risk and climate adaptation* (IPCC, 2012) ties action on climate change to the management of disaster risk, pointing to increased disaster risk as more vulnerable people and assets are exposed to weather extremes, even without climate change. It concludes that climate extremes will play an increasingly significant role in disaster impacts and highlights the need to improve existing risk management measures.

The outcome document of the United Nations Conference on Sustainable Development held in Rio de Janeiro, Brazil in June 2012, ("Rio+20"), "The Future We Want", recognizes the urgent need to address disaster risk reduction and for building resilience to disasters in the context of sustainable development and poverty eradication (United Nations, 2012). In this regard there is a need, but also an opportunity, to view disaster risk reduction in the context of broader development strategies and to capitalize on additional resources.

To begin to penetrate the many interrelated risk factors in order to increase the wider understanding of risk, this chapter presents regional trends of mortality and economic losses of selected hazards. It addresses both severe, large-scale "intensive" disasters as well as the more frequent, lower consequences of smaller but recurrent disasters. It focuses on the risk of loss and damage particularly associated with these low-severity and high-frequency disasters that are sometimes referred to as "extensive" disasters.

Extreme hydro-meteorological events such as floods, tropical cyclones and landslides triggered by rain or floods are featured in the discussion because of their prevalence in the region. These hydro-meteorological hazards are the principal cause for human suffering from disasters in Asia and the Pacific, and their occurrence is greater than other types of disasters. As they are by no means the only relevant hazards of concern, government officials and the public also need to remain vigilant and prepared to manage the impacts which geophysical and climatological hazards also inflict across the region.

Regardless of their individual characterizations, all these types of hazards require close relationships to be built and maintained between governance, prevailing risks, and the resulting states of physical and economic exposure.

1.2 The Thailand floods of 2011 have a historical impact

The basis for the current concerns about disaster risks in Asia and the Pacific can be conveyed vividly by considering the consequences of the fourth severe tropical storm of the 2011 Pacific typhoon season. Typhoon Nok Ten made three landfalls across the South-East Asia subregion between 24 and 31 July 2012 causing loss and destruction throughout the area. Continuous heavy rainfall affected 1.2 million people in Cambodia, causing 250 fatalities and estimated losses of $161 million. The Lao People's Democratic Republic suffered an estimated economic loss of $174 million, including damage to 140,000 houses. Viet Nam lost 175,000 homes and 99,000 hectares of agricultural land to the floodwaters, with an estimated loss of $135 million (CRED, 2012).

While its effects were widespread, the resulting floods were particularly severe in Thailand. The heavy monsoon rainfall was further intensified by LaNina cyclical climatic effects, and floods in Thailand became the second most costly disaster in 2011. Extreme flooding spread slowly through the provinces of northern and north-eastern Thailand before reaching the central provinces in the Chao Phraya River basin. By the end of October, the floods reached Bangkok where the urban centre was protected by dykes, but the northern suburbs remained exposed to very costly consequences (figure I.I). The city had weeks to prepare for the floods, but despite partial and what proved to be inadequate precautions, many parts of the city and its environs were inundated for an extended period.

The floods were assessed as the worst disaster in Thailand in half a century as they flooded 66 of the country's 77 provinces.[1] They affected 13.6 million people; more than 884 people were killed and millions of residents were either left homeless or displaced across the country. The floods became the fourth costliest disaster in the world, exceeded only by the 2011 Great East Japan Earthquake and tsunami, the 1995 Kobe, Japan earthquake and Hurricane Katrina in the United States in 2005 (CRED, 2012).

1.2.1 The economic losses and consequences of the Thailand floods

The total damage and losses from the 2011 floods in Thailand amounted to THB 1.43 trillion ($46.5 billion)[2]. Overall the private sector suffered approximately 90 per cent of the damage and losses, with the manufacturing sector incurring roughly 70 per cent of them, largely from the flooding of industrial estates located in the five flood-affected provinces: Bangkok, Ayutthaya, Nakhon Sawan, Pathum Thani, and Samut Sakhon. The damage to physical assets amounted to THB 630.3 billion ($20.5 billion), with additional losses in associated economic activities estimated as amounting to about THB 795 billion

[1] The worst previous Thailand floods in recent history were recorded in 1831, 1942, 1983, 1995,1996, 2002, and 2006.
[2] Rapid Assessment for Resilient Recovery and Reconstruction Planning, GFDRR, World Bank, 2012.

Figure I.I **Satellite images of the Chao Phraya River in Ayutthaya Province on 11 July 2011 and on 23 October 2011**

Source: NASA Satellite Images

($26 billion).[3] Of the total $46.5 billion in damage and losses, only $12 billion was insured (Swiss Re, 2012). The losses were very significant in national terms as manufacturing accounts for about 38.5 per cent of Thailand's gross domestic product (GDP) and is one of the main contributors of Thailand's exports.

Housing, tourism and the financial sectors also were heavily affected. After manufacturing, the housing sector suffered the second largest losses. About 1.9 million houses were affected with about 19,000 homes destroyed, but the greatest damage was to personal household goods. Although there was some damage to tourism infrastructure, the greatest impact on tourism was from lost revenue from associated services (Rapid Assessment for Resilient Recovery and Reconstruction Planning, GFDRR, World Bank, 2012).

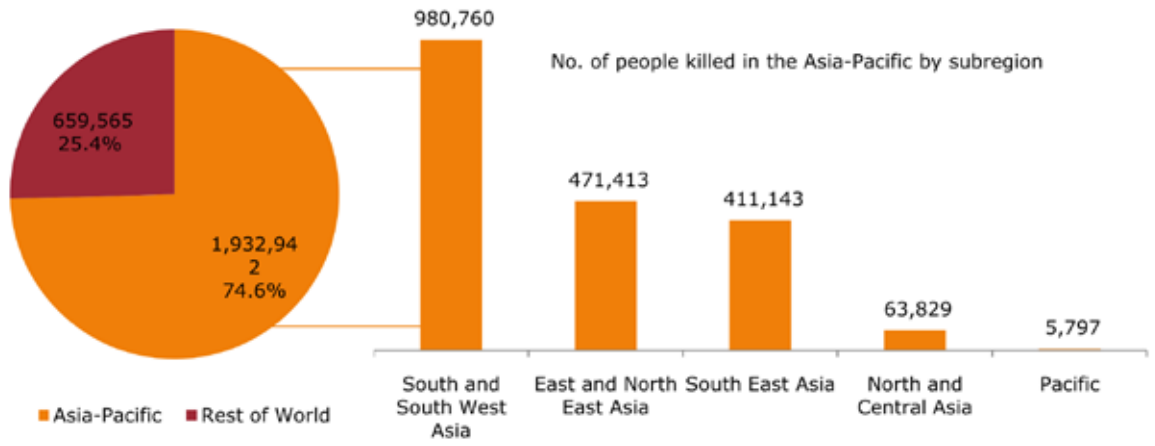
1.3 Understanding human and economic losses from disasters in Asia and the Pacific

The Asia-Pacific region accounted for more than 74 per cent of global human fatalities from disasters between 1970 and 2011. Figure I.II illustrates the subregional distribution of these deaths based on data maintained by the international disaster database, EM-DAT (CRED, 2012). The graph illustrates that most people killed in the specified hazards were inhabitants of South and South-West Asia, accounting for nearly half of the disaster fatalities in the entire Asia-Pacific region. Although the Global Assessment Report (GAR) 2011 (UNISDR, 2011) suggests that deaths due to disasters are declining globally, the number concentrated in the region remains enormous.

The economic losses from disasters in the Asia-Pacific region during only 2011 are similarly disproportionate when compared to global disaster economic losses. The Centre for Research on the Epidemiology of Disasters (CRED) reported total global losses of $366.1 billion during the year, of which a staggering $294.8 billion, or 80 per cent, was attributed to losses in the Asia-Pacific region alone (figure I.III and table I.1). Almost 90 per cent of the 2011 Asia-Pacific losses were attributed to the major combined earthquake and tsunami disasters in Japan (Box I.1)

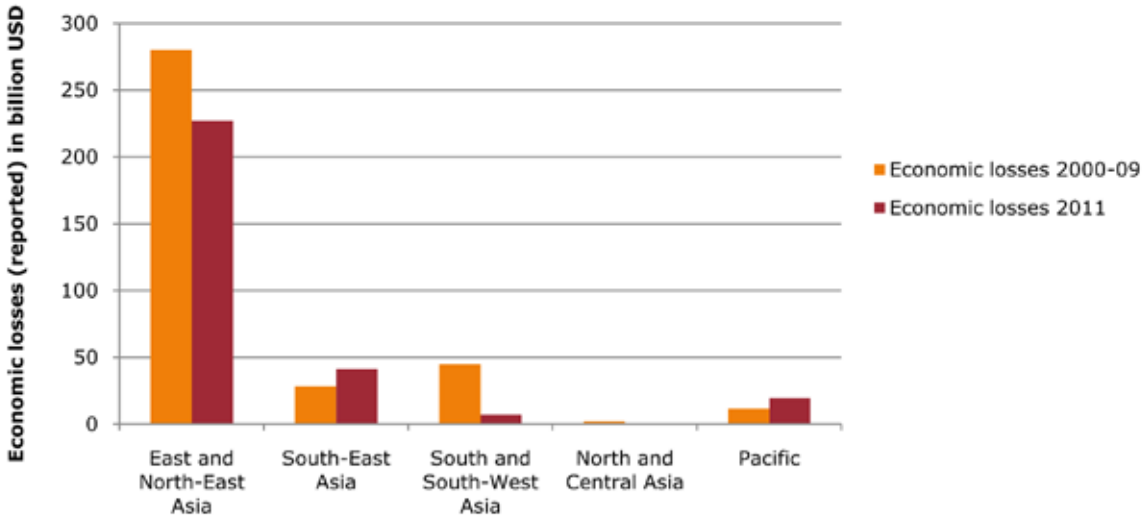
[3] These loss estimates are projected over the three year period, 2011–2013.

Figure I.II **Global and Asia-Pacific disaster fatalities, 1970-2011**



Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain . www.emdat.be (accessed 28 August 2012).
Note: The hazards considered in this analysis are earthquakes and tsunamis (seismic activity), temperature extremes, floods, wet and dry mass movements, storms, volcanoes and wildfire.

Figure I.III **Economic losses from Asia-Pacific disasters, 2000-2009 and 2011, by subregions**



Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain . www.emdat.be (accessed 22 May 2012).

Table I.1 **Economic losses from Asia-Pacific disasters, 2000-2009 and 2011, by subregion**

Subregions	Economic losses 2000-2009 (billion US dollars)	Economic losses 2010 (billion US dollars)	Economic losses 2011 (billion US dollars)
East and North-East Asia	280.1	23.75	227.0
South-East Asia	28.3	1.58	41.3
South and South-West Asia	44.9	11.85	6.9
North and Central Asia	2.1	3.91	0.1
Pacific	11.6	16.68	19.6
Asia-Pacific	366.9	57.76	294.8
Global	896.2	57.76	366.1

Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain. www.emdat.be (accessed 22 May 2012).

Table I.2 **The most costly natural hazard disasters of 2011**

Disasters, 2011	Countries and areas	Damage (billion dollars)
Earthquake and tsunami, March	Japan	210.0
Flood, August-December	Thailand	40.0
Earthquake, February	New Zealand	15.0
Storm, May	United States	14.0
Storm, April	United States	11.0
Drought, January-December	United States	8.0
Hurricane Irene, August-September	United States, Puerto Rico, Bahamas, Dominican Republic, Haiti, Canada	7.9
Flood, June	China	6.4
Flood, April-May	United States	4.6
Flood, September	China	4.3

Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain www.emdat.be (accessed 22 May 2012).

Table I.3 **The most costly seismic disasters, 1900-2012**

Country or area, disaster	Date	Damage (billion dollars)
Japan, tsunami	11 March 2011	210
Japan, earthquake	17 January 1995	100
China, earthquake	12 May 2008	85
United States, earthquake	17 January 1994	30
Chile, earthquake	27 February 2010	30
Japan, earthquake	23 October 2004	28
Italy, earthquake	23 May1980	20
Turkey, earthquake	17 August 1999	20
New Zealand, earthquake	22 February 2011	15
Taiwan Province of China, earthquake	21 September 1999	14

Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain. www.emdat.be (accessed 22 May 2012).
Note: Sorted by economic damage at the country or area level.

Table I.4 **Seismic disasters in Asia and Oceania, compared to other global regions, 1900-2012**

Region	Seismic disasters	No. of events	Human fatalities	Total number of people	Losses (billion dollars)
Asia	Earthquake	617	1 559 045	127 967 949	312.1
	Tsunami	33	261 915	2 806 269	222.6
Oceania	Earthquake	41	610	691 015	0.0
	Tsunami	10	2 793	20 843	0.2
Subtotal: Asia and Oceania		701	1 824 363	131 486 076	534.9
Total of other regions: Africa, Americas, Europe		504	738 936	39 566 335	175.5

Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain. www.emdat.be (accessed 22 May 2012).

Box I.1 **The Great East Japan Earthquake, 2011**

Photo credit: Mohri UN-CECAR (Flickr)

One of the most devastating disasters to occur in the modern era was the Great East Japan Earthquake in March, 2011. It was the biggest earthquake to strike Japan since official records have been maintained from the early 1900s. The 9.0 magnitude earthquake was followed by a massive tsunami that resulted in the costliest disaster of the modern historical era. Almost 16,000 people were killed in the double disaster, which in turn triggered a third crisis at the Fukushima nuclear plant. Almost 300,000 buildings were destroyed with an additional one million more damaged by the earthquake, tsunami or resulting fires. (Source: National Police Agency of Japan).The total estimated losses for these combined disasters were reported as $210 billion.

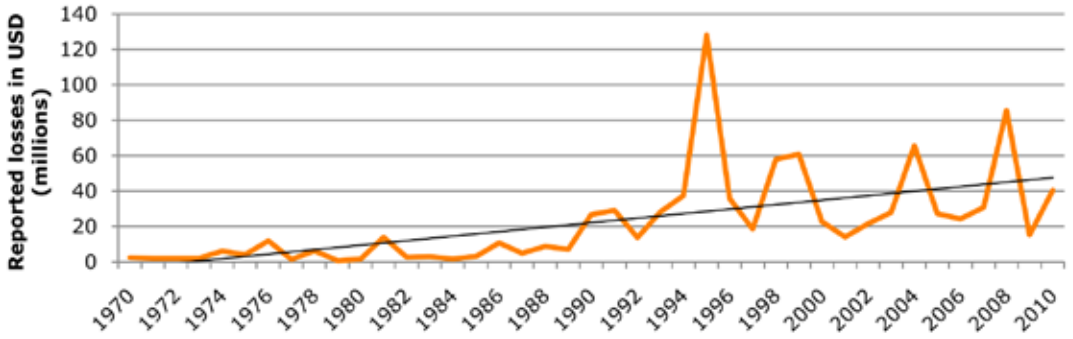
and the Thailand floods. Other major earthquakes occurred elsewhere in the region during the year in New Zealand and Turkey, while like Thailand, Australia also experienced unprecedented floods. This series of disasters contributed to the extraordinary Asia-Pacific economic losses.

To put these regional losses for one year in perspective, the total Asia-Pacific disaster losses for the decade from 2000-2009 were $366.9 billion, so the annual losses of $294.8 billion for 2011 alone, was 80 per cent of the region's ten years accumulated disaster losses. Losses in 2011 was also close to six times than those in 2010 (Table I.1) highlighting the exceptional nature of the 2011 year. By itself, the 2010 losses of $57.76 billion in Asia-Pacific region was not that small, as it surpassed annual losses for each year in 2000-2009, except 2008 where Sichuan earthquake in China alone resulted in $85 billion losses

Globally, 2011 has been the most costly year for loses from disasters. Table I.2 shows the 10 most costly natural hazard disasters for the year in terms of economic damage.

Table I.3 clearly indicates that the major economic losses in the region are predominantly due to earthquakes and tsunamis, the region's most destructive hazards which also occur frequently. Table I.4 illustrates that seven of the 10 most costly seismic disasters since 1900 have occurred in the Asia-Pacific region.

Figure I.IV **Economic losses due to all types of disasters in Asia and Pacific, 1970-2009**



Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain. www.emdat.be (accessed 22 May 2012).

In terms of the overall impact of the geophysical hazards in the region, table I.4 illustrates the gravity of both the mortality and the economic losses associated with them in comparison to the rest of the world. The total reported losses from earthquakes and tsunamis in Asia and Oceania regions is 3 times higher than in the rest of the world with 2.5 times more fatalities.

The preceding tables I.2, I.3, and I.4 demonstrate the seriousness and frequency which seismic events display in many Asia-Pacific countries. Even as earthquakes and tsunamis present highly complex issues that challenge both scientists and disaster risk management officials, the global research community is attempting to model earthquake risks in the region through the Global Earthquake Model (GEM) initiative. This is only one example of how the wider recognition of further study of disaster risk data and experience can provide the region with more understanding of earthquake hazards, exposure and vulnerability.

1.3.1 Rising economic losses

Based on the reported losses of all types of disasters in the EM-DAT database, the modelled economic exposure of Asia-Pacific subregions indicates that estimated economic losses associated with all disasters continue to grow every year with the increasing exposure (figure I.IV).

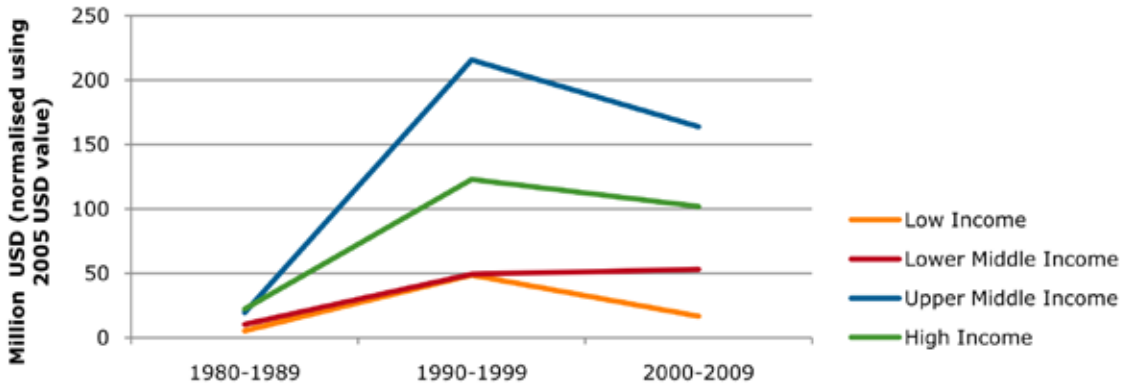
Losses in the region have grown by more than 16 times since 1970, while the GDP has increased by 13 times. Losses in high and upper-middle income countries are higher compared to lower-middle and low income countries. This trend in losses indicates that a larger proportion of the growing economies remain at risk despite the availability of more capital assets. This confirms that economic growth alone has failed to reduce economic losses due to all disasters (figure I.V).

When taken together as a subregion, the countries which comprise East and North-East Asia (China, Democratic People's Republic of Korea, Japan, Mongolia and Republic of Korea) account for the largest disaster losses in the Asia-Pacific region as analysed between 1970 and 2010. Losses incurred by China alone during the 40 year period are far more than the losses of all the countries in South-East Asia, South and South-West Asia, North and Central Asia and the Pacific combined.

Figure I.VI shows the relationship between the percentage change in human exposure to disasters and in GDP for South Asia, East Asia and the Pacific combined, from 1980-2010. It is evident from the two charts that exposure has been increasing to a greater extent in both of these areas. While GDP has increased by more than six times since 1980 in South Asia, exposure has increased five times, reflecting the growth in economic development.

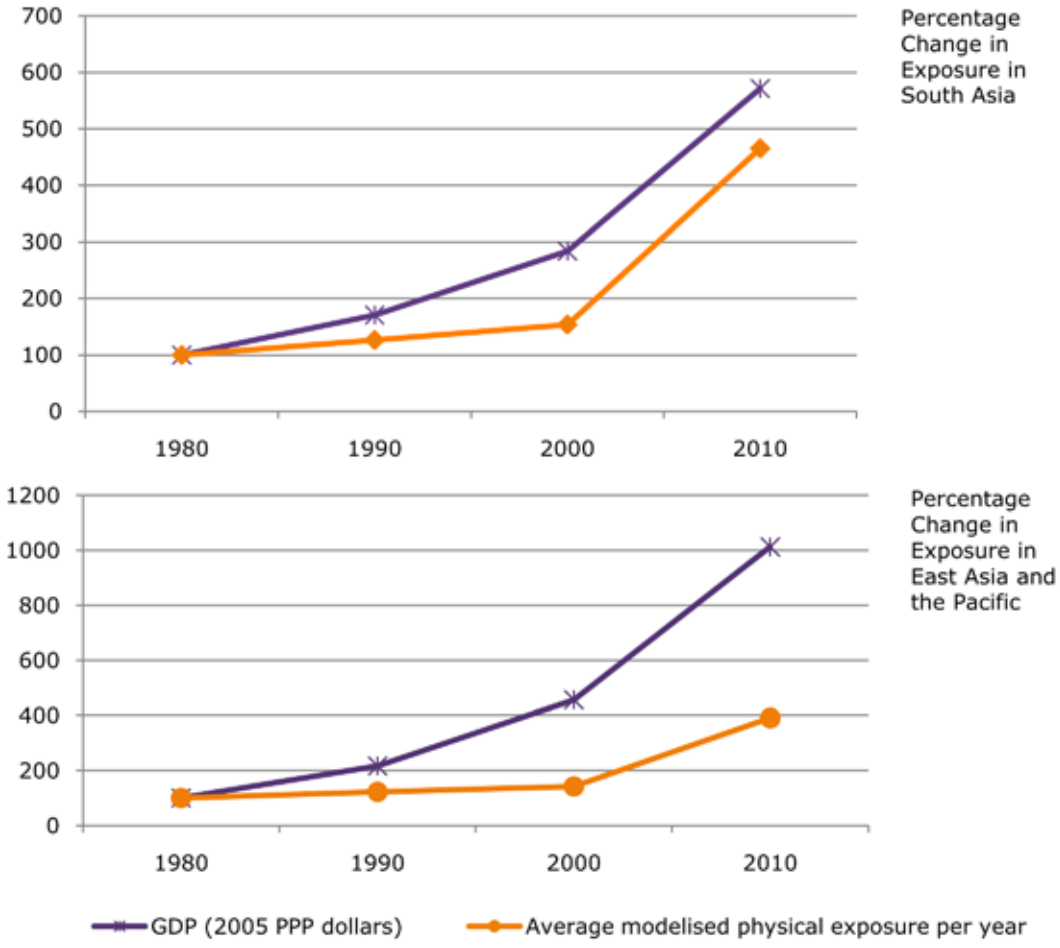
These analyses show that while the Asia-Pacific region has experienced considerable economic growth, during the same time the economic losses and human exposure to all types of hazards have continued to increase. This observation illustrates that economic growth in the region is not resulting in a reduction of disaster losses nor of human exposure to disasters.

Figure I.V **Economic losses from disasters in Asia and Pacific by income classification of countries, 1970-2009**



Source: UNISDR analysis based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain. www.emdat.be (accessed 22 May 2012).

Figure I.VI **Changes in Gross Domestic Product (GDP) and the exposure of population to disasters for South Asia, and East Asia and the Pacific, 1980-2010**



Source: GDP data from World Bank. http://data.worldbank.org (accessed June 2012). Human physical exposure from UNEP and UNISDR, The PREVIEW Global Risk Data Platform, http://preview.grid.unep.ch (accessed May 2012).

1.4 Risk from hydro-meteorological hazards in the Asia-Pacific region

Although the impacts of geophysical disasters in the Asia-Pacific region are significant and should not be underestimated, hydro-meteorological hazards occur more frequently and have greater cumulative effects. Whether hazards are categorized as being geophysical, hydro-meteorological, climatological or biological[4] all of their impacts in Asia-Pacific exceed the hazards' consequences anywhere else in the world.

The understanding of different risk factors improves as better data, research and technologies become available and are circulated more widely. The Global Risk Model developed for the GAR 2009 (UNISDR, 2009) and further refined for the GAR 2011 (UNISDR, 2011a) has made important progress in modelling hydro-meteorological risks although limitations remain in doing so for geophysical risks. As hydro-meteorological hazards have been the most frequent hazards affecting the greatest number of people in Asia-Pacific, the following discussion provides more detailed analysis about the occurrence and distribution and effects of those hazards.

According to EM-DAT data, 1.2 billion people have been exposed to hydro-meteorological risks in the region through 1215 disasters since 2000. By comparison, about 355 million people have experienced 394 climatological, biological and geophysical events during the same period. The number of people living in flood-prone areas has increased by 12.5 per cent between 2000 and 2010, and the number of people living in tropical cyclone-prone areas has increased by 9.6 per cent (UNEP and UNISDR, 2012).

The following discussion presents information about trends in mortality risk, physical exposure and economic exposure.[5] It provides a regional analysis of the global risk model datasets generated for the GAR 2011 as mandated by the United Nations and pursued by agencies working in development and environment domains.[6]

The trend in mortality risk in Asia-Pacific reaffirms the global findings from GAR 2011 in that it remains highly concentrated in countries with low GDP and weak governance. The analysis of physical exposure demonstrates subregional variations as well as indications of declining vulnerability accompanied by continually increasing exposure. Similarly, the analysis of economic exposure indicates varying degrees of increased exposure in different subregions and among various hazards. Although overall disaster exposure is identified as the main driver of risks in the Asia-Pacific region as a whole, efforts to reduce vulnerability might have been able to overcome growing exposure in some respects, specifically in being able to reduce tropical cyclone risks.

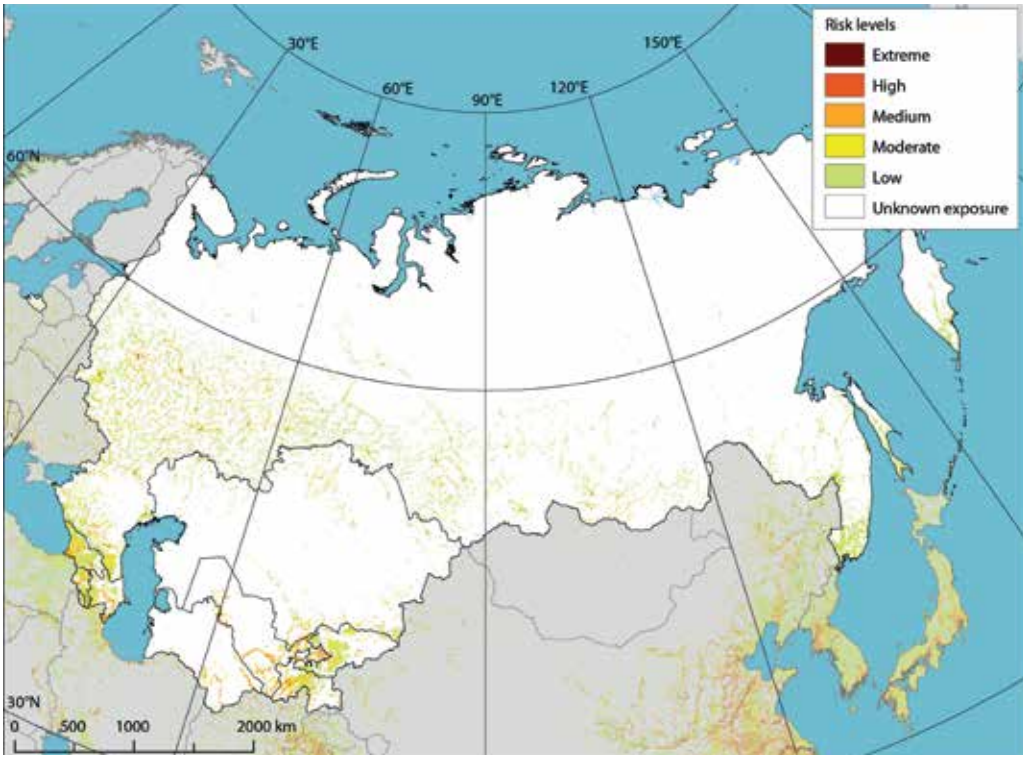
1.4.1 Distribution of potential mortality risk from hydro-meteorological hazards

Mortality risk (Peduzzi, et al, 2012) associated with major hydro-meteorological hazards is now declining globally, including in the Asia-Pacific region where most of the risk is concentrated. It accounts for 91 per cent of global human exposure to tropical cyclones, 92 per cent for floods and 66 per cent for landslides, calculated on a per capita basis. Although the absolute number of people exposed to all these hazards continues to increase, national HFA implementation reports submitted in 2011 indicate that individual countries continue to make progress pursuing initiatives to reduce vulnerability and to strengthen disaster management capacities. It is important to note that mortality risk in the region still varies considerably within subregions and with regard to specific hazards. The global trend also is influenced significantly by progress in China where increased urbanization in modern habitats has largely reduced the population's vulnerability to these specific hazards.

The maps I.1 through I.5 show the distribution of mortality risk, i.e. the probability of people being killed by hydro-meteorological hazards. The areas of highest mortality risk correspond to areas where high concentrations of vulnerable people are exposed to severe and frequent hazards. The risk is noted by five different levels calculated by spatial modelling of data for three hydro-meteorological hazards (tropical cyclones, floods and rain-triggered landslides) and related population exposure. The hazards' frequencies and intensities were intersected with population distribution models and the identification of vulnerability parameters identified using statistical regression analysis of past events. The hazards are set as a constant to remove seasonal variability in order to capture the long-term trends in exposure and vulnerability changes better. The hazard levels are replaced by the average frequency and severity values

[4] Classifications designated by EM-DAT, the CRED International Disaster Database. For descriptions of each, see http://www.emdat.be/classification (accessed 18 September 2012).
[5] For definitions see Annex I.1.
[6] UNDP, UNISDR, GTZ, UNEP and IUCN.

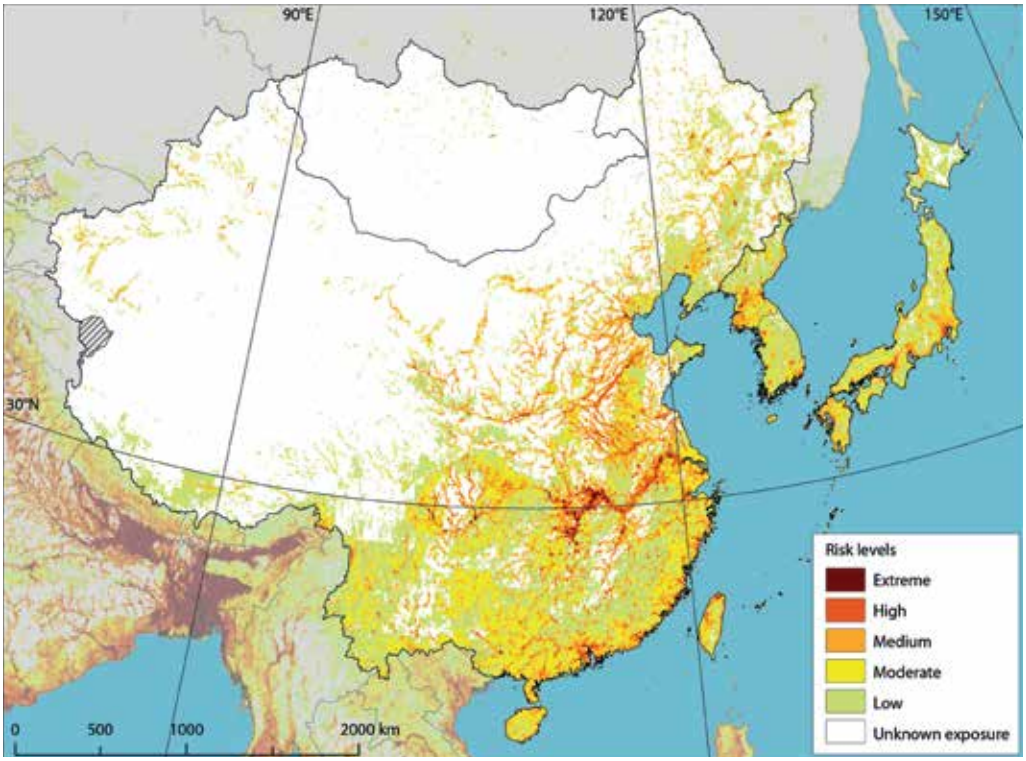
Map I.1 **Mortality risk distribution of selected hydro-meteorological hazards (tropical cyclones, floods and rain-triggered landslides) in North and Central Asia.**



Data Sources: *UNEP and* UNISDR, The PREVIEW Global Risk Data Platform, http://preview.grid.unep.ch (accessed May 2012).
Cartography: UNEP/GRID, Geneva 2012.

Disclaimer: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

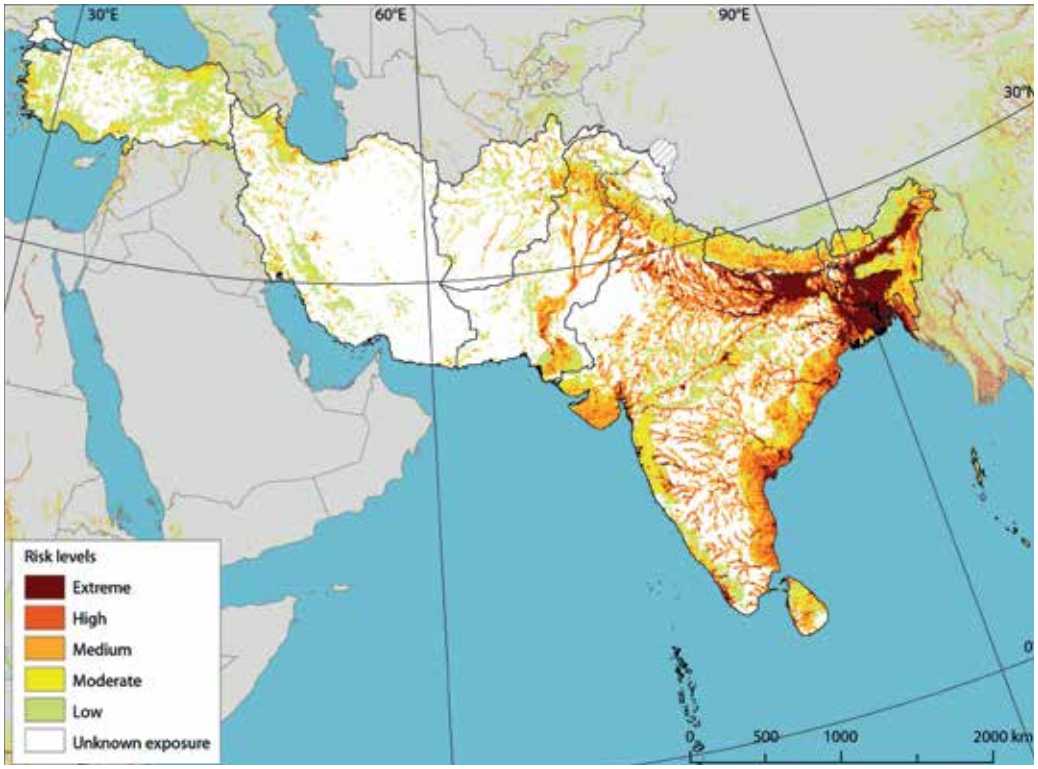
Map I.2 **Mortality risk distribution of selected hydro-meteorological hazards (tropical cyclones, floods and rain-triggered landslides) in East and North-East Asia**



Data Sources: UNEP and UNISDR, The PREVIEW Global Risk Data Platform, http://preview.grid.unep.ch (accessed May 2012).
Cartography: UNEP/GRID, Geneva 2012.

Disclaimer: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not been agreed upon by the parties.

Map I.3 **Mortality risk distribution of selected hydro-meteorological hazards (tropical cyclones, floods and rain-triggered landslides) in South and South-West Asia**

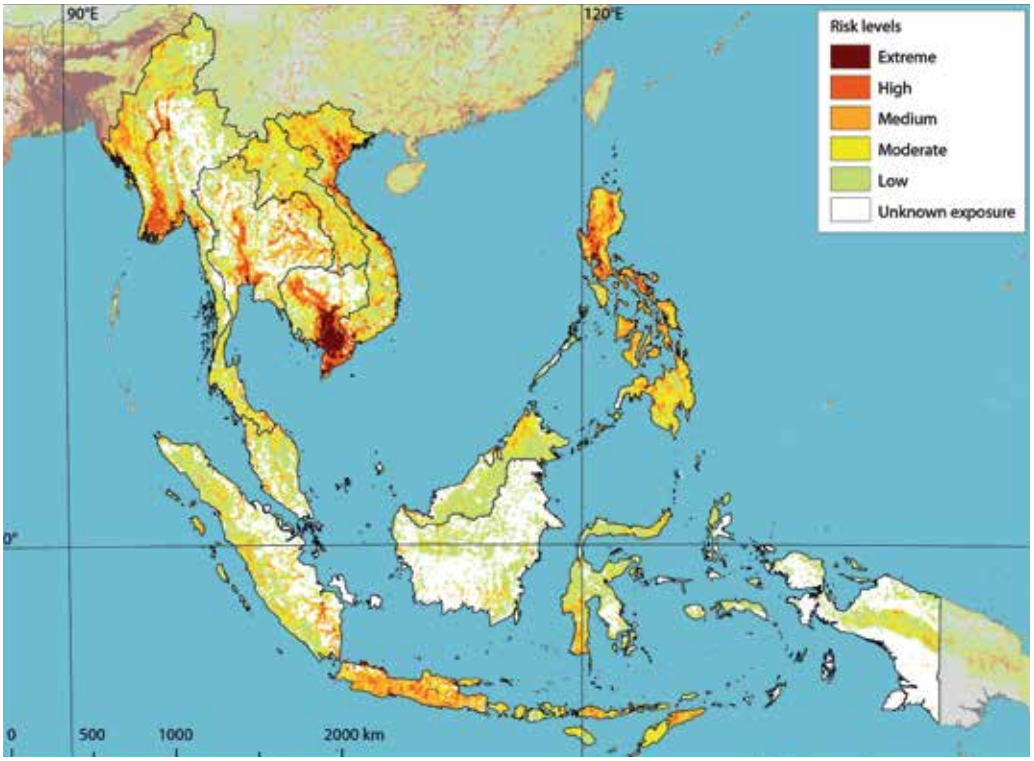


Data Sources: UNEP and UNISDR, The PREVIEW Global Risk Data Platform, http://preview.grid.unep.ch (accessed May 2012).
Cartography: UNEP/GRID, Geneva 2012.

Disclaimer: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not been agreed upon by the parties.

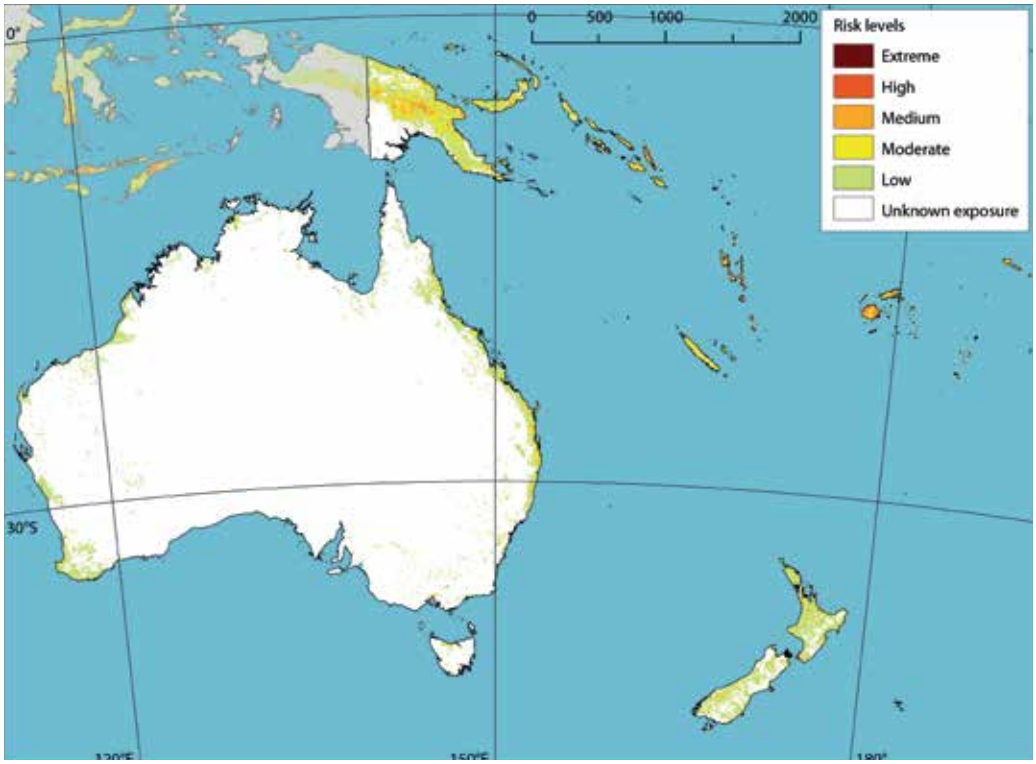
Map I.4 **Mortality risk distribution of selected hydro-meteorological hazards (tropical cyclones, floods and rain-triggered landslides) in South-East Asia**



Data Sources: UNEP and UNISDR, The PREVIEW Global Risk Data Platform, http://preview.grid.unep.ch (accessed May 2012).
Cartography: UNEP/GRID, Geneva 2012.

Disclaimer: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Map I.5 **Mortality risk distribution of selected hydro-meteorological hazards (tropical cyclones, floods and rain-triggered landslides) in the Pacific**



Data Sources: UNEP and UNISDR, The PREVIEW Global Risk Data Platform, http://preview.grid.unep.ch (accessed May 2012).
Cartography: UNEP/GRID, Geneva 2012.

Disclaimer: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

for each location, at 1 km^2 resolution (UNISDR 2009, UNISDR 2011a, Peduzzi et al., 2012). The maps are on the PREVIEW Global Risk Data Platform, http://preview.grid.unep.ch (UNEP and UNISDR, 2012).

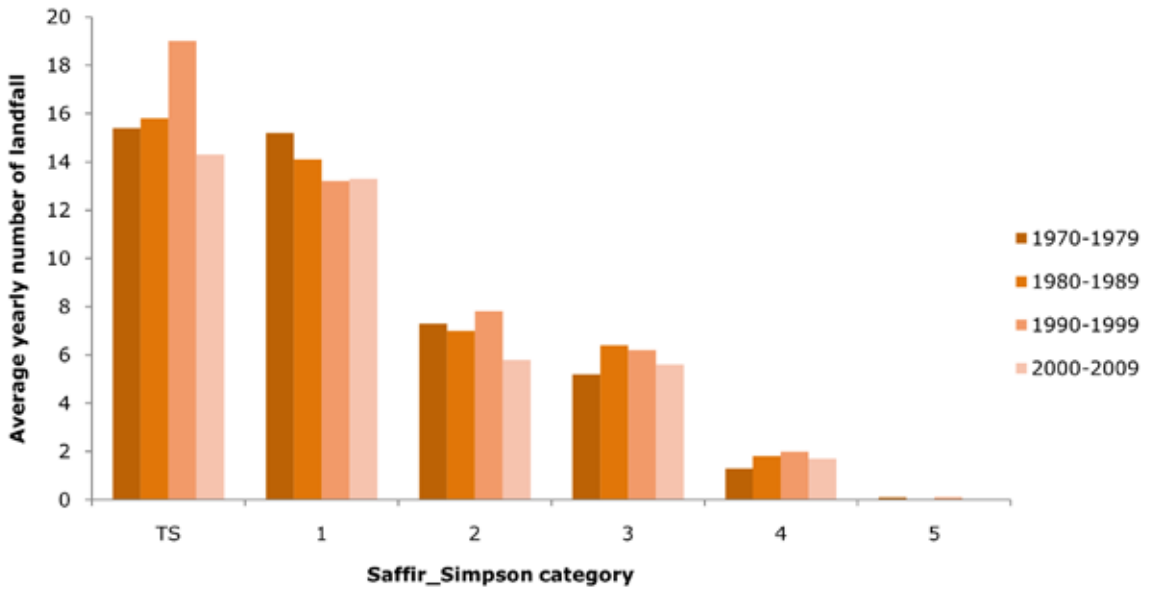
The global analyses conducted for the GAR in 2009 and 2011 (UNISDR 2009 and 2011a) revealed that flood mortality risk is highest in rural areas with a densely concentrated and rapidly growing population in countries with weak governance. Tropical cyclone mortality risk is highest in densely populated, isolated rural areas with low GDP per capita (UNISDR, 2009; Peduzzi et al., 2012). Landslide risk mortality is highest in areas with low GDP per capita (UNISDR, 2009). For each of these selected hazards, countries with low GDP and weak governance tend to have drastically higher mortality risks than wealthier countries with stronger government practices.

1.4.2 Trend analysis of physical exposure to hydro-meteorological hazards

Human exposure to hydro-meteorological hazards continues to rise. While the Asian and Pacific population increased by 91 per cent from 2.2 billion to 4.2 billion between 1970 and 2010, the average number of people exposed to flooding every year more than doubled from 29.5 to 63.8 million (Herold et al., 2009; Herold and Mouton, 2011). Population growth has occurred primarily in coastal areas and often in flood plains, suggesting that economic opportunities have outweighed negative considerations of flood risks. Similarly, the population inhabiting cyclone-prone areas also has grown from 71.8 million to 120.7 million during the same period (UNISDR, 2009, UNISDR, 2011a and Peduzzi et al., 2012). Likewise, despite a lower level of magnitude, the annual exposure to rain-triggered landslides nearly doubled during the same period.

Despite the overall increase in regional exposure to hydro-meteorological hazards, there is considerable variation among the subregions. As illustrated in the case of tropical cyclones alone, two thirds of the population exposed to them is located in East and North-East Asia, although the rate of increasing exposure is less than that experienced in South Asia (table I.5). With regard to floods, 85 per cent of people's physical exposure and the highest rate of increasing exposure are situated in South Asia (table I.6). Landslides show a similar pattern, with lower levels of exposure in the Pacific of 2.2 per cent, but with the highest rate of increasing exposure for the hazard (table I.7).

Figure I.VII **Average annual number of tropical cyclone landfalls in Asia-Pacific, 1970-2009**



Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction.* (Geneva, United Nations, 2011). Reprocessed at regional level by UNEP/GRID-Geneva.

The figures in tables I.5, I.6 and I.7 are subregional averages, so while they provide insight on aggregated tendencies they cannot reflect individual country variations.[7] The trend analysis for individual hydro-meteorological hazards follows.

Trend analysis for exposure to tropical cyclones

There has been little change in the overall number of tropical cyclones making landfall in the region since 1970 (figure I.VII). The number of recorded categories 1 and 2 cyclones has been decreasing, while the number of categories 4 and 5 has been increasing (Landsea et al., 2006). Although most of the annual average exposure to this hazard is concentrated in East and North-East Asia, exposure is growing most rapidly, almost doubling since the 1980s in all other regions routinely experiencing the hazard except for the Pacific (table I.5). According to the IPCC, under the different climate change scenarios, heavy rainfalls associated with tropical cyclones are likely to increase with continued warming. Average tropical cyclone maximum wind speeds are likely to increase, too, although increases may not occur in all ocean basins. It is likely that the global frequency of tropical cyclones will either decrease or remain essentially unchanged (IPCC, 2012).

[7] For individual country data see http://preview.grid.unep.ch (UNEP, UNISDR, 2012).

The trend in human exposure to tropical cyclones from a baseline in 1980 shows that East and North-East Asia has a lower increase compared to the two Southern Asia subregions, however the former concentrates two thirds of the entire region's human exposure.

The corresponding analysis of trends in modelled risk, vulnerability and exposure for the various subregions and hazards illustrate that vulnerability is decreasing in most cases, except in North and Central Asia, and in South and South-West Asia. With regard to human exposure, increases are evident in three regions with more than 50 per cent of 1980 values, while it remains very low in North and Central Asia; in East and North-East Asia the increase is limited to around 25 per cent.

Previous risk levels depend on combined exposure and vulnerability levels and are observed to be generally decreasing at least since 1990, with the exception of South and South-West Asia. Even though exposure in South-East Asia shows an increasing trend, the overall risk is still declining compared to 1980 values due to a decrease in vulnerability. This tendency is even more visible in East and North-East Asia which reflects a combined limited increase in exposure and a strong decrease in vulnerability. Figure I.VIII illustrates the respective trends of risk, exposure and vulnerability in the region.

Table I.5 **Tropical cyclone exposure in the Asia-Pacific region**

Subregion	Modelled people exposed per year, in millions			
	1980	1990	2000	2010
East and North-East Asia	63.8	71.1	76.4	79.5
North and Central Asia	0.1	0.1	0.1	0.1
Pacific	0.3	0.4	0.4	0.5
South-East Asia	16.1	20.7	25.6	30.5
South and South-West Asia	5.7	7.1	8.7	10.1
Total	85.9	99.4	111.1	120.7

Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction.* (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

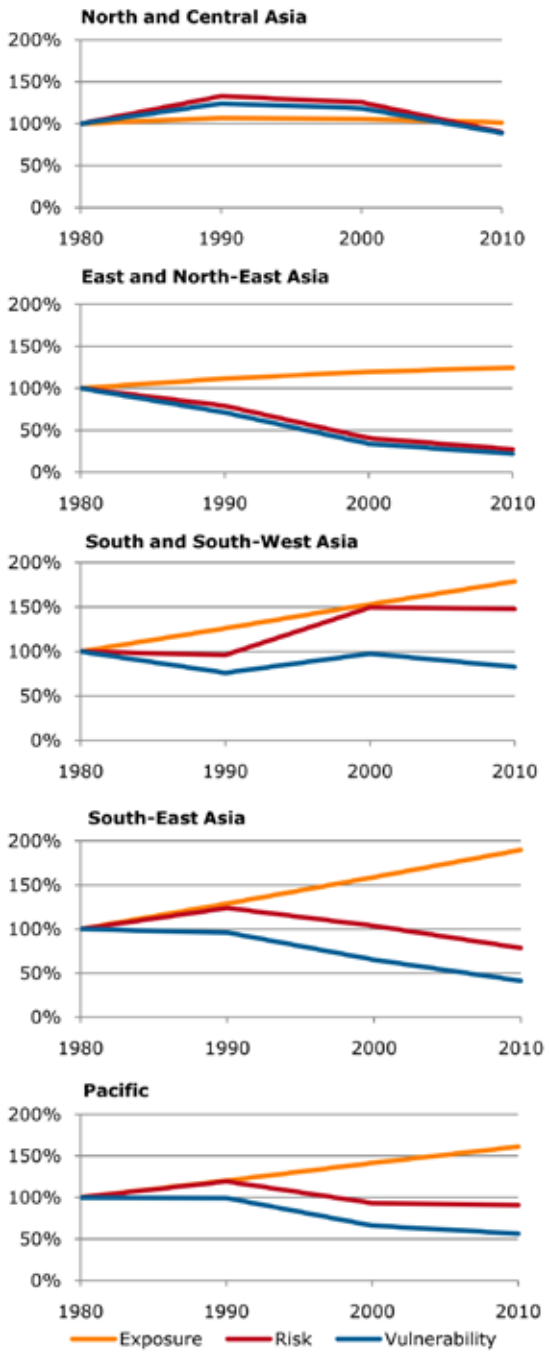
Trend analysis for exposure to floods

The lack of comprehensive monitoring of floods prevents the calculation of the hazard's trend in the same way as for tropical cyclones. The following analysis is based on the global flood hazard model from Herold and Mouton (Herold et al., 2009; Herold and Mouton, 2011) and reflects a flood severity corresponding to a 1:100 year return period. The model relates to river floods and does not include flash floods, urban flooding (often resulting from inadequate drainage) or coastal floods. As the model cannot be applied to catchments smaller than 1000 km2, data from the Pacific are not included, so exposure and risk easily can be underestimated.

The analysis of trends in human exposure to floods in the subregions from a 1980 baseline (table I.6) illustrates that it has more than doubled because of demographic changes. South-East Asia and particularly South and South-West Asia show the highest values of exposure and the greatest rates of increase. The two Northern subregions both show the lowest values, with a stable exposure prevailing in North and Central Asia since 1980.

The corresponding analysis of trends in flood mortality risk, vulnerability and exposure (figure I.IX) shows that vulnerability is continuously decreasing in East and North-East Asia, and South-East Asia. It remains nearly constant in North and Central Asia and in the Pacific. An increase is evident in South and South-West Asia prior to 2000, although a net decrease is registered since then. This reflects the urbanization and economic development in the region among possible other issues contributing to the reduced mortality risk from floods. Exposure increases in all regions, but with the greatest increase of more than 75 per cent since 1980 observed in South Asia. Minimum values are seen in North and Central Asia with only a 9 per cent increase during the same period.

Figure I.VIII **Modelled percentage change in tropical cyclone mortality risk, exposure and vulnerability, 1980–2010**



Source: United Nations International Strategy for Disaster Reduction, Global Assessment Report on Disaster Risk Reduction. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

Table I.6 **Flood exposure in the Asia-Pacific region**

Subregion	Modelled people exposed per year, in millions			
	1980	1990	2000	2010
East and North-East Asia	5.9	6.9	7.6	8.2
North and Central Asia	0.5	0.5	0.5	0.5
Pacific[a]	..	..	..	..
South-East Asia	5.8	7.3	8.8	10.1
South and South-West Asia	24.9	31.6	38.4	44.9
Total	37.1	46.3	55.4	63.8

Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction*. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.
Note: [a] Pacific data unavailable because of model limitations for basins smaller than 1,000 km^2..

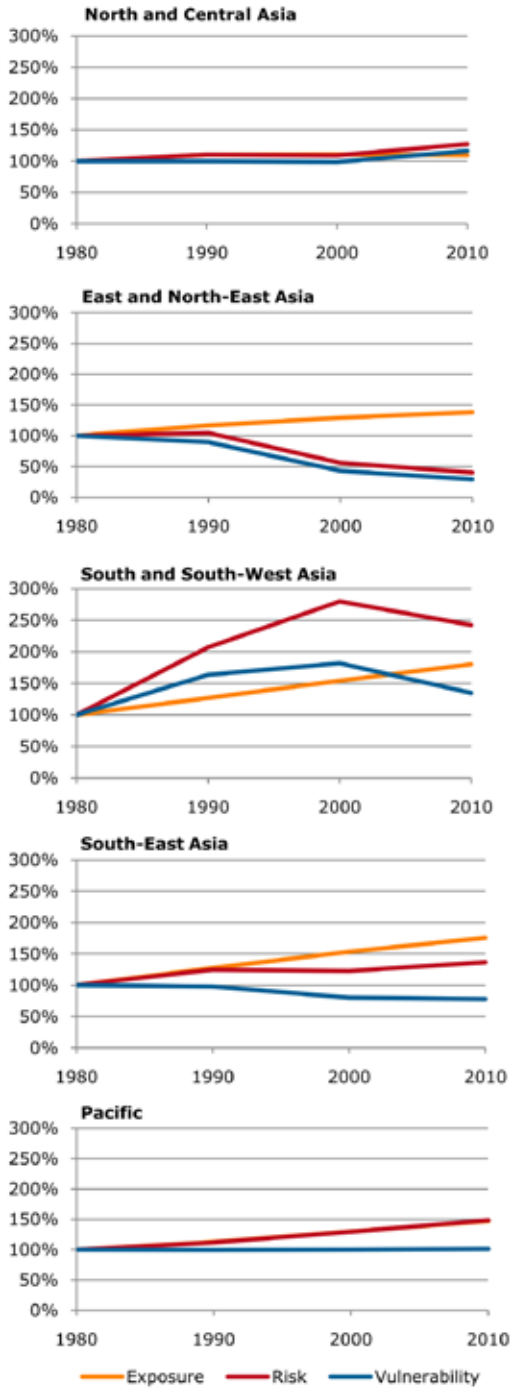
The flood risk trends follow those of vulnerability with a general increase in all subregions except for East and North-East Asia where it decreases by 40 per cent from 1980 values. South and South-West Asia demonstrates the largest increase in flood risk with a 180 per cent increase since 1980. North and Central Asia reflect the minimum increase at 27 per cent.

Trend analysis for exposure to rain-triggered landslides

Similar to floods and tropical cyclones, the trend in exposure to rain-triggered landslides from a 1980 base is increasing across the region, even as the measure is of a lesser magnitude and is expressed on a different scale (thousands of people exposed, in contrast to millions of people exposed to cyclones and floods). Table I.7 illustrates that together the two Southern subregions represent more than 70 per cent of the exposure, increasing at a rate about double 1980 values, which is also observed in the Pacific. The increase is limited in the two Northern subregions with a decreasing trend evident in North and Central Asia since 1990.

One can conclude from the foregoing analysis that there are important subregional differences in mortality risk trends. The only subregion showing a constant decrease of mortality risk for all hazards is East and North-East Asia. In addition to exhibiting an impressive 72 per cent reduction of tropical cyclone risk, it also represents fully 66 per cent of the overall Asia-Pacific exposure to the hazards discussed (figures I.VIII, I.IX, and I.X). By contrast, South and South-West Asia shows the highest increase in tropical cyclone and flood mortality risks, indicating

Figure I.IX **Modelled percentage change in flood mortality risk, exposure and vulnerability, 1980–2010**



Source: United Nations International Strategy for Disaster Reduction, Global Assessment Report on Disaster Risk Reduction. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

that growing exposure in this subregion continues to outpace reductions in vulnerability. The Pacific subregion exhibits the greatest increase in landslide mortality risk.

Table I.7 **Landslide exposure in the Asia-Pacific region**

Subregion	Modelled people exposed per year, in millions			
	1980	1990	2000	2010
East and North-East Asia	14.5	16.5	18.0	18.9
North and Central Asia	0.2	0.2	0.2	0.2
Pacific	0.8	1.0	1.3	1.6
South-East Asia	19.0	23.5	27.7	31.9
South and South-West Asia	10.3	12.9	15.8	18.5
Total	44.8	54.1	63.0	71.1

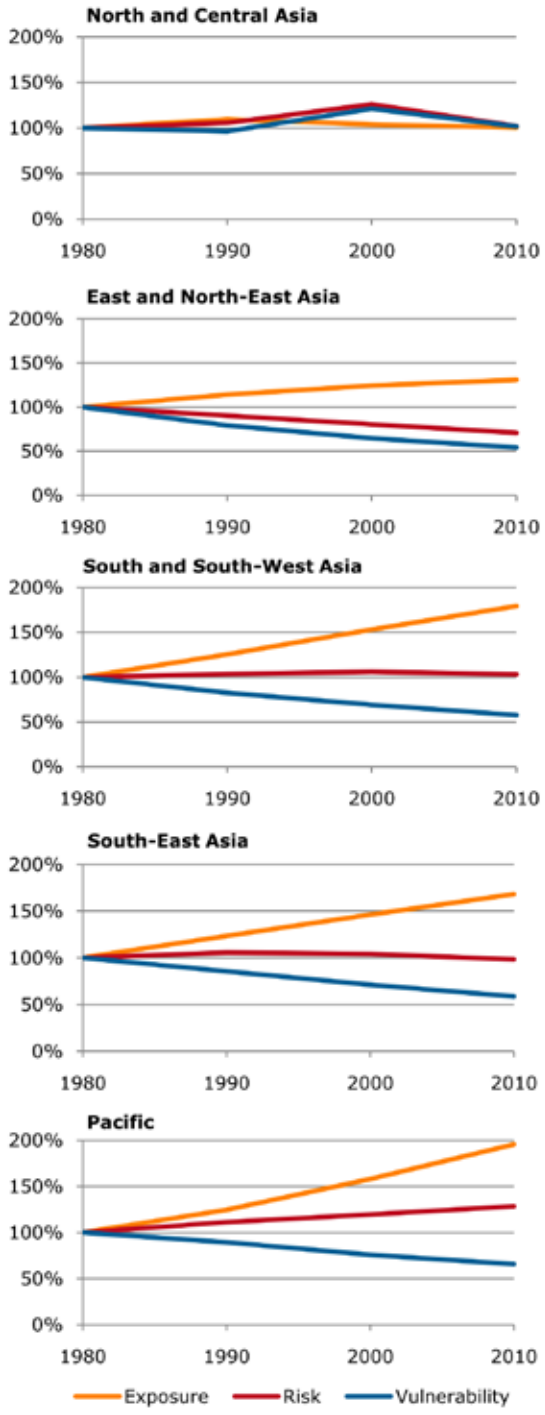
Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction*. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

In terms of relative mortality risk, expressed as a percentage of the exposed population, figure I.XI indicates that the trends are decreasing for all subregions and hazards between 1980 and 2010. Trends in relative mortality risk show some inconsistency in a few subregions, such as the case of tropical cyclone and landslide mortality risks in North and Central Asia, or tropical cyclone and flood risks in South and South-West Asia.

1.4.3 Trend analysis of economic exposure to hydro-meteorological hazards

In comparison with mortality risk and physical exposure, economic exposure is increasing dramatically in all the subregions of Asia-Pacific. The decreasing mortality risk could be attributed to increasing operational capacities of countries in disaster preparedness, emergency response, early warning and strengthened risk governance capacities. By contrast, the rapidly growing exposure and economic growth throughout the region places more assets of a country at greater risk. This section analyses the current trends of the economic exposure in the subregions and considers them relative to the specific hydro-meteorological hazards being discussed. This trend analysis is based on constant hazard, annual GDP and population data provided by the World Bank (2012).

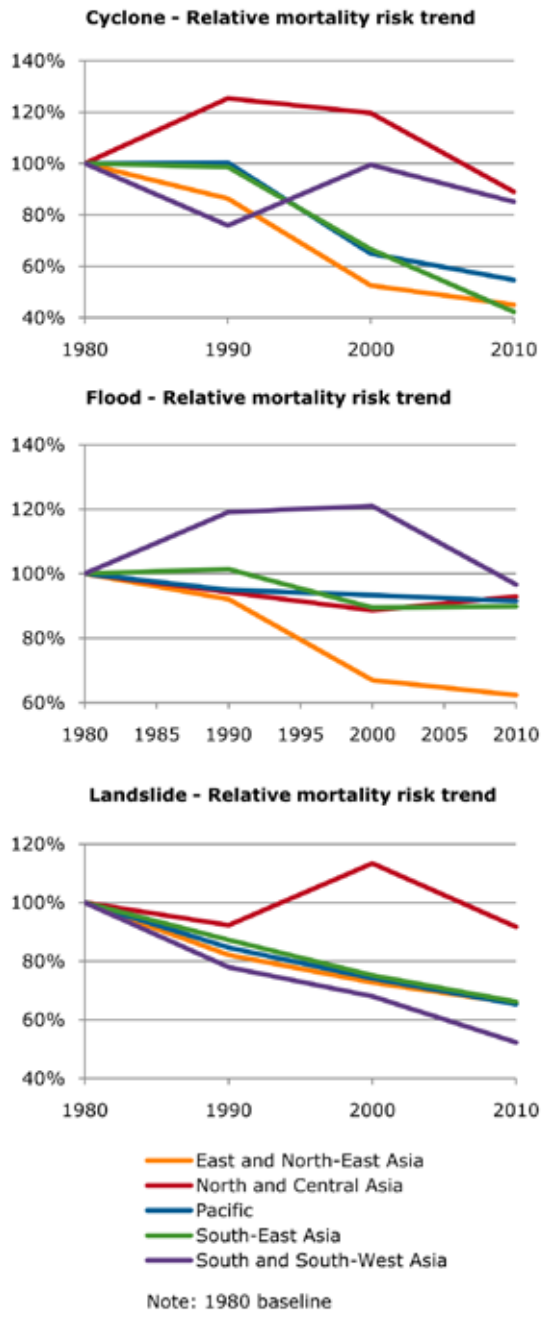
Figure I.X **Modelled percentage change in landslide mortality risk, exposure and vulnerability, 1980-2010**



Source: United Nations International Strategy for Disaster Reduction, Global Assessment Report on Disaster Risk Reduction. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

The population of the world has almost doubled between 1970 and 2010, during which time the global GDP has more than tripled from 12.4 to 40.2 trillion dollars (in constant 2000 US$). The Asia-Pacific GDP has grown by four and a half times during the same period, demonstrating an increase from 23 per cent to 33 per cent of the world GDP over these 40 years. Contrary to the physical exposure which shows different trends in the various subregions, the trends in economic exposure are increasing for

Figure I.XI **Percentage change in relative mortality risk in the Asia-Pacific region**



Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction*. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

nearly all subregions and for each of the hazards considered. The East and North-East region exhibits a concentration of primary economic exposure, while the rate of increased economic exposure varies among the other subregions and hazards. The sole exception to this observation is North and Central Asia which maintains a very low level of absolute exposure except for flood hazards.

Table I.8 **Economic exposure of Asia-Pacific subregions to tropical cyclones, 1980-2010**

Subregion	Economic exposure in billion 2000 US dollars			
	1980	1990	2000	2010
East and North-East Asia	738.9	1134.2	1398.3	1627.8
North and Central Asia	0.2	0.2	0.1	0.2
Pacific	2.8	4.2	6.1	7.7
South-East Asia	13.3	15.9	21.8	33.8
South and South-West Asia	1.4	2.3	3.9	7.4
Total	756.6	1156.9	1430.2	1677.0

Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction*. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

Table I.9 **Economic exposure of Asia-Pacific subregions to floods, 1980-2010**

Subregion	Economic exposure in billion 2000 US dollars			
	1980	1990	2000	2010
East and North-East Asia	4.6	8.3	14.4	27.0
North and Central Asia	1.2	1.4	1.0	1.6
Pacific	0.4	0.5	0.7	0.9
South-East Asia	2.4	3.9	6.4	10.7
South and South-West Asia	4.5	6.9	11.2	20.6
Total	13.1	21.0	33.7	60.8

Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction*. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

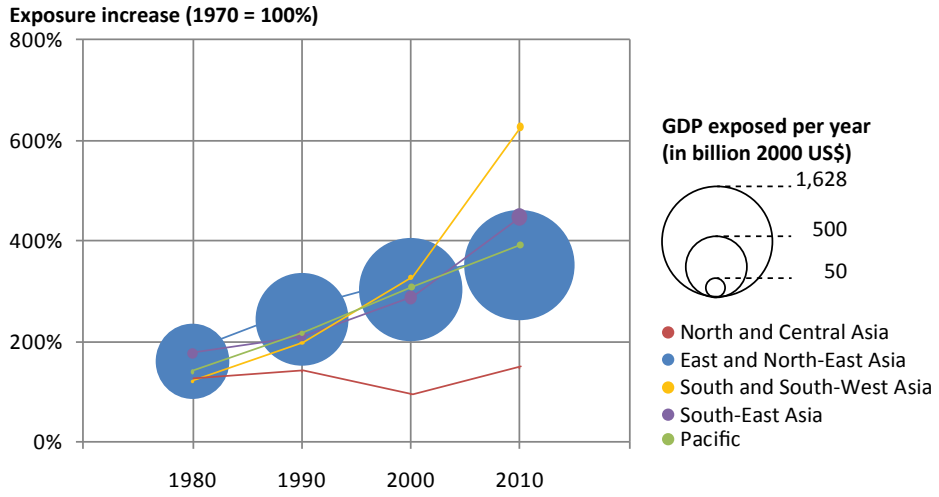
Economic exposure to tropical cyclones

Figure I.XII and table I.8 illustrate that since 1970 the Asia-Pacific region steadily accumulated more than 85 per cent of the global economic exposure to tropical cyclones. East and North-East Asia accounts for 98 per cent of the total Asia-Pacific exposure which has quadrupled since 1970. Other subregions show a similar trend of four to five times in the growth of their respective economic exposure from a 1970 baseline, except in North and Central Asia where it has varied only moderately above 1970 values.

Economic exposure to floods

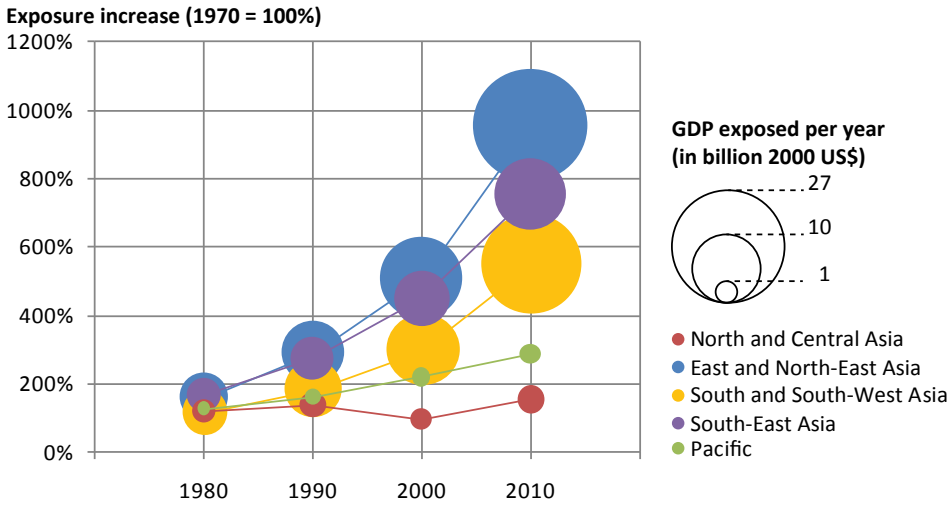
The rate of increase in economic exposure for flood hazard from 1970-2010 is the highest of all hazards

Figure I.XII **Trends in economic exposure to tropical cyclones in Asia-Pacific subregions, 1970-2010**



Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction.* (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

Figure I.XIII **Trends in economic exposure to floods in Asia-Pacific subregions, 1970-2010**



Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction.* (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

being considered (figure I.XIII and table I.9). It has increased 1000 per cent in East and North-East Asia, almost 800 per cent in South-East Asia, and nearly 600 per cent in South and South-West Asia. With this growth in their economic exposures these three Asian subregions have increased their combined percentage of global economic exposure to floods from 26 per cent to 49 per cent.

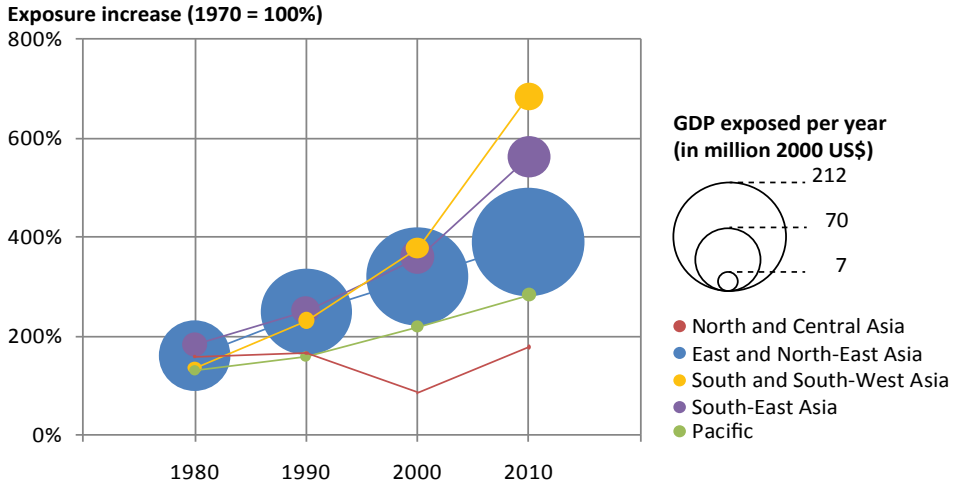
Economic exposure to rain-triggered landslides

Figure I.XIV and table I.10 indicate that as with the case of other hazards, East and North-East Asia represents the predominant economic exposure to rainfall-triggered landslides in the region with 85 per cent of the total. Despite the scale of exposure being measured in millions of dollars instead of billions as with tropical cyclones and floods, the rate of increase nonetheless remains significant since 1970. East and North-East Asia's economic exposure has grown by 400 per cent and South and South-West Asia has increased by more than 600 per cent.

1.5 Recognition of low-severity and high-frequency disaster impacts

As people consider the seriousness of various disasters, there is a tendency to focus on powerful earthquakes,

Figure I.XIV **Trends in economic exposure to rainfall-triggered landslides in Asia-Pacific subregions, 1970-2010**



Source: United Nations International Strategy for Disaster Reduction, Global Assessment Report on Disaster Risk Reduction. (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

Table I.10 **Economic exposure of Asia-Pacific subregions to rainfall-triggered landslides, 1980-2010**

Subregion	Economic exposure in billion 2000 US dollars			
	1980	1990	2000	2010
East and North-East Asia	86.4	134.9	173.2	211.6
North and Central Asia	0.3	0.3	0.2	0.3
Pacific	1.6	1.9	2.6	3.4
South-East Asia	10.3	14.1	20.1	31.4
South and South-West Asia	2.8	4.8	7.9	14.2
Total	101.4	156.0	204.0	261.0

Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction.* (Geneva, United Nations, 2011). Global analysis, reprocessed at subnational level by UNEP/GRID-Geneva.

1:100 year return tsunamis, unprecedented floods or historically destructive tropical cyclones. Recent study rather suggests that the accumulated consequences of recurrent small or medium-scale disasters have the greater impact.

The analysis of large and small-scale disasters, sometimes referred to as being either "intensive" or "extensive" depending on whether they are high-severity and low-frequency events or low-severity and high-frequency ones respectively, shows the serious extent of their often higher mortality and economic losses. These observations can be demonstrated by analysing the historical records of national disaster databases. Examples from the Islamic Republic of Iran and Nepal both indicate that small-scale disasters can cause similar numbers of death and property losses over a period of time when compared to individual, larger disasters (figures I.XV and I.XVI).

1.5.1 Mortality and property losses increase in small-scale disasters

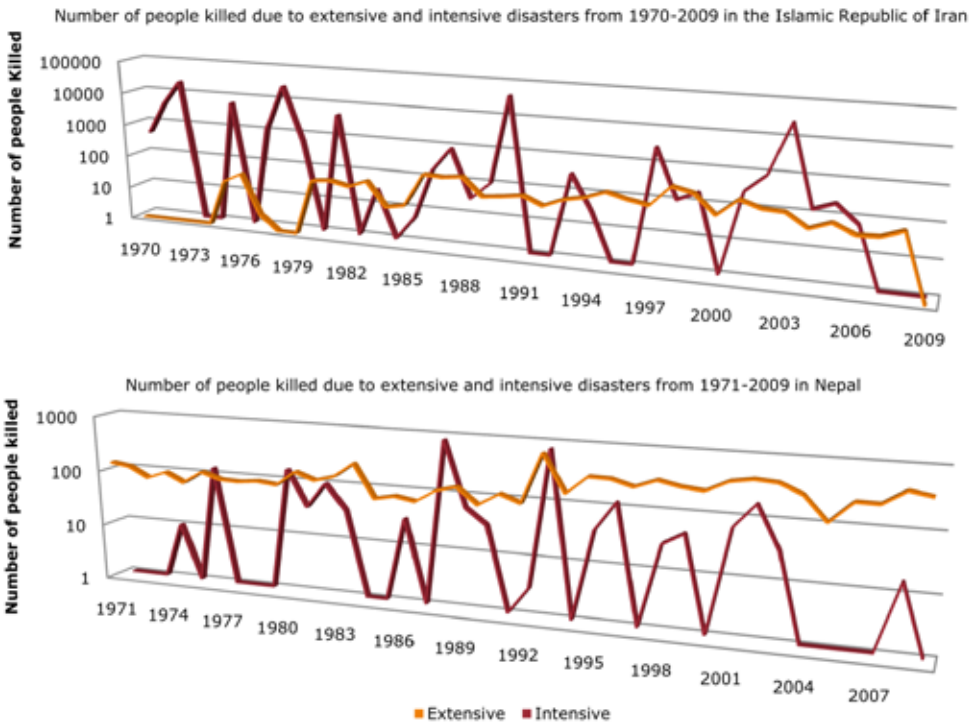
GAR 2011 noted that the risk of death in a cyclone or flood is generally less now than it was 20 years ago, but in several Asia-Pacific countries mortality in extensive disaster events is still increasing. The incidence of mortality in extensive disasters between 1990 and 2009 in Indonesia and Viet Nam demonstrates this trend (figure I.XVII).

In addition to mortality, economic losses also are increasing in extensive events, at least in some countries. Figure I.XVIII shows that increasing property losses can be associated with growth in economic development of a country when measured in terms of GDP per capita (World Bank, 2012). As discussed in the previous sections, despite the economic growth across the Asia-Pacific region, more people are exposed and assets continue to be lost as consequences of disasters.

1.6 Urbanization presents increasing risk patterns

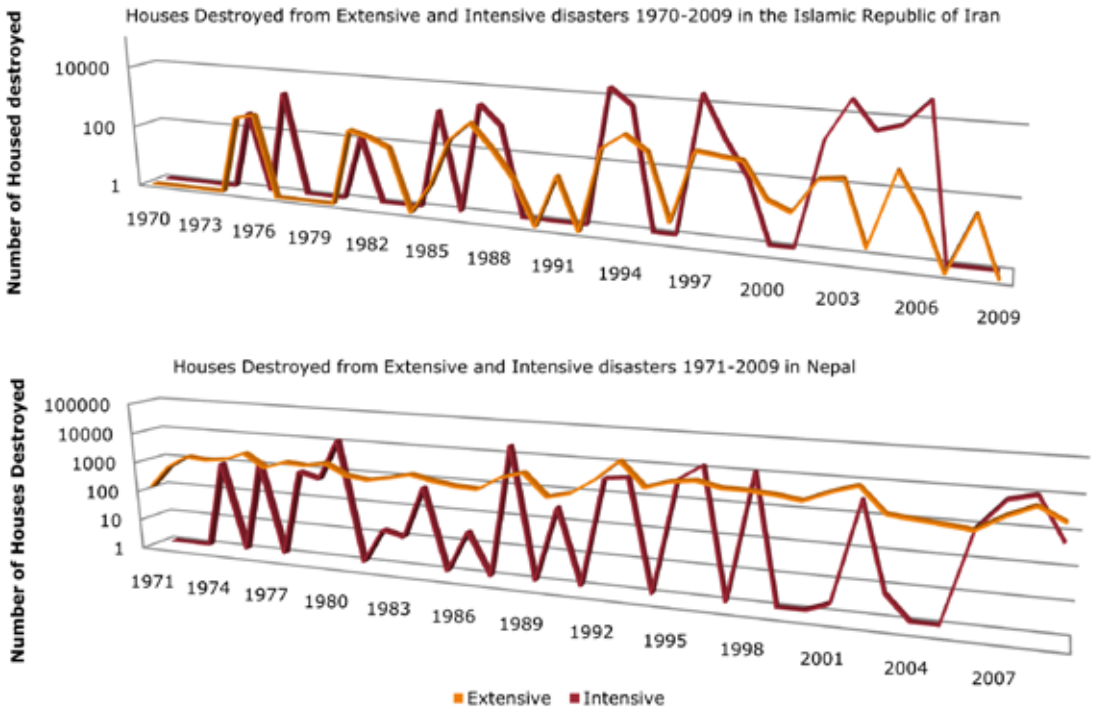
The rapid urbanization and the corresponding higher density of urban populations across Asia and the Pacific result from both economic growth and

Figure I.XV **Mortality from extensive and intensive disaster events in the Islamic Republic of Iran, 1970-2009, and Nepal, 1971-2010**



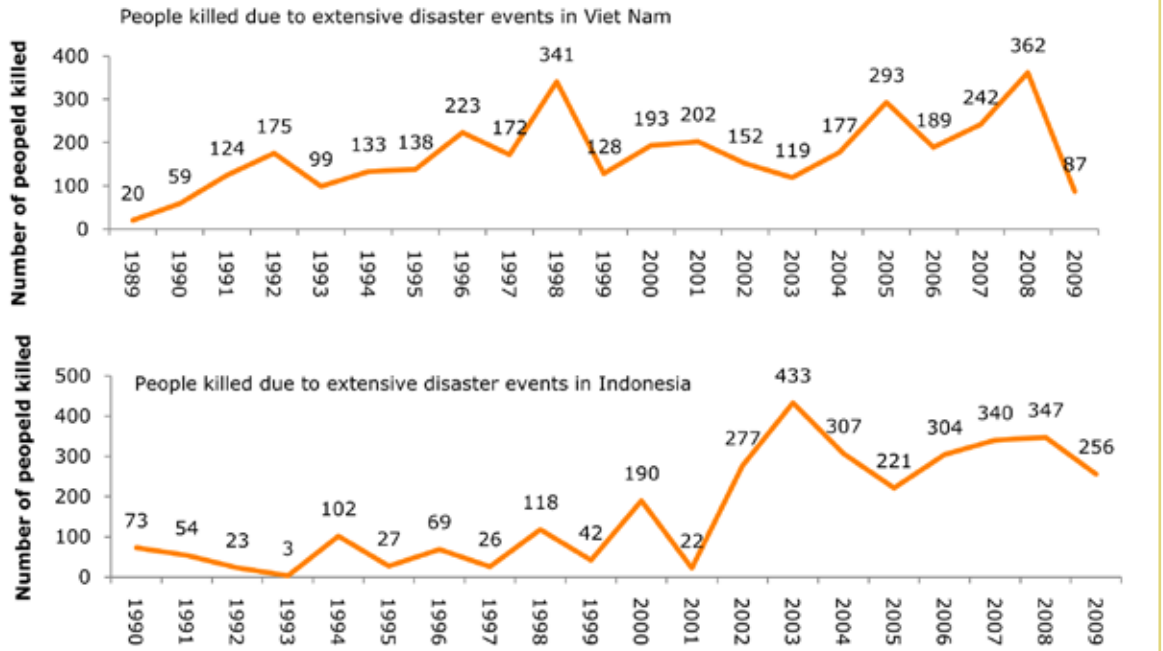
Source: UNISDR from DesInventar Project Team, Disaster Information System Database. http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=or (accessed 20 May 2012).

Figure I.XVI **Houses destroyed by extensive and intensive disaster events in the Islamic Republic of Iran, 1970-2009, and Nepal, 1971-2009**



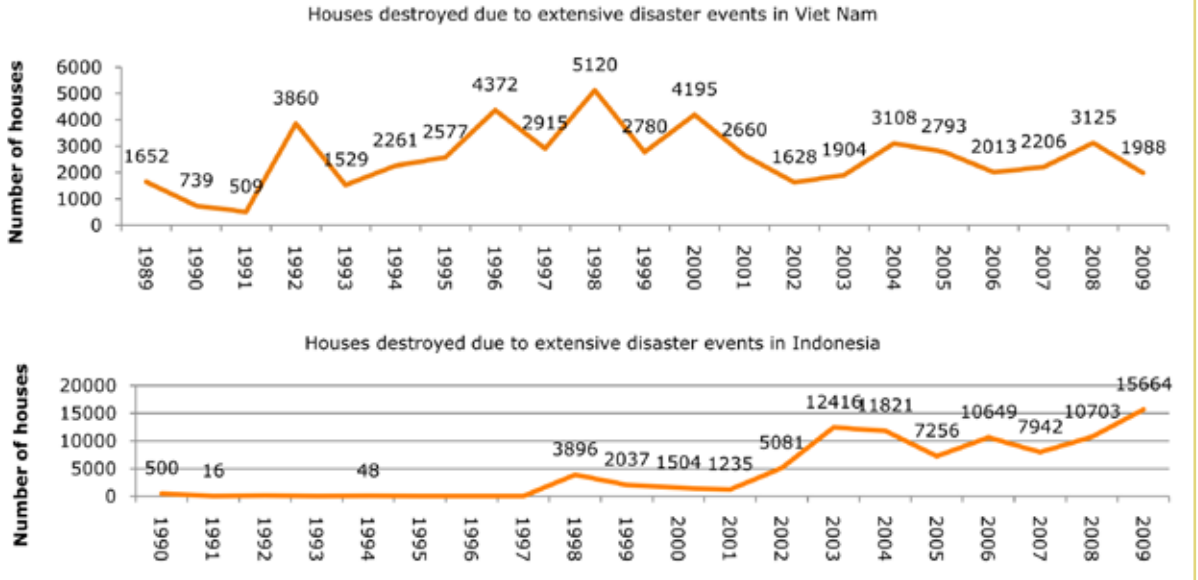
Source: UNISDR from DesInventar Project Team, Disaster Information System Database. http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=or (accessed 20 May 2012).

Figure I.XVII **Mortality in extensive disasters in Viet Nam, 1989-2009, and Indonesia,1990-2009**



Source: UNISDR from DesInventar Project Team, Disaster Information System Database. http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=or (accessed 20 May 2012).

Figure I.XVIII **Houses destroyed in extensive disasters in Viet Nam, 1989-2009, and Indonesia, 1990-2009**

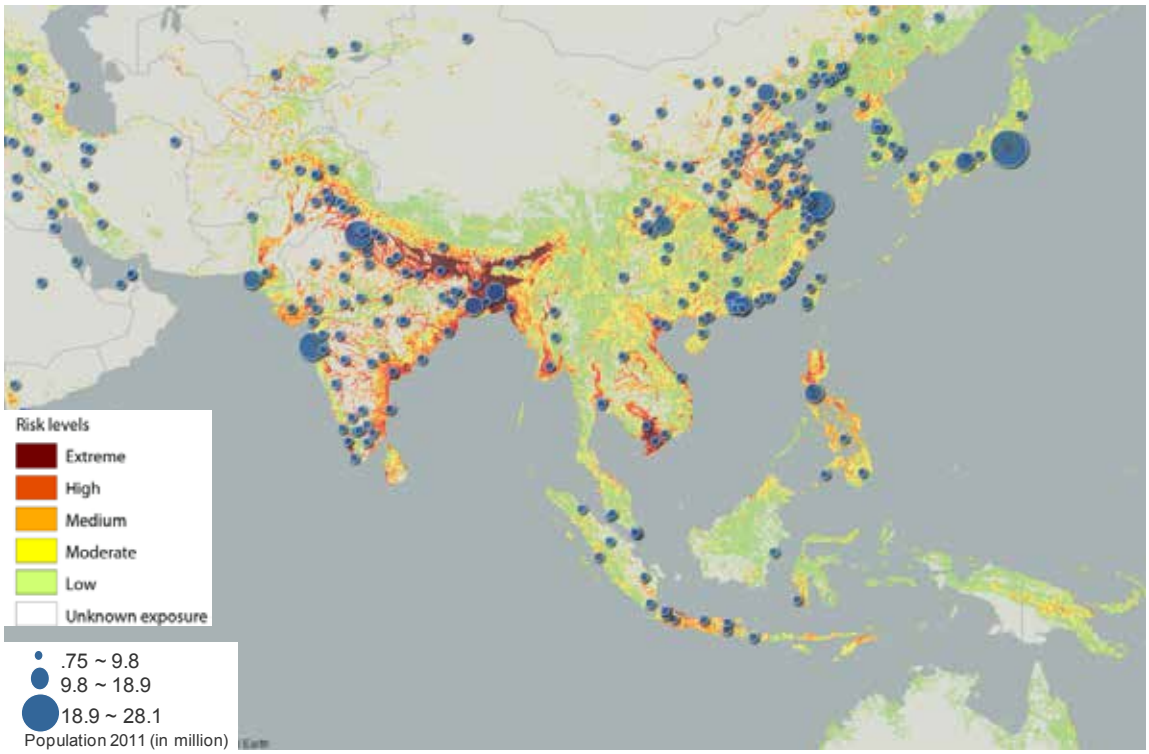


Source: UNISDR from DesInventar Project Team, Disaster Information System Database. http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=or (accessed 20 May 2012).

development opportunities. Together they stimulate greater incoming migration. The percentage of Asia's population considered to be urban has increased from 17 per cent to 44 per cent between 1950 and 2010; it is likely to reach 64 per cent by 2050. Thirteen of the 20 most populated urban areas in the world are presently in Asia. It is estimated that by 2030 about 60 per cent of the world's population will live in urban areas and by 2050 this figure will have risen to 70 per cent (UNDESA, 2011).

These magnitudes and the pace of this rapid urbanization certainly places more people and economic assets at risk, especially as urban areas concentrate people and economic assets, often in particularly hazard-prone coastal areas and

Figure I.XIX **Major Asian urban locations in 2011, and the distribution of potential mortality risk from hydro-meteorological hazards**



Sources: Potential mortality risk: UNEP and UNISDR, The PREVIEW Global Risk Data Platform. http://preview.grid.unep.ch, 2000-2011 (accessed May 2012).
Cartography by UNEP/GRID, Geneva 2012.
Urban agglomerations: Based on *World Population Prospects: The 2008 Revision and World Urbanization Prospects: The 2009 Revision* (Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2009).
Cartography: UNISDR
Disclaimer: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

along rivers or in flood plains Of the 305 urban agglomerations in the Asia-Pacific region, 119 are situated along Asian coastlines (UNDESA, 2011) where they are frequently exposed to hydro-meteorological hazards. In the developing world, some 95 per cent of urban population growth takes place in low-quality, overcrowded housing or is associated with informal settlements (World Bank, 2010).

By combining data about the distribution of mortality risk in Asia with the location and growth of current urban agglomerations, the likelihood of prevailing risks leading towards future disasters becomes very evident (figure I.XIX). Many primary urban locations are in areas of medium to extreme mortality risk from disasters as exemplified by the examples of the Indo-Gangetic plain, economically important coastal areas of southeastern China and Viet Nam, and the many densely populated cities in South and South-West Asia, and among the metropolises of East and North-East Asia.

It is crucial that these features be fully realized as a reflection of current disaster risk in Asia and the Pacific. This has implications for how risk is likely to be realized in the form of a disaster. Over recent decades there has been a more limited view of disasters as occurring in rural or largely agrarian environments. Typically a predominantly rural and often agrarian environment has been considered the scenario stimulating efforts to develop more effective means of responding to emergency assistance needs of impoverished. Often belatedly, administrative arrangements and resources were committed to manage effective recovery in the aftermath of disasters.

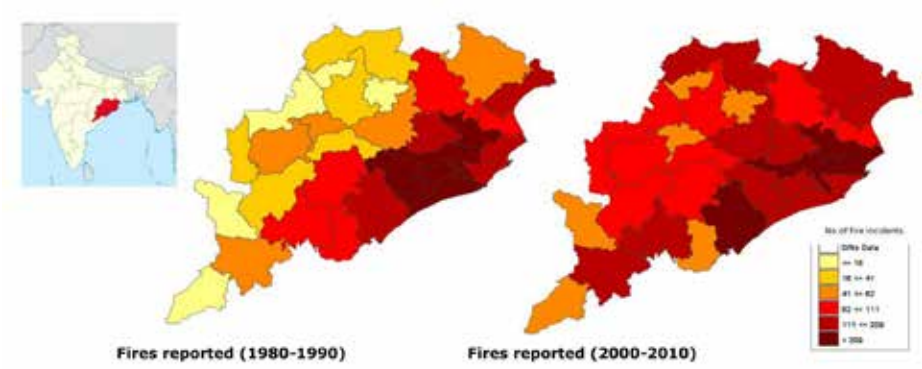
Considering the current reality of significantly increased urban exposure to future disasters, with their concentration of populations, capital assets and the economic activities which that entails, presents new and unique challenges, but also previously unrealized opportunities, for strategic disaster reduction. The principles of community-based disaster risk management which have been promoted and applied with rural contexts uppermost in mind for the past two decades urgently need to be reconsidered, if they are to be applied effectively in urban environments. The need for empowering both anticipatory and compensatory disaster risk management capacities in cities will be critical in coming decades.

Table I.11 **Household fires caused by extensive risks in Odisha, India, 1980-2010**

Year	Fire incidents	Losses (million Indian Rupees)	Houses destroyed	People affected	Deaths
1980-1990	1 351	873	171 658	335 377	268
1990-2000	1 208	828	74 638	138 307	847
2000-2010	980	1 603	73 973	545 547	283

Source: UNISDR from DesInventar Project Team, Disaster Information System Database. http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=or (accessed 22 May 2012).

Figure I.XX **Statewide distribution of extensive household fire events in Odisha, India**



Source: UNISDR from DesInventar Project Team, Disaster Information System Database. http://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=or (accessed 22 May 2012).
Disclaimer: The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Unplanned growth increases risk: settlement fires in Odisha, India

The rapid population and economic growth of cities are pushing communities into unsustainable practices, such as by encroaching on fragile landscapes, living in vulnerable structures and unsafe congested environments. GAR 2011 highlighted how extensive risks are expanding and the example of settlement fires in the Indian state of Odisha confirms this finding. Historical disaster records for Odisha from 1980-2010 (DesInventar, 2012) indicate that while the number of both urban and rural fire events have declined, their severity has increased. Data summarized in table I.12 indicates that while there was a 27 per cent reduction in the number of fires from 1351 events during 1980-90 to 980 between 2000 and 2010, figure I.XX illustrates that the locations of the fires spread from occurring in 6 districts in 1980-1990 to 15 in 2000-2010. It is also significant that while the number of houses destroyed in the last reported decade was less than half of those in 1980-1990, the value of the losses had more than doubled and the number of people affected in the past decade was 60 per cent more.

The population density of Odisha's capital Bhubaneswar increased from 638 people/km^2 in 1951 to 6172 people/km^2 in 2011. During this period, both the population and the housing have increased, although the rapidly growing demand for housing has not always been satisfied by adequate and safe houses. The expanding urban population has resulted in more informal settlements and slum dwellers as indicated by the more than 350,000 people living in unsafe housing in 377 slums in Bhubaneshwar alone.

Most of the fire incidents occur in vulnerable conditions associated with the unplanned growth of human settlements, congested markets and in slums with primary causes often traced to inappropriate housing design, unsafe construction or electrical short circuits. The lack of fire safety measures or enforcement of fire regulations only adds to the problem.

1.7 Emerging risks

The emergence of complex hazards such as the combined Great East Japan Earthquake, the resulting tsunami, and the serious nuclear disaster event which was triggered in Fukushima, Japan in March 2011 demonstrates an urgent need for expanded thinking and attention for future disaster risks. Despite some similar features in terms of magnitude and far-reaching effects with the aftermath of the 2004 Indian Ocean tsunami, a more considered comparison reveals some significant differences. The Indian Ocean tsunami was the third most deadly disaster since 1975 affecting many countries. The 2011

Japanese tsunami resulted in the largest economic losses recorded from a disaster (CRED, 2012), primarily affecting a single country. By drawing on these two examples, there are additional important distinctions to be made in understanding the nature of possible events, their multiple consequences and the duration of the impacts of likely, if not previously imagined, future disasters.

Most States are presently prepared to respond to natural hazard crises and to arrange initial emergency assistance, even though the capacities and available resources varies widely. The anticipation of extraordinary events, and increasingly previously unconsidered crises is rare as disaster management policy and practice is prone to plan from past example rather than from future possibilities of risk. The Fukushima nuclear incident demonstrated how radiation severely limited access to the primary areas of consequence and need, even when authorities are trying to respond to the threats, contain their worst effects, and to limit much wider destruction.

The long-lasting effects of a nuclear incident also can remove large areas of land and other essential resources from human use for an extended time, imposing significant limitations on the habitation, livelihoods and basic economies of affected communities. Additional national threats can spread through a society as extraordinary or complex events impact food or water security, energy policy or supply, public health, or the abrupt loss of shelter and community for very many people. The inability of authorities to anticipate and be able to address critical disaster conditions can erode the accepted roles of government that extend much beyond matters of public safety.

After the Indian Ocean tsunami the coastal infrastructure and, many if not all livelihoods were restored within months or not more than some years later. The full recovery of land, population settlement and livelihoods in areas affected by Fukushima's nuclear radiation may takes decades or even generations to achieve. The reconsideration of Japan's national energy policies after the Fukushima event is another far-reaching consequence with extreme future economic implications.

The organization of societies continues to evolve with improved technologies and more information continuously becoming available which can decrease people's vulnerability. These same advances equally can expose more people to potentially dangerous infrastructure with their growing complexity, leading more easily to secondary hazards. Despite the progress that continues to be made and even with the better understanding about reducing disaster risks, large sections of humanity continue to live under poor conditions that expose them to disproportionate mortality from natural hazards when compared to more developed societies (UNDP, 2004).

By contrast, the Fukushima radiation circumstances highlight the highest economic and technological vulnerability of developed countries. The underlying lesson for all societies is that "zero risk" does not exist anywhere. In facing the prospect for future risks with such long term consequences risk management planning must anticipate wider and more complex dimensions of future disasters. This includes possibilities such as nuclear contamination, seriously demobilized cities, suspended public services or disrupted commercial supply chains from public health epidemics such as Severe Acute Respiratory Syndrome (SARS) or Avian influenza. While these hazards are familiar to specialists, comprehensive risk planning for possible future hazards has received insufficient consideration on a society-wide basis.

Because of its dynamic nature, risk needs to be re-evaluated periodically. Studying risk requires the understanding of all its components: the distribution, frequency and intensity of natural hazards; the potential influence of climate change on various hazards; the intervening roles of humankind; the demographic changes in population density, location and equitable access to the assets on which they must depend. Attention also has to be focused beyond the physical characteristics of exposure, considering the evolution of socioeconomic conditions and the related contexts associated with human vulnerability. This continuing evaluation cannot be separated from a wider understanding of the relationships and potential impacts of changing and often deteriorating ecosystems and natural resources on future disaster risks.

In looking towards the future, more consideration needs to be given to the human-technological interfaces that exist among human society, natural hazards and the potentially dangerous assets that drive development and national growth. These include nuclear power facilities, the chemical industry, dams and other energy systems and infrastructure, and the interdependent elements of electronic communications. All of these elements are bound together in modern societies which remain exposed to the cumulative effect of successive or compound disasters. Future leaders need to be enquiring and bold as they acknowledge that not all accomplishments reduce human vulnerability. The evaluation and management of risk will remain a constant quest.

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Annex I.1
Definitions and concepts of risk and related terms

Risk and its components

Historically risk evolved from the perspective of a physical event to a more integrated approach taking account of additional socio-economic factors which influence human vulnerability. Various disciplines such as natural science, engineering, social science, humanitarian action, and sustainable development each had a distinctive focus for risk concepts. While a particular context was meaningful within the individual community of practice, it could be viewed differently by other practitioners. Individual disciplines sometimes used the same words but with different meanings or connotations. Because the definitions are not universal, a clarification is provided here to understand how the key concepts of risk and related terms are used in the present report.

As the professional and institutional contexts of this document reflect the work and interests of the United Nations , the choice of terminology employed follows closely that which is used by UNDP and UNISDR. The definitions provided here are derived primarily from UNISDR's terminology, http://www.unisdr.org/we/inform/terminology (UNISDR, 2011b).

Risk

Risk should not be confused with losses. Losses or impacts refer to the number of human losses, the type and amount of infrastructure damaged or destroyed, or the amount of crops damaged other economic losses, or quantifiable damage to the natural environment. They are sometimes referred to "realized risk" or "disaster losses" (Peduzzi, 2012).

By observing the related components of risk as described by UNDRO (1979) in the notation,

$R = H * E * V$

Where:
R = Risk (expected losses for a specific length of time, hazard type and intensity)
H = Hazard (frequency of occurrence, for a specific intensity)
E = Elements at risk (number of people or assets), (also see Exposure, below)
V = Vulnerability (percentage of losses as compared with total exposure)

Risk is the outcome of the interaction between a hazard phenomenon, the elements at risk in a specific location or community, and the extent of likely vulnerability of those elements to loss or damage. This relationship among the components is justified because should any one of them (hazard, exposure or vulnerability) be absent, then the risk is nil (Peduzzi et al., 2001; Peduzzi et al., 2002; UNDP, 2004). Each of these components is described below.

Hazards

A hazard is the probability of occurrence of a physical phenomenon which may threaten human lives, lead to injuries, property damage or dysfunction of social and economic systems or the degradation of natural ecosystems, depending on related vulnerability of the elements exposed (UNISDR, 2011a).

Each hazard can be characterized by its location, frequency (probability of occurrence), and strength (measured in magnitude, intensity or toxicity) (UNISDR, 2011a). The potential destructive power of a hazard depends on the magnitude, duration, location, and timing of the event (Burton et al., 1993).

Hazards can be of natural origin, a category that includes tectonic hazards (such as earthquakes, tsunamis, volcanic eruptions); hydro-meteorological hazards (such as floods, tropical cyclones, rain-triggered landslides); biological hazards (such as plague, epidemics) and climatic hazards (such as drought, temperature extremes). They can also be of anthropogenic origin, such as pollution (oil or chemical spills, nuclear accidents), fires, civil conflict or explosions. Many hazards can trigger secondary hazards, which in some cases lead to greater impacts than those of the initial hazard. For example, the 2011 Japanese earthquake created a devastating tsunami, which in turn led to a major nuclear incident.

Exposure

Exposure is the number of "people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses." (UNISDR, 2011b). Measures of exposure can include the number of people or types of assets in a specified location or area. An intersection between an area potentially affected by a hazard and the population or economic assets can be described, for example by using GIS techniques to identify how many people are living or assets are located in a hazard-prone area.

Vulnerability

Vulnerability is a complex component to comprehend. For UNISDR, vulnerability includes "the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. […] arising from various physical, social, economic, and environmental factors" (UNISDR 2011a). Vulnerability also can be computed as a percentage of losses as compared with total exposure (UNDRO, 1991).

The present report addresses vulnerability through contextual parameters associated with vulnerability. These include the elements of poverty, capacity of early warning, knowledge of emergency action or crisis management, the existence of appropriate evacuation plans or presence of shelters, or the appropriate design of buildings, among other protective or mitigating practices. When information is not necessarily available directly, proxy indicators may be employed to express relative degrees of existing vulnerability. For example, the number of radios per inhabitants can be a useful indicator of early warning capacity.

There are additional supporting notions related to vulnerability.

Coping capacity is "the ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters" (UNISDR, 2011a). Vulnerability and coping capacity can be merged. Coping capacity

can be seen as the opposite of vulnerability, although in theory vulnerability is more closely associated to an individual's abilities and attributes whereas coping capacity is associated with an institutional or wider societal embodiment or demonstration of collective capabilities.

Resilience is "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2011a). Resilience is used more specifically in engineering to compute the solidity of buildings, as for example in expressing their resistance to a shock.

Decreasing the likely occurrence of a hazard or the extent of existing vulnerability with means of structural resilience can be achieved by building dikes or dams for avoiding or minimizing flood hazards. Retrofitting buildings through structural improvements or improving the design and enforcement of building codes to make the structures more resilient to higher cyclone intensities are additional examples of effective resilience measures. However, structural resilience also may increase exposure and lead to a disaster should the hazard be stronger than the maximum forces envisaged when building infrastructure.

Measuring resilience can be challenging for a society. It is a concept that can be better understood when it can be considered by evaluating a variety of other indicators. These can include assessing the levels of wealth, education, information, preparedness within a community, or by considering the relative existing exposure to hazards, quality of planning, level of governance, participation of civil society, culture and perception of risk among the population concerned. While there is no comprehensive way of measuring vulnerability, resilience and coping capacity physically, there are a number of methods that attempt to grasp these concepts and characterize them as usefully as possible (Birkmann et al., 2006).

Thailand Floods (2011)
Credits: Nuttun Chanchumras

2 Scaling up vulnerability reduction

The socio-economic gains from growth across the region have been dramatic, despite their having been uneven. Consequently, considerable progress has been achieved in implementing the Millennium Development Goals (MDGs) and the Hyogo Framework for Action (HFA). Yet human casualties and economic losses from disasters have continued to increase, with negative effects on the growth potential of affected countries and the human development capacities of their populations. This suggests that people's vulnerabilities to hazards continue to rise, and economic and social vulnerabilities are closely interlinked. There is now an urgency to manage disaster risks within an overarching sustainable development framework.

This chapter underscores reforms in social protection systems that can build the coping capacities of poor and vulnerable people before a disaster occurs, and foster more effective recovery processes afterwards. Consistent with the United Nations Conference on Sustainable Development (Rio+20) outcome document, future development agendas will need to acknowledge these increasingly complex realities of growing risks, and strive to integrate them within development strategies, policies and practices. This chapter proposes means to create common ground between MDG and HFA implementation.

2.1 Introduction

The trends discussed in chapter one are very much affected by the underlying vulnerabilities of people living in areas exposed to natural hazards and the individual and institutional capabilities to cope with them. This is central to the Hyogo Framework for Action (HFA), and even though disaster risk reduction was not explicitly included in the formulation of the Millennium Development Goals (MDGs), the Millennium Declaration recognized that "disasters can jeopardize development" and included a commitment to intensify "collective efforts to reduce the number and effects of natural and manmade disasters". As economic and other losses from disasters have continued to increase it is clear that they make the attainment of MDGs more precarious and lasting development accomplishments more uncertain.

Notably, the United Nations Secretary-General's report "Keeping the promise" (United Nations, 2010) was clear about the risk of disasters increasing globally, and that it was highly concentrated in middle- and low-income countries. Reducing that risk and increasing resilience to natural hazards in the various development sectors would multiply opportunities to accelerate the achievement of the MDGs.

This is emphasized in the outcome document from Rio+20, (United Nations, 2012) which stresses the importance of stronger linkages among disaster risk reduction, recovery and long-term development planning in line with the three dimensions of sustainable development. It also reaffirms the global community's commitment to the HFA and "....calls for DRR and the building of resilience to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication". Future efforts after 2015 will build on the progress already achieved in meeting internationally agreed goals and strategies.

There is considerably more interest now in pursuing essential linkages between MDGs and the HFA in terms of underlying economic and social vulnerabilities. However, establishing these complex linkages has proven to be challenging. Both the MDGs and HFA contain numerous goals, targets and indicators that are expressed differently and which have their own linkages within each framework. This makes the task of identifying correlations between the two frameworks very complex, so the final section of this chapter explores a possible approach to identify and capitalize on such linkages.

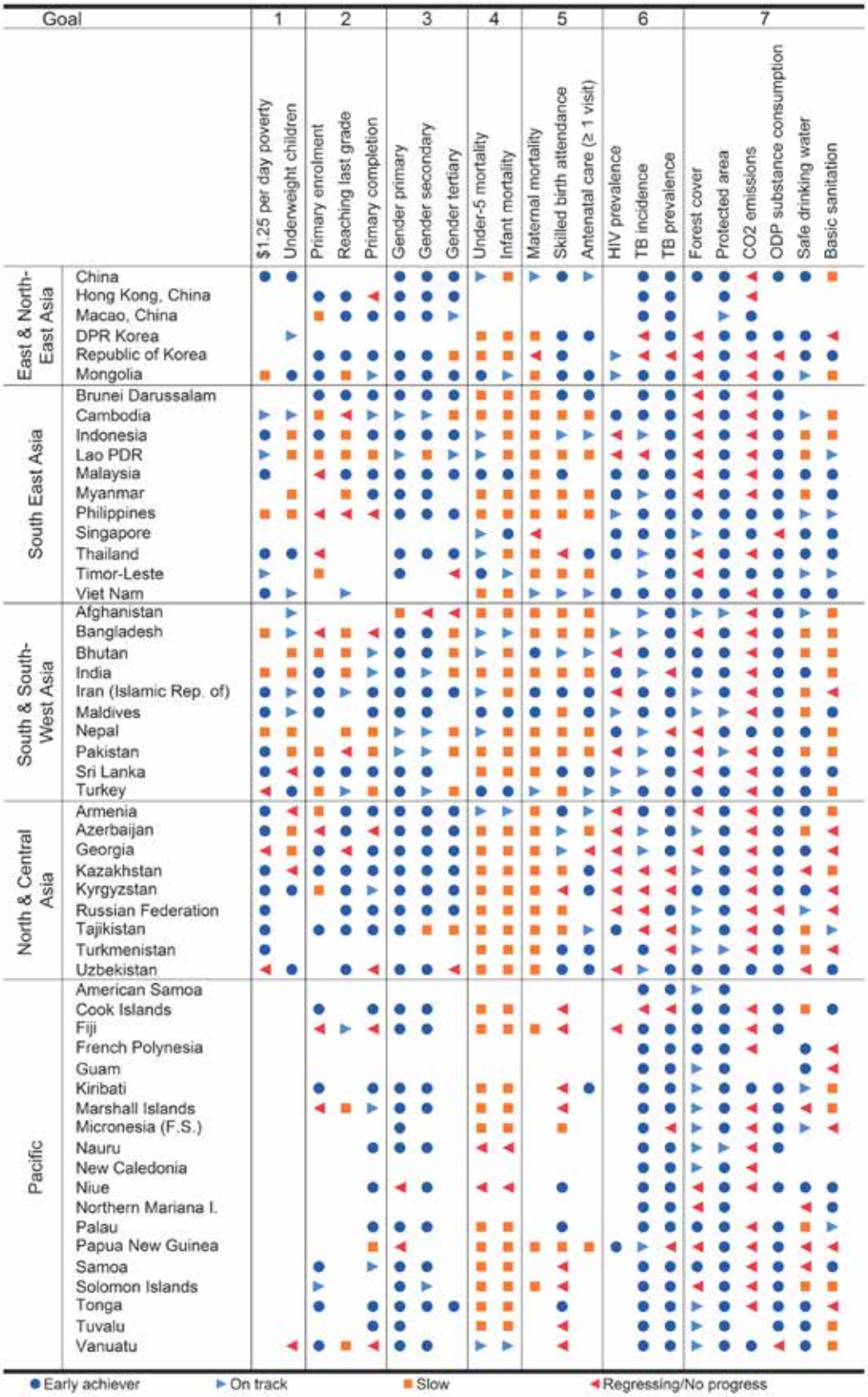
2.2 Critical vulnerabilities in Asia and the Pacific region

The gains from socio-economic growth have been dramatic in Asia and the Pacific, though they are distributed unevenly across the region. Between 1990 and 2009, 699 million people have been lifted out of absolute poverty. Most countries have grown rapidly, with urban areas having become centres of wealth accumulation with significant social, educational and health improvements couched in rich cultural values. Infant mortality has been reduced by nearly 40 per cent. As the proportion of people living on less than $1.25 a day has been halved from 50 per cent to 22 per cent of the population, better opportunities for improved housing, individual living conditions and livelihoods have reduced some disaster vulnerabilities. Good progress has been made towards the MDG targets for reducing gender disparities in primary and secondary education, reducing HIV prevalence and the spread of tuberculosis, reducing the use of ozone-depleting substances, and halving the proportion of people without access to safe drinking water (United Nations and ADB, 2012) (figure II.I). Although 505.5 million people live in slums in Asia and the Pacific constituting half the world's slum population, the region has had considerable success in achieving the MDG goal of improving the standards of living for 172 million slum dwellers between 2000 and 2010 (UN-HABITAT, 2010).

However, these improvements also mask other major areas where Asia and the Pacific is still lagging. The proportion of protected land areas and forests has increased significantly, but many of the forests are plantations of non-native species, which does not support the MDG target to reduce biodiversity loss. The remarkable gains made in poverty alleviation have been concentrated in South-East Asia and China. Least Developed Countries (LDCs) and other small economies have made no or limited progress in most of the MDGs.

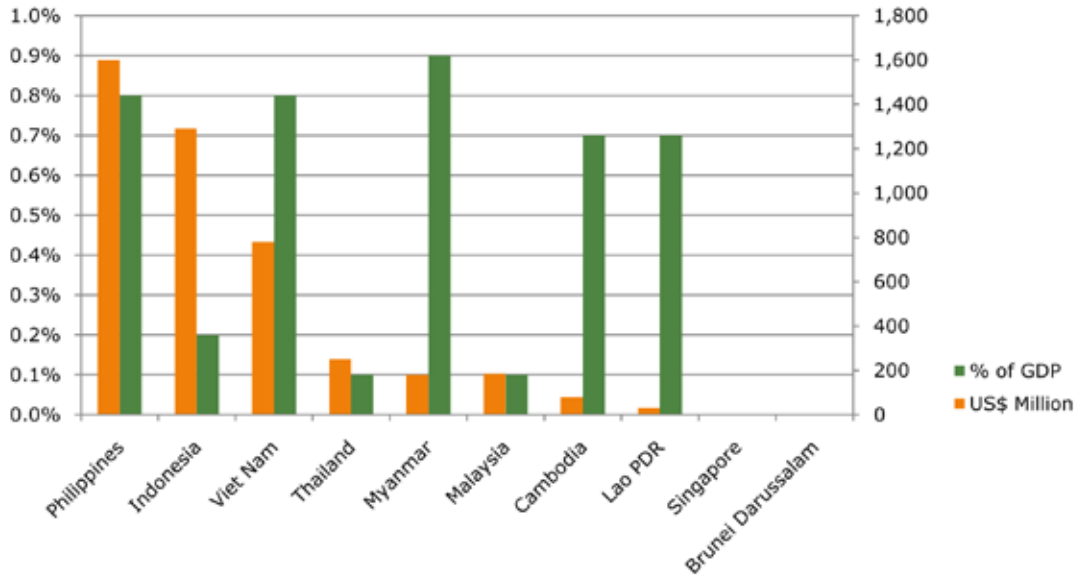
Consequently, Asia-Pacific is still home to the largest number of people without basic sanitation. The region also has more underweight children under 5 years, more people infected with tuberculosis, and the largest number of rural inhabitants without access to clean water than anywhere else (United Nations and ADB, 2012). Extreme poverty still affects 782 million people in the region (ESCAP, 2012). These conditions represent major vulnerabilities, which when combined with people's physical exposure to hazards, place populations at great risk of suffering serious disaster consequences.

Figure II.I **Progress towards accomplishing MDGs in Asia-Pacific**



Source: United Nations and ADB, *Asia-Pacific Regional MDG Report 2011/12: Accelerating Equitable Achievement of the MDGs - Closing Gaps in Health and Nutrition Outcomes* (Bangkok, 2012).

Figure II.II **Economic vulnerability in South-East Asia**



Source: World Bank, Advancing Disaster Risk Financing and Insurance in ASEAN Member States: Framework and Options for Implementation (Washington, 2012).

Several of these vulnerable conditions often are combined within individual households, just as some segments of the population are subjected to multiple types of vulnerability. An unfortunately frequent example would be an elderly woman who is disabled, poor and living alone in informal housing without proper sanitation. She would be far more vulnerable to the impacts of hazards and certainly will face greater challenges in recovering from disasters, even in contrast to other impoverished families who may be her neighbours. The frequent situation of compounded vulnerability, often overlooked as commentators focus on individual development sectors, create a vicious cycle of vulnerability.

By contrast, there are also individual communities aware of and engaged in managing the disaster risks which threaten their immediate environment and livelihoods. Some countries such as Bangladesh, Indonesia, Philippines and Viet Nam have worked systematically to reduce vulnerabilities despite a prevalence of poverty. There are also examples of countries where persistent conditions of vulnerability have prevailed despite relative affluence among much of the population.

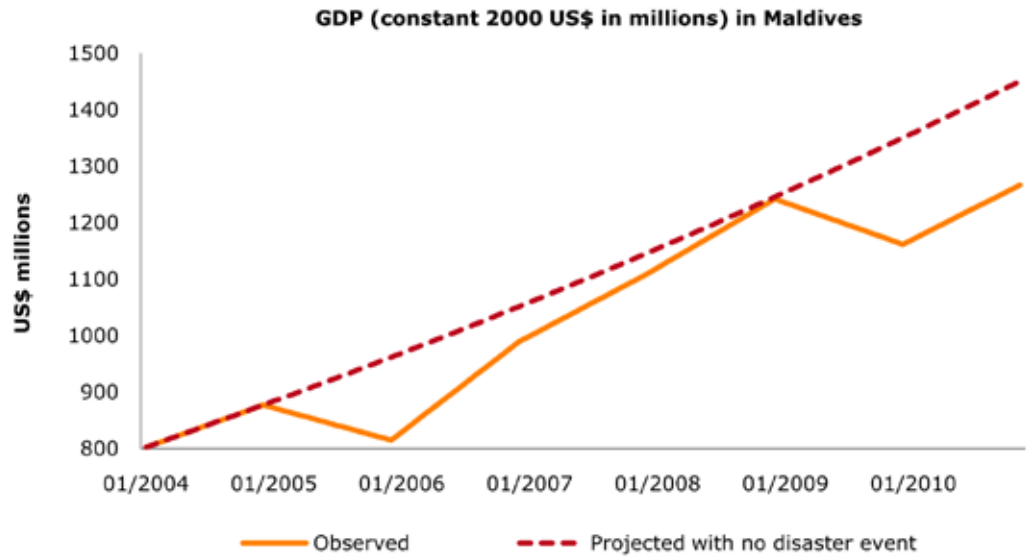
2.3 Many facets of economic vulnerability

The size of national economies, their proximity to hazard environments, the diversity of production structures, and the available fiscal space are critical factors that determine the economic vulnerability to the effects of various hazards. A recent study (World Bank, 2012a) on the economic vulnerability to disasters in 11 South-East Asian countries highlights these issues. Each year, on average, South-East Asia suffers damage in excess of $4.4 billion, equivalent to more than 0.2 per cent of the subregion's GDP, from disaster losses associated with floods, tropical cyclones, earthquakes, volcanic eruptions and droughts. Annual expected losses (AEL)[1] due to disasters have been found to be the highest for the Philippines, Indonesia, and Viet Nam, in that order, while Singapore and Brunei Darussalam present the lowest expected economic losses from the subregion. The study reports that Myanmar's average annual loss is close to 0.9 per cent of its GDP, while it is nearly 0.8 per cent in the case of Philippines and Viet Nam. These three countries have the highest AEL as a percentage of GDP in South-East Asia. The Lao People's Democratic Republic and Cambodia also have significant average annual losses equivalent to 0.7 per cent of their respective GDPs. Indonesia, Thailand and Malaysia have AELs within 0.2 per cent of their respective GDP (figure II.II).

Disasters place a significant fiscal burden on governments. The study also reports that the governments of Myanmar, the Philippines, Cambodia, the Lao People's Democratic Republic and Viet Nam face average annual disaster response bills in excess

[1] The annual expected loss (AEL) is an expression of the average annual loss over a long period of time.

Figure II.III **Variation in GDP potential following disasters in Maldives**



Source: ESCAP estimates based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain www.emdat.be (accessed June 2012). Real GDP data, World Bank, GDP, Per Capita, Population data. http://data.worldbank.org (accessed June 2012).

of 0.5 per cent of total public expenditure. Therefore, the extent of the available fiscal space is an important aspect of economic vulnerability.

The relative size of an economy adds to vulnerability, as seen particularly in the cases of the Lao People's Democratic Republic and Cambodia, but the specific contexts of different hazards and relative exposure will determine the ultimate degree of vulnerability of economic systems. In terms of absolute numbers as well as in relation to GDP, the AELs of the Philippines, Indonesia, Viet Nam, Thailand and Myanmar exemplify greater economic vulnerability in the context of hazard effects among Asian countries.

2.3.1 Vulnerability of small economies

The vulnerability of small economies to hazards is particularly apparent and can have long-term consequences for national development, especially for LDCs and Small Island Developing States (SIDS). In the case of the Maldives, the estimated damage from the 2004 Indian Ocean earthquake and tsunami was a staggering loss of over 62 per cent of GDP. The overall estimated damage exceeded $470 million with nearly 10 per cent of the country's total population directly affected (ADB and World Bank, 2004). Although the tsunami waves swept over the entire land area of the country because of its very low-lying topography, they failed to crest, preventing even greater destructive force.

The Maldives is regarded as one of the most vulnerable countries, and it is also one of the smallest. Its significantly externally-oriented economy depends on tourism for over 28 per cent of GDP and more than 60 per cent of export earnings. These characteristics make it highly susceptible to external conditions and shocks which can range from global financial crises to disasters and climate change effects. Between 2000 and 2010, the Maldives sustained an average annual real GDP growth of 6 per cent except for its decline in 2005 following the consequences of the Indian Ocean tsunami and when GDP contracted in 2009 by almost 5 per cent as tourist arrivals and capital inflow decreased because of the global financial crisis.

The magnitude of the impact of the Indian Ocean earthquake and tsunami in 2004 can be quantified by comparing the observed GDP in Maldives with a projected GDP without any disaster events.[2] The variation between the predicted and the actual GDP, and the time it took for the Maldives to return to the historical trend GDP is clearly shown in figure II.III.

Despite the heavy toll from the tsunami, the Maldives' GDP bounced back and increased until 2008 when a sharp decline occurred because of the global financial crisis. The counterfactual GDP, calculated with no external shocks, continued its upward trend to the extent that by six years after the disaster it significantly exceeded the actual GDP. Based on the

[2] See Annex II.1 for methodological notes.

counterfactual assumption, if the Maldives' economy had not been affected by the shocks, the economic growth could have averaged 8.7 per cent from 2004 to 2010, 2 per cent higher than the actual growth rate. Although it is important to note that the variation between the actual and projected GDP encompasses other destabilizing factors besides disasters, the differences provide a useful expression of the negative effects of external shocks and the resulting indicative growth consequences.

While it is important for all countries to be prepared for the compound effects of external shocks, it is particularly so for small economies like the Maldives' so that they can adjust their macroeconomic policies in a timely manner with prior fiscal considerations. This becomes a crucial strategic policy that can increase an economy's resilience to external disturbances, while also institutionalizing a continuing awareness of altered domestic vulnerabilities and to take account of emerging disaster risks. In this respect, and looking towards even the near term, it is particularly relevant that the Maldives is one of the countries in the world most prone to by rising sea levels.

2.3.2 Structural vulnerability stalls full recovery

Sometimes, an economy is not able to return to its trending long-term growth path when it is struck by another disaster which compounds its earlier losses. There are numerous reasons which can contribute to this challenge, but a weakened economic structure itself certainly can reflect more vulnerable conditions prior to the onset of successive hazards. Pakistan has been affected by a series of major disasters in the past decade and has sufficient comparable data to analyse the cumulative effects of repeated disasters.

In October 2005, a magnitude 7.6 earthquake struck mountainous areas of Afghanistan, India and particularly Pakistan was very severely affected. In Pakistan alone, the earthquake killed at least 73,000 people, injured about 70,000 more and left 2.8 million people in need of shelter barely a month before harsh winter weather. The preliminary damage and needs assessment report estimated $2.3 billion of direct damage and $576 million of indirect losses. The housing subsector incurred the most damage at $1.03 billion, followed by losses in the transport, education, agriculture and livestock subsectors. The impact of the earthquake on Pakistan's official GDP (which excludes GDP from Azad Jammu and Kashmir) was estimated to be 0.4 per cent, while the costs for recovery and reconstruction were estimated to be $3.5 billion. These combined economic impacts amounted to nearly 4 per cent of Pakistan's 2004-2005 GDP, with a substantial portion designated for housing reconstruction (ADB and World Bank, 2005).

Two years later, parts of southern Pakistan were devastated by Cyclone Yemyin and subsequent flooding. In the most affected districts of Balochistan and Sindh provinces, an estimated 371,000 people lost their homes and 2.5 million people were affected. Total estimated damage was $1.62 billion.

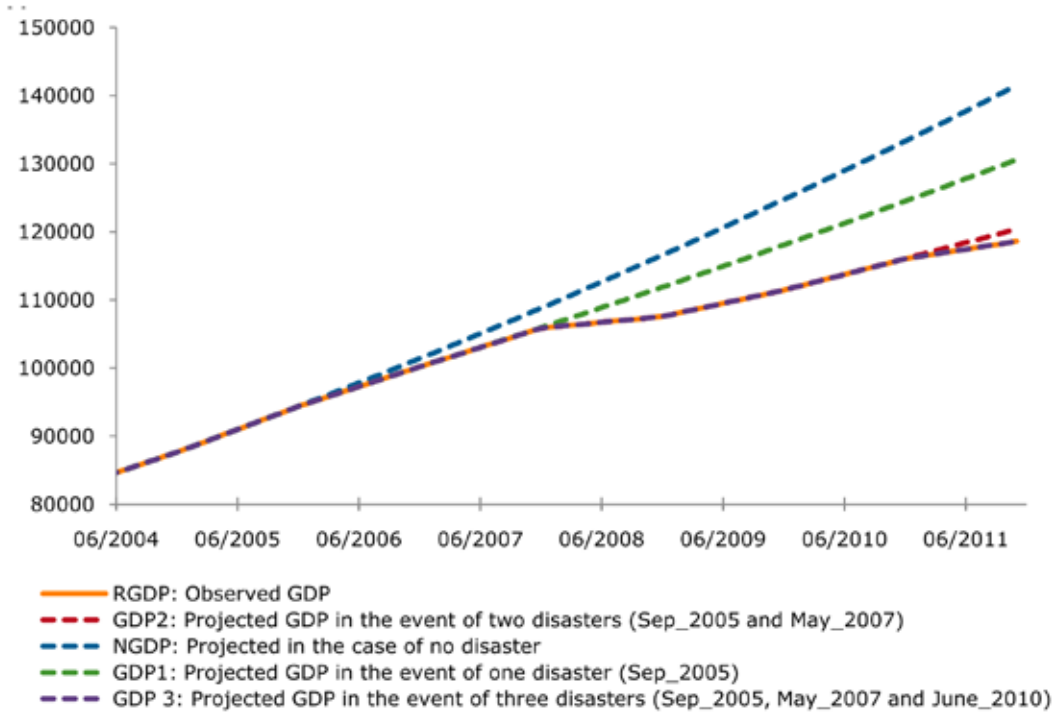
Extraordinary floods next swept across Pakistan from July to September, 2010 affecting over 20 million people and causing nearly 2,000 human fatalities. The floods and resulting landslides damaged the country's infrastructure, washed away entire villages and destroyed thousands of acres of crops and agricultural lands. The total damage and losses were estimated at $10.1 billion, with the damage accounting for about 5.8 per cent of the country's 2009/2010 GDP. Substantial damage in the agriculture subsector was about half of the total losses. The scale of the disaster had a significant impact on the country's economic growth with estimated reconstruction costs ranging towards 5.3 per cent of the 2009/2010 GDP. At the time, the reconstruction of damaged infrastructure was expected to stretch over more than three years (ADB and World Bank, 2010).

While the country was still recovering from the impacts of the previous floods, Pakistan was struck again by severe flooding during August and September, 2011, affecting more than 9 million people, again mostly in Sindh and Balochistan provinces. Damage was estimated at $2.5 billion with the housing and agricultural subsectors again being the most affected; 1.5 million homes were partially or fully damaged and 2.1 million acres of farmland were inundated. There were additional concerns about future national food production as irrigation systems essential for about 80 per cent of the wheat planted in Sindh province were seriously damaged and millions of livestock were affected by flooded pastures or destroyed feed stocks (Pakistan, NDMA, 2011).

The cumulative effects of these major disasters can be assessed by comparing Pakistan's observed GDP and projected GDP under different scenarios. Figure II.IV shows four trajectories with estimated GDP values between 2004-2011. The GDP growth would have been greatest without any disaster effects, while growth actually diminished with each successive disaster.

Economic vulnerability to the effects of a disaster also can be exacerbated by the lack of diversity in the structural composition of a country's GDP. Economies that are largely agrarian, once affected

Figure II.IV **Variations between Pakistan's actual observed GDP and projected GDP without disasters, 2004-2011**



Source: ESCAP estimates based on data from the Centre for Research on the Epidemiology of Disasters, EM-DAT, the international disaster database, version: v12.07. Brussels: Université Catholique de Louvain www.emdat.be (accessed June 2012). Real GDP data, World Bank, GDP, Per Capita, Population data. http://data.worldbank.org (accessed June 2012).

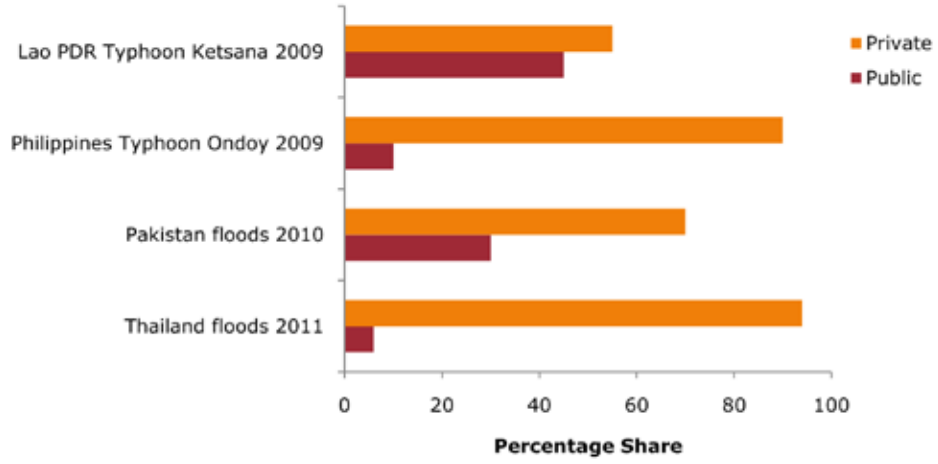
by repeated natural disasters, take much longer to recover, with devastating impacts on livelihoods. Diversified economies have been found to be more robust and therefore much more resilient to future shocks. The global experiences of "building back better" during recovery after a disaster emphasizes that more diversified economies have more resilient communities and can become less vulnerable to subsequent hazard impacts (UNISDR, 2010).

2.3.3 Who pays the costs of economic vulnerability?

Economic vulnerability especially the context, size and structure, results in terms of who are they who have to pay for the disaster losses? To understand this, disaster impacts of Typhoon Ketsana (2009) in the Lao People's Democratic Republic, typhoon Ondoy (2009) in the Philippines, Pakistan floods (2010) and Thailand floods (2011) – representing the diverse context of economic vulnerability - have been analyzed. The available post-disaster damage and loss assessments data for these disasters were used to arrive at the economic losses to the public and private sectors incurred during the disasters (figure II.V). Assuming that post-disaster investments do not match the damage and losses as the result of disaster impacts, the following inferences have been drawn:

- Typhoon Ketsana in the Lao People's Democratic Republic resulted in economic impact to the extent to $58 million. Maximum damage and losses were reported in productive sector especially agriculture. As a result, poor and marginal farmers who were mostly affected due to the sectoral impact had to pay for the economic losses.
- Typhoon Ondoy (2009) caused economic damage and losses of $4.3 billion. The impact was severest in urban areas and as the result poor urban holds had to pay for losses.
- Pakistan floods (2010) caused losses to the extent of $10 billion. The impact was severest in the agriculture sector, which supports the livelihoods of the farmers who had to pay for the economic losses.
- The private sector bore almost 94 per cent of the colossal total economic losses of $44 billion incurred during the Thailand floods in 2011. Primarily, manufacturers and insurance companies had to pay the costs of those economic losses.

Figure II.V **Who pays for disaster losses?**



Sources: ESCAP estimates based on:
(a) Lao People's Democratic Republic, World Bank, ADB, ASEAN, FAO, AusAID, GFDRR and ADPC, *Damage, Loss and Needs Assessment: The Ketsana Typhoon in the Lao People's Democratic Republic* (2009). http://gfdrr.org/docs/PDNA_LaoPDR_KetsanaTyphoon.pdf;
(b) Pakistan, ADB, World Bank, *Pakistan Floods-2010: Preliminary Damage and Needs Assessment* (2010). http://www.gfdrr.org/gfdrr/sites/gfdrr.org/files/publication/Pakistan_DNA.pdf;
(c) Philippines, ADB, United Nations, World Bank, *Philippines Typhoons Ondoy and Pepeng: Post-Disaster Needs Assessment Sector Report* (2009);
(d) World Bank, *Thailand Floods 2011, Rapid Assessment for Resilient Recovery and Reconstruction Planning* (Bangkok, World Bank, 2012). http://www.gfdrr.org/gfdrr/sites/gfdrr.org/files/publication/Thai_Flood_2011_2.pdf.

2.4 Social vulnerability

Among the poor, vulnerable groups like women and children, people with disabilities and the aged, experience additional vulnerability to hazards and have different needs to reduce those vulnerabilities. Often the professional capacities or social services to do so are not necessarily found in disaster management agencies but are conveyed through other institutions and different sectors. Furthermore, with profound demographic changes that will see families, society and economies supporting more elderly people in the future, there is a critical need to address prevailing social vulnerability in building resilient societies now. Some of these key dimensions of social vulnerability are elaborated in box II.1.

2.4.1 Women and children are among the most vulnerable

Although gender disaggregated data on disaster mortality and damage are seldom available, case studies demonstrate that women suffer more in disasters and their specific needs are mostly ignored in relief and rehabilitation measures. More women than men died in the Indian Ocean tsunami with estimates of between 60 and 70 per cent of the deaths being among women and children. The 2010 floods in Pakistan demonstrated that women were either overlooked in the distribution of relief, or were unable to reach places where relief was being distributed because of social norms that restricted their mobility. Women also are more likely to suffer hunger and malnutrition in the aftermath of disasters.

The work of women arising from their socially prescribed roles, increase sharply after every disaster, particularly in caring functions. The number of women-headed households grew after the 2001 earthquake in Gujarat, India. The dropout rates for girls in school increase, and violence against women soars under the stresses of disasters in many countries. In some countries there are indications that a sizeable number of women and girls are trafficked or driven to prostitution after disasters (UNEP, 2011).

Emergency response systems throughout the region remain dominated by men. Very few standard operating protocols for early warning, evacuation, search and rescue operations adequately consider the special physical, health, psychosocial needs or capacities of women and girls. Patriarchal gender ideologies still represent women in nearly all countries as passive victims of disasters rather than engaging them as productive survivors who can build resilience in communities and advance coping mechanisms. Women with national and even local decision-making authority or who are represented on national platforms for disaster reduction continues to be low. As a result, their involvement in disaster preparedness planning and disaster recovery is seldom evident and not widely reported.

Box II.1 **Impact of disasters on vulnerable groups**

Disaggregated data about vulnerable groups are not widely available, but the following information indicates the extent of some significant disaster impacts on vulnerable groups.

- In Aceh, Indonesia, 21.1 per cent of the victims of the Indian Ocean Tsunami were children below 10 years and 32.6 per cent were elderly above 70 years. Nearly two thirds of the dead or missing people were women or girls; women were found to have consistently higher mortality than the male population in any age group ("Tsunami Mortality in Aceh Province", Disasters, Vol. 30 No.3, 2006).
- The Indian Ocean Tsunami caused high mortality among children in Sri Lanka (31.8 per cent for 0-5 years, 23.7 per cent for 5-9 years), and among senior adults older than 50 years (15.3 per cent). By comparison, young adults between the ages of 20 and 29 years had a mortality rate of 7.4 per cent (Nishikitori in Sawai, 2011).
- The 2005 earthquake in Pakistan killed more than 15,000 school children because of collapsed school buildings. In the Wenchuan Earthquake centred in Sichuan, China, nearly half of the 90,000 people killed were children, many in the more than 3,000 school buildings which collapsed (SAARC 2011).
- More than 65 per cent of the victims killed or missing in the 2011 Great East Japan Earthquake and tsunami were 60 years of age or older (http://www.unescap.org/idd/working%20papers/IDD-DRS-who-is-vulnerable-during-tsunamis.pdf).
- More than 2 per cent of people with disabilities were killed or missing in the three prefectures primarily affected by the Great Japan Earthquake and tsunami disaster, compared to 1 per cent among people who were not disabled (Katsunori Fujii, Japan Disability Forum).

On the basis of contrary evidence such as that demonstrated by many grassroots organizations[3], women have demonstrated numerous capacities and abilities in reducing disaster risks through preparedness activities, organizing resources and in rebuilding communities. Significant lessons emerge and need to be disseminated much more widely. More fundamentally, additional effort is required to engage many more women in positions of disaster risk management responsibility and social leadership in order to fully promote productive gender issues in national and local level planning, emergency action and disaster risk reduction practice on a continuing basis.

Children in the age group 0-14 compose nearly 25 per cent of the population of the Asia-Pacific region (ESCAP, 2011a). With the absence of child-segregated data it is difficult to quantify the extent of losses suffered by children in disasters, but empirical evidence suggests that child mortality accounts for nearly 40 per cent of total disaster casualties. In the South-East Asia floods of 2011, more than 2.4 million people were affected, including 800,000 children. In Viet Nam, the floods caused 43 fatalities, of which 38 were children. In Cambodia, children accounted for more than half of the 257 deaths (UNICEF, 2011). Thailand reported 813 deaths, of which 13 per cent were children (World Bank, 2012d).

Children are more vulnerable as they must depend on others, and mostly family members for much of their well-being and survival. These dependencies can easily be weakened or even disappear in the destruction and disruption of disasters, particularly if already scarce resources are diminished. There are many limitations to developing and sustaining support mechanisms that can provide necessary psychological, educational, protection and legal needs of children affected by disasters. As with all other effective efforts for reducing disaster risks, such measures need to be established and operational well before disasters occur.

Children's vulnerability can increase acutely during certain hazards. In Mongolia, during the *dzud*,[4] infant, child and maternal mortality rates increase due to inadequate access to emergency medical care,

[3] See the Huairou Commission (http://www.huairou.org/), SEEDS (http://www.seedsindia.org/), Duryog Nivaran (http://www.duryognivaran.org/), the All-India Disaster Mitigation Institute (http://www.aidmi.org/), among others.

[4] A *dzud* is a particular Mongolian severe winter weather condition during which livestock are unable to obtain sufficient fodder through the snow and ice cover. Because of starvation and the bitter cold, many animals die, decimating herds and family livelihoods.

Table II.1 **Population affected in Mongolia *dzud*, 2010**

Mongolia country data, affected population	Total	Total population percentage	Affected population	Affected population percentage
Population	2 756 000	-	769 106	28.0
Number of provinces	21	-	-	-
Number of disaster provinces	15	-	-	-
Child population, 0-14 years	761 000	27.6	-	-
Population aged 0-18 years	978 000	35.5	279 609	36.4
Children, under 5 years	297 000	10.8	77 621	10.1
Elderly population, above 60 years	163 000	5.9	44 260	5.8

Source: UNICEF, "*Situation Analysis of Children in Mongolia*"; UNICEF, Dzud Fact Sheet (2010), http://www.unicef.org/eapro/dzud_factsheet.pdf; ESCAP, *Statistical Yearbook 2011* (Bangkok, Thailand, 2011) http://www.unescap.org/stat/data/syb2011/index.asp

malnutrition, and an increased risk in the spread of zoonotic, water-borne and vector-borne diseases. Table II.1, and figures II.VI and II.VII illustrate the population affected overall and the increased mortality rates of from 35 per cent to 42 per cent reported in the *dzud*-affected areas of the country (UNICEF, 2012).

There are several initiatives that have been embraced by international organizations in recent years to raise the visibility of children's vulnerability throughout the region. A school safety programme aims to ensure that children are safe in school facilities. This has been reinforced by additional efforts to identify and disseminate learning materials and encourage school curricula about developing a culture of safety by reducing disaster risks. Another initiative being pursued in some countries empowers children to become more engaged as change agents in their local communities by advancing better disaster awareness and preparedness before they occur and more effective response and recovery after they happen.[5]

2.4.2 People with disabilities have special needs, and unique insights for reducing risks

Conservative estimates indicate that about 10 per cent of Asia-Pacific people live with some disability, although official data may underestimate those numbers given their reliance on data reflecting only recipients of official government assistance. There are very few studies about the disproportionate effects of disasters on people with disabilities in the region or which document their special needs. There are even fewer examples of capable individuals with disabilities being involved in crucial planning and educational roles to create a safer society in which they live, despite their particular insight and values in communicating needs at the time of crisis.

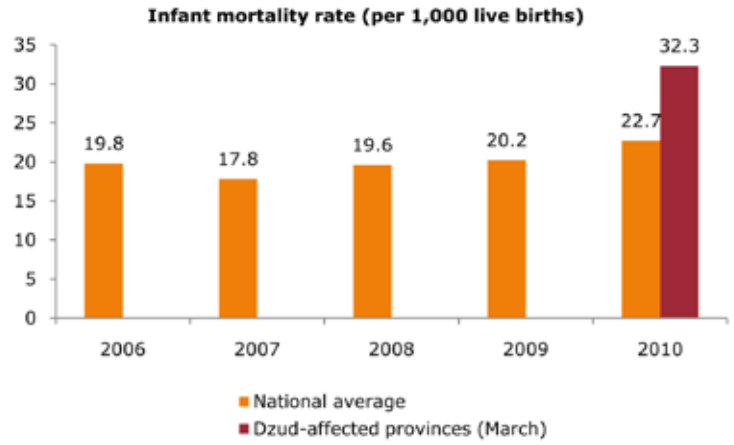
Significant guidelines have been developed like the United Nations Convention on the Rights of Persons with Disabilities (CRPD) in 2006 and the Bonn Declaration on Disasters and Disabilities in 2007. Both instruments include guidance that can be incorporated into the policies and practices of national and local institutions that address disability issues, as well as by disaster and risk management authorities in their public information, planning, and practice. Few avail of the additional resources that people with disabilities represent within a community and who can contribute a wider and generally overlooked range of experience and indeed abilities that can be valuable in planning for conditions of critical needs. Many countries in the region are in the process of developing new legislation and policies for the implementation of CRPD. In 2012, China announced a policy for equal access of people with disabilities to participate fully in social and economic life and to reap the benefits of national development. This will necessarily include the incorporation of special needs into disaster preparedness, response, risk reduction and recovery circumstances.

2.4.3 Elderly populations provide a foundation for communities at times of need

Overall, 7 per cent of the Asian and Pacific populations is above the age of 65. This number is expected to more than double by the year 2025, with many countries ageing even faster with their declining birth rates. These demographic changes pose challenges

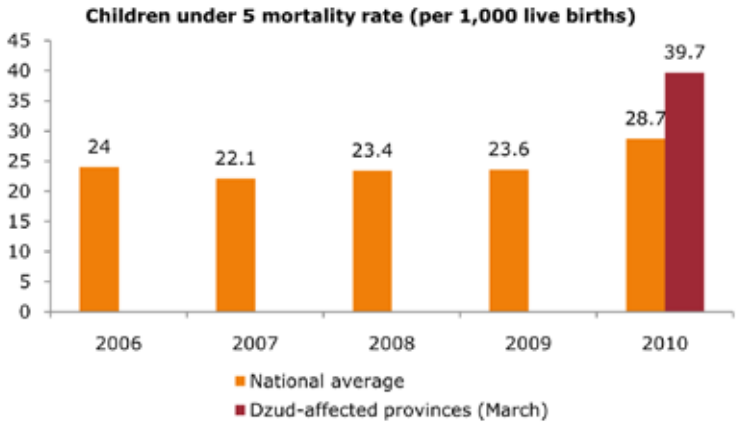
[5] For more information, refer to the "1 Million Safe Schools and Hospitals Initiative" http://www.safe-schools-hospitals.net/en/Home.aspx and the "Disaster Risk Reduction through Schools" project http://www.childreninachangingclimate.org/database/other/Publications/Disaster%20risk%20reduction%20through%20schools.pdf

Figure II.VI **Infant mortality rate, comparing national average to dzud-affected period and provinces, 2006-2010 (per 1000 live births)**



Source: UNICEF, *State of the World's Children 2011*; Ministry of Health, Mongolia, www.doh.gov.mn (accessed 9 August 2012)

Figure II.VII **Under 5 children mortality rate, comparing national average to dzud-affected period and provinces, 2006-2010 (per 1,000 live births)**



Source: UNICEF, *State of the World's Children 2011*; Ministry of Health, Mongolia, www.doh.gov.mn (accessed 9 August 2012).

for redefining the vulnerability for a growing number of elders and increasing needs for societies to take appropriate measures to reduce the risks involved. During the Great East Japan Earthquake, more than 65 per cent of the people killed by the tsunami were 60 years or older, even though the elderly represented 35 per cent of the resident population (ESCAP, 2001c). The higher mortality likely resulted from reduced mobility, delayed evacuation and possibly a later awareness of the seriousness of the immediate situation.

The available time for warning and effective evacuation between the Japanese earthquake and the tsunami was only 30 minutes, an interval which would challenge most anyone's abilities to ensure their safety from both hazards. The case of the elderly in Japan also demonstrates the challenges that even a very well prepared and technologically advanced country faces in mitigating its people's vulnerabilities. The Madrid International Plan of Action on Ageing (UNDESA, 2012) recommends equal access for older people to food, shelter, medical care and other services during and after disasters caused by natural hazards and other humanitarian emergencies. It further encourages more opportunities for older people to contribute to the reconstruction of communities and rebuilding of the social fabric following crises. They are very well suited to do this, given the variety and depth of their experience and a long attachment to their communities.

Historical data is important for a better understanding of the critical factors of vulnerability related to mortality and survival. Even though basic mortality data is available in most Asia-Pacific countries, significantly less data is available for particularly vulnerable groups. Most existing data still requires

additional disaggregation by sex, age and with regard to identified vulnerable groups, their special needs and their respective public resource allocations. Until vulnerability information is recorded to common standards, over comparable time periods and used at all administrative levels, many citizens' vulnerabilities will remain obscured and insufficiently addressed. More attention is required to maintain sound historical and socially relevant data so that effective policies can be developed and implemented by governments to reduce the vulnerability from hazards for all the people in society.

2.5 Urban poverty as acute vulnerability

In 2011, 10 of the world's 20 largest megacities (cities with more than 10 million inhabitants) were located in Asia (UNDESA, 2011). The physical concentration of the poor in the region's megacities and metropolitan urban areas has brought vulnerabilities to the fore as they are leading to more complex disaster events. While the annual recurrence of flooding is along-established phenomenon, recent events experienced in Bangkok, Beijing and Manila dramatically indicate acute and growing conditions of vulnerability in urban environments.

Megacities and their extended urban regions attract much greater political attention and financial capital, but they maintain relatively advanced governance structures for addressing disaster risks in a few locations. Around 10 per cent of the region's urban population live in megacities, while an additional 60 per cent lives in cities of a million people or fewer.

Problems and challenges facing these smaller cities and towns generally attract even less disaster risk management (DRM) attention at the local levels of responsibility. These many smaller urban habitats are particularly vulnerable to the occurrence of extreme hazard events if there are no determined efforts to raise greater attention to reducing disaster risks. Cities of all sizes have been established in some of the most hazardous locations possible. Slightly more than half of Asia's urban population lives in low-lying coastal areas.

Urban poverty is an important driver for the many deaths, destruction of property and people displaced in all urban locations, although it is not the only dimension of disaster vulnerability. While these conditions are more prevalent in developing countries, they exist to some extent in nearly all Asia-Pacific countries. For example, case studies of the 2011 Thailand floods and the flash floods in Cagayan de Oro, Philippines found that the urban poor were significantly more seriously affected by these urban flood disasters compared to the general urban population for several reasons.

First, the fastest urbanization is taking place in the LDCs and other low-income countries, as a 4.4 per cent annual urban growth rate in the Lao People's Democratic Republic and a 3.6 per cent annual increase in Nepal can attest. This has placed serious burdens on cities in countries that have weak institutions and lower capacity to provide necessary infrastructure and services, or possess the skills required for sustainable urban planning and land management. The rapid growth results in ever higher concentrations of vulnerable people being exposed to hazards.

Second, a visible expression of rapid urbanization has been the proliferation of slums[6] in many Asia-Pacific cities. ESCAP estimates that the region now has around 571 million slum dwellers, or around 33 per cent of the region's urban dwellers. In some countries and cities the percentage is much higher, as in Bangladesh, Cambodia, Lao People's Democratic Republic, Mongolia and Nepal, a majority of the urban populations live in slums. These poor living conditions and informal settlements magnify the inhabitants' multiple vulnerabilities to hazards, as well as becoming additional disaster risks, themselves.

One such example is the extent of "rooftop slums" (figure II.VIII) that exist in many cities of Asia. Families build informal structures on existing buildings with easy access to water and electricity. While the unauthorized rooftop structures are less visible and therefore less likely to invite destruction or eviction of the inhabitants, they also become high-risk locations with few escape routes in often very congested areas. Open stoves and informal electricity connections frequently cause fires which spread quickly through the insubstantial structures, beyond the reach of firefighters.

Similarly, slums grow on marginal or wasteland locations that are unsuited for habitation, often dangerous, and inhabited by the poorest segments of the population are routinely consumed by frequent fire hazards, floods, landslides, storm and wind damage, and toxic pollution.

[6] Understood here in the sense of a United Nations HABITAT definition which refers to "any formal and informal settlement that exhibits one or more of the following deficiencies: security of tenure, structural quality and durability of dwellings, access to safe water, access to sanitation facilities and sufficient living area".

Figure II.VIII **Rooftop slum fire in the centre of Phnom Penh, Cambodia**

Photo credit: Peter Swan

Third, there is tendency to underestimate the extent of urban poverty. Although visible evidence and data point to the widespread lack of basic infrastructure and services, few international comparisons and national poverty assessments disaggregate the distinctive conceptual features between rural and urban poverty. Statistical comparisons often still obscure large disparities within cities in terms of mortality, health, nutrition, access to water and sanitation, or the levels and types of income in various locations. In rural areas, people's basic daily needs may be hedged in times of crisis by self-sufficiency or through simple barter exchanges. This becomes more difficult in urban areas as people must rely on complex interdependencies which are based almost entirely on monetary payments for all goods and services.

Finally, vulnerability in urban environments is further heightened by significant structural changes that families undergo in urban settings. Nuclear or single parent families are more common as kinship and previous social community linkages are diluted as people move into urban areas. Invariably, the already more vulnerable children, the elderly and disabled people become more isolated, even under the best of circumstances. As people spread more widely across sprawling urban landscapes, the motivation and occasion for reducing their vulnerability to risks diminish as they focus their decreasing resources on obtaining their basic needs for survival.

Overall, the consequences of not defining urban poverty more realistically nor recognizing these distinctive characteristics are that poverty continues to be neglected in national policies, financial allocations and specifically in explicit disaster risk management considerations. This is evident every time already impoverished urban inhabitants are affected by a disaster, they have no recourse to any compensation for loss of their unauthorized "illegal" settlements, nor are they likely to be provided with access to essential public services which they never had before.

2.6 MDGs affected by disasters

Establishing direct links between MDGs and disasters is not an easy task, considering the complex interplay of the various types of economic, social, urban, and environmental vulnerabilities. It is difficult to determine correlations between MDG progress and levels of disaster risk, and to systematically quantify a range of MDG indicators for the extent to which progress in MDGs are affected by disasters. Time series data are not usually available and additional complications arise as disasters are localized, often affecting only some parts of the country. When MDG indicators are available, they mostly reflect aggregated national efforts. Measuring actual impact becomes even more problematic as some goals are more qualitative than quantitative (Zapata and Madrigal, 2009).

Notwithstanding these difficulties, several recent case studies clearly show the impact of disasters on several MDGs. When Cyclone Sidr struck Bangladesh in 2007, its impacts on the economy amounted to $1.67 billion. Damage and losses of $925 million in the social sector affected MDGs 2 (achieving universal primary education), 4 (reducing child mortality) and 6 (combating HIV/AIDS, malaria, etc.). Damage and losses of $489 million in the productive sector affected MDG 1 (eradicating extreme poverty and hunger) while losses of $253 million in infrastructure affected MDG 1 and MDG 7 (ensuring environmental sustainability) (Bangladesh, 2008).

Cyclone Nargis was even more devastating for Myanmar in 2008 with its $4.02 billion impact on the national economy. The productive sector incurred $2.81 billion in damage and losses, seriously, affecting MDG 1. The social sector sustained losses of $968 million with consequential effects on MDGs 2, 4 and 6. Infrastructure losses totaling $190 million had an unavoidable impact on MDGs 1, 7 and 8 (developing a global partnership for development).

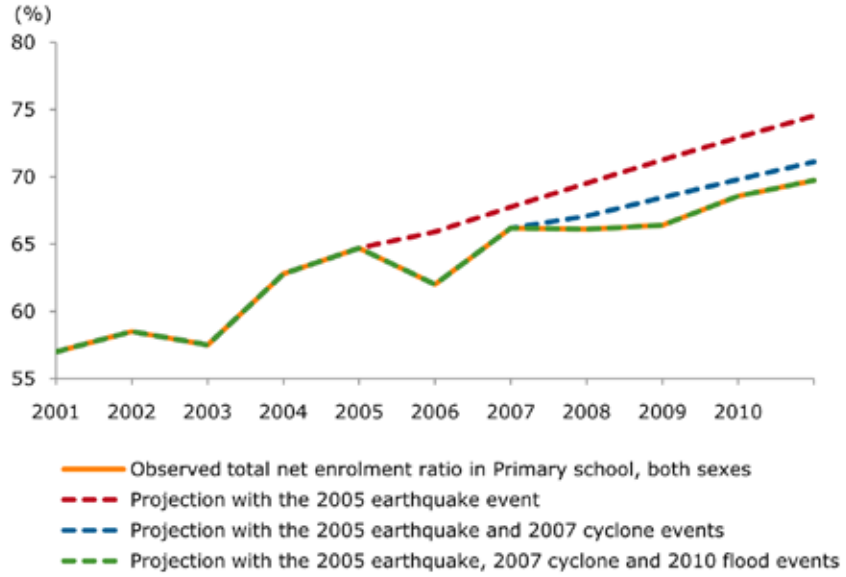
In Pakistan, there was sufficient damage and loss data available from several post-disaster needs assessments of successive disasters to assess their impacts on the education sector. This provides insight into the extent that disasters have affected the progress of achieving MDG 2 by using the MDG

Table II.2 **Damage, losses and estimated needs for recovery and reconstruction of the education subsector in Pakistan, from 2005 earthquake and 2010 floods**

Disaster events in Pakistan	Damage and loss assessment of the education sub-sector				Assessment of needs for recovery and reconstruction of the education sub-sector	
	Direct damage (million Pakistan rupees)	Indirect losses (million Pakistan rupees)	Combined damage and losses (million US dollars)	Total damage and losses (percentage)	Costs for recovery and reconstruction (million US dollars.)	Total costs for recovery and reconstruction (percentage)
2005 Earthquake [a]	19 920	4 133	405	14	472	13
2010 Floods [b]	22 047	4 418	311	3	505	6

Sources:
[a] ADB and World Bank, *Pakistan 2005 Earthquake: Preliminary Damage and Needs Assessment* (2005).
[b] Pakistan, ADB, World Bank, *Pakistan Floods-2010: Preliminary Damage and Needs Assessment* (2010). http://www.gfdrr.org/gfdrr/sites/gfdrr.org/files/publication/Pakistan_DNA.pdf.

Figure II.IX **Observed and projected MDG 2 progress on educational enrolment in Pakistan**



Source: UNICEF, State of the World's Children 2011; Ministry of Health, Mongolia, www.doh.gov.mn (accessed 9 August 2012).

indicator on net enrolment ratios in primary schools.

During the 2005 earthquake in Pakistan, about 7,670 government and privately-owned schools were affected, of which 5,690 were primary and middle schools. About half of the damaged schools collapsed or were beyond repair. The education subsector also lost a significant number of teachers. The country's education subsector accounted for 14 per cent of the country's total damage and losses, estimated at $405 million. Of the total disaster effects, an estimated $335.4 million of direct damage resulted from direct damage and losses to physical assets in the affected areas, while the remaining $69.6 million is attributed to indirect losses to the economy arising from the lost use of those physical assets projected over the next few years. Recovery and reconstruction costs were estimated to add an additional $472 million to resume classes at all levels in the short-term and to restore damaged schools over an extended period (table II.2) (ADB and World Bank, 2005).

As a result of Cyclone Yemyin and subsequent flooding in 2007, more than 1,300 schools were destroyed (Pakistan NDMA, 2007). The educational services were further disrupted when schools were used to house people displaced by the disaster. Three years later, floods destroyed 3,741 educational facilities and another 6,666 were partially damaged with the education subsector accounting for 3 per cent of the national losses of $311.3 million. Recovery and reconstruction costs were estimated to add an additional $504.8 million (table II.2) (ADB and World Bank, 2010).

To quantify the impact of these disasters on the achievement of the education-related MDG goal, a comparison was conducted of the observed net enrolment ratio and the projected net enrolment ratio under the assumption of a scenario without disaster events (See Annex II.1 for details on the data and methodology).

The projection (figure II.IX) shows the cumulative impacts of the earthquake, cyclone and floods that damaged education facilities, although it could also reflect other external factors influencing the education sector. The projection that reflects both the 2005 earthquake and the 2007 cyclone results in lower values than the one representing only the earthquake effect. The projection that also includes the 2010 floods shows even lower values. These are not much different from the observed values although there are slight differences in the actual numbers. The insignificant difference between the observed and projected values is due to the unavailability of observed statistical data on net enrolment ratio in primary schools in 2010. The 2010 value used was itself a projection at the time of this study.

Pakistan was on track to realize the MDG indicator for primary enrolment in schools based on its statistical trend in 2004, but slower progress was recorded in 2008 and 2009. Taking the ISDR definition of vulnerability as "the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard" (UNISDR, 2009), it follows that the disasters resulted in the reduced quantity, quality and prevailing level of education. This creates conditions of worsening opportunities for personal development, therefore leading to a cycle of worsening poverty and as a result, increased disaster risk. Development efforts to attain MDG targets without appropriate risk reduction measures can unintentionally increase levels of vulnerability and consequential disaster risks.

2.7 Investments to reduce vulnerabilities and consequential disaster risks

Well-targeted investments and strategic programmes with a "no regrets" approach to development can provide significant benefits and contribute to reducing disaster vulnerabilities and achieving MDGs. Much remains to be done to expand and strengthen investment commitments and especially to manage disaster risks within overall objectives of resilience in strategic development explicitly directed towards

Table II.3 **Indonesia budgetary allocation for disaster management as a percentage of total budgets and GDP, 2006-2012**

Financial reference	2006	2007	2008	2009	2010	2011	2012
National budget	0.38	0.47	0.44	0.41	0.49	0.68	0.69
Central government budget	0.58	0.71	0.63	0.61	0.74	0.99	1.02
GDP	0.08	0.09	0.09	0.07	0.09	0.12	0.12

Source: Darwanto, Herry, *Understanding Existing Methodologies for Allocating and Tracking National Government Budget for Disaster Risk Reduction in Indonesia.* Unpublished Asian Development Bank Report (2012).
Note: GDP figures for 2011 and 2012 are based on government projections.

reducing disaster risks. Investments that leverage the synergies inherent in regional cooperation initiatives, targeted towards readily demonstrable benefits such as effective early warning systems, safer schools, or community-led efforts to instil a local "culture of safety", can create lasting value. Developing better evidence from innovative efforts, creating standards for systematic investment and benefit data, and improved tracking of investments for reducing risks, will contribute to creating a more convincing investment climate for national governments and international donor interests.

Bangladesh is one of the few countries that appears to have experienced a decline in disaster losses (CRED, 2012). The Government of Bangladesh has invested more than $10 billion during the past 35 years to make Bangladesh less vulnerable to natural hazards. The investments made for increasing public understanding of disaster risks and the resulting efforts to reduce public vulnerability to floods and cyclones have focused on local communities through multiple sectoral development plans and were targeted towards the especially vulnerable segments of the population (World Bank, 2012b). Although this had led to declines in direct disaster losses over the past 35 years, over the past decade economic losses have continued to range between 0.5 per cent and 1.0 per cent of annual GDP, and are expected to rise as climate change effects intensify in future.

Indonesia presents another case of progressive investment in reducing risk through budgetary commitments over the past six years. The national budget allocated for disaster management issues has nearly doubled from 0.38 per cent of the total to 0.69 per cent between 2006 and 2012 fiscal years. The budget for central government authority showed a similar doubling of financial commitments as the

allocations grew from 0.58 per cent to 1.02 per cent during the same period (table II.3). The projected ratio of the budget for disaster prevention to the GDP has grown in 2012 to 0.12 per cent, a significant increase from the 0.08 per cent in 2006 (Darwanto, 2012).

2.8 Social protection reforms can reduce vulnerabilities

The extent of public coverage for social protection programmes has remained quite limited in Asia and the Pacific for several reasons, but a significant feature is the substantial size of the informal sector which employs as much as 80 per cent of the workforce in some countries. Despite difficulties of devising adequate funding mechanisms, the needs and public expectations for social protection measures have grown along with the national economies, demanding attention at the highest levels of governments.

However, more recently this has been abetted by the convergence of food, energy and financial crises and the resulting demands for debilitating austerity measures which erode traditional social protection measures dating from an earlier era. Among these domestic social pressures, the parallel demands of further unmitigated disaster impacts may provide forceful motivation for policymakers to make higher investments in social protection. There is no escaping the fact that vulnerabilities will need to be addressed by building resilience against external shocks.

To be effective, social protection first needs to be viewed in terms of overall objectives which can be accommodated within accepted policy values and less on specific methods. These include the fundamental concepts of reducing vulnerability, bolstering social and economic capital and making it universally available.

ESCAP's 67th Session of the Commission in 2011 emphasized that instead of approaching social protection through specific reactive measures driven by individual events, countries of the region were now moving towards a universal social protection floor which could strengthen coping capacities and resilience. This is based on the principle that society as a whole accepts the responsibility to provide basic levels of benefits and services to those with the greatest need (ESCAP, 2011b). Many social protection initiatives were formulated against the backdrop of global economic and financial crises. As social protection is grounded in spreading risk and offsetting losses, it could also provide a beneficial impact for minimizing the consequences of disasters. In times of economic recession, with countries forced to balance budgets and reduce expenditures, this would become even more important as their vulnerabilities to disasters and other external shocks will only increase.

The analysis noted further that the costs of providing a minimum level of social protection would vary according to economic development and other factors such as population structures, but that they were largely affordable with estimates for most countries ranging from 1 to 3 per cent of gross national income. These amounts are feasible even at the lower end of the development spectrum considering the overall sound macroeconomic fundamentals that continue to be the hallmark of policy management in the region. The rate of return on investments also would be expected to rise in the long term through more equitable and robust economic growth, such as through greater domestic consumption, higher levels of human development and greater shared opportunity. These beneficial attributes would equally contribute to improved disaster resilience (ESCAP, 2011b).

In practical terms, the specific measures required before, during and after disasters, can only be effective to the extent that they are able to be implemented. Other supplemental initiatives designed to lessen the impacts of disasters caused by natural hazards are less effective if sound social protection systems are not already in place beforehand so that they can be extended as emergency needs arise. Supplementary income or in-kind transfer programmes and subsidies for basic needs, or labour-intensive public works and recovery strategies are some examples of policies that are familiar, but underutilized.

The National Rural Employment Guarantee Scheme of India first piloted in the late 1970s is one such example which provides a buffer to people facing economic crises or disaster loss. Another cash-based programme that began in Bangladesh in 2010 is the Employment Generation Programme for the Poorest which supports vulnerable people by maintaining their basic food security and preventing destitute migration. These schemes have been useful overall, and they have demonstrated a particular advantage in enhancing female participation in public endeavours while increasing their income (World Bank, 2012c).

The Mongolian experience of cash transfer programmes after dzud disasters and aligning micro-insurance with disaster risk reduction provides other lessons. The 2009/2010 dzud destroyed 7.8 million head of livestock or 17 per cent of all of Mongolia's livestock with devastating impact on herders and rural communities. Following this disaster, the Mongolian

Ministry of Finance transferred cash assistance to more than 8,500 herder families to buy food and other necessities. This timely intervention helped to mitigate the risk of further deterioration of livelihoods during the following spring season when the worst of the winter's impact was felt (ADB, 2010). This expedient initiative and later research led the country to develop an innovative "livelihood expense insurance" designed to help herders who have lost their means of livelihood because of disasters caused by natural hazards (HFA, 2009-2011).

2.9 Mainstreaming disaster risk reduction into policies and programmes for vulnerable groups

All countries of the region have adopted numerous global and regional conventions for the welfare, development and empowerment of women, children, elderly and persons with disabilities and have proceeded to develop various policies and plans of action for the social protection of generic vulnerable groups. However, significant gaps remain between the professed policies and implementation practices, often because of resource constraints and limited capacities at all levels of institutional engagement. A more fundamental constraint remains a common lack of sustained commitment to institute complex social and economic changes leading to contingent social protection measures.

Various civil society initiatives have supplemented government efforts to conduct trial initiatives and local innovations which project disaster risk reduction into sectoral programmes and policies, but historically few pass beyond an initial project concept to accepted policy. Commitment has been uneven, the learning process slow and often piecemeal, or replication has been limited. As with other sectoral interests, specialized institutions dedicated to working with vulnerable groups with their own cadres, norms and budgets, can easily remain focused within their own particular contexts. These conditions do not readily lend themselves to be influenced by the wider rationale and embedded practices required for effective disaster reduction, unless disasters already have taken heavy tolls on their constituents.

Japan has made some progress integrating gender into disaster management laws and programme frameworks since the Kobe Earthquake in 1995, however in reality, implementation has been slow. More recently, following the Great East Japan Earthquake in 2011 efforts have been made to encourage more women to become involved in decision-making recovery processes and risk reduction activities. In the aftermath of the Wenchuan earthquake of 2008, Chinese authorities issued specific policy directives to provide further protection for disabled people, orphans, the aged and others who were most in need.

Despite the Asia-Pacific Disaster Report 2010 noting the surge of academic interest in mainstreaming disaster risk reduction over the past 10 years, the practical relationships between poverty reduction, economic growth and disaster losses have remained complex and difficult to model because of the multiple influences involved with each domain. For example, primary school enrolment rates (MDG goal 2, indicator 6) impact poverty levels and consequently affect vulnerability to natural hazards. Conversely, as was discussed above in Section 2.6 the example of Pakistan demonstrates how disasters can reduce the quantity, length and availability of schooling, further deepening poverty and vulnerability to future hazards.

As in other aspects of disaster risk management, there is the widely recognized problem of data availability that limits substantive comparability. The Global Assessment Report 2009 noted that available poverty data does not include detailed natural hazard information, nor is it often expressed in local statistics. While anecdotal evidence can be compelling, it is insufficient to establish quantifiable conclusions across sectors, locations or countries without appropriate data. Extensive work is required in data collection and analysis that would permit quantification of these causal effects if disaster risk reduction is to be truly mainstreamed into reducing people's vulnerabilities across development sectors. The importance of this needs to be stressed, so it is noteworthy that ESCAP has embarked on an initial scoping exercise to build a comprehensive regional database, populated with comparable statistics from official sources to provide temporal, geospatial and socioeconomic information about the impacts of disasters.

Since the vulnerability and exposure to hazards are often increased due to unsustainable development practices, an integrated process is needed that factors risk reduction analysis and practice into development planning and investments. As development has sought to maximize growth over the last few decades, it has also contributed to policies that have degraded the natural environment, undermined the livelihoods of many poor people and thus expanded levels of vulnerability. A failure to prioritize how development can shape disaster risk reduction will cause current opportunities to use MDG implementation to reduce disaster risks to be lost. There is a pressing need to determine how MDG and HFA frameworks can

Box II.2 **Social protection to increase the resilience of risk-prone communities**

Of the 36 countries that reported their progress on the HFA in the 2009-2011 review period, 16 countries reported minor progress or very little systematic progress in introducing social safety nets to risk-prone communities. Of the initiatives in place, 14 countries reported crop and property insurance, 8 reported employment guarantee schemes, 8 had adopted conditional cash transfers and 17 had aligned DRR with poverty reduction, welfare policies and related programmes. Nineteen countries reported having microfinance schemes in place, 7 pursued micro-insurance programmes, 11 had national or sectoral public investment systems incorporating DRR, and 15 reported investments in retrofitting critical infrastructure, including schools and hospitals. Although this is an encouraging development, these self-assessments also reveal that there are still 17 countries in the region that have no social safety measures in place to increase resilience for communities and households exposed to disaster risks.

Source: UNISDR, Hyogo Framework for Action 2005-2015 mid-term review. http://www.unisdr.org/we/inform/publications/18197 (accessed 27 Sept 2012).

become integrated in their purpose and use so as to obtain shared benefits and common value for more, sustainable and safer development – and for many vulnerable people.

2.10 Integrating MDGs into disaster risk reduction

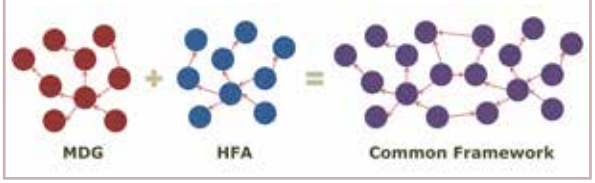
Review of HFA accomplishments has established that the least progress is being made on issues related to gender and other vulnerable groups. One of the practical and more effective entry points for applying the MDG goals related to gender and vulnerable groups into DRR practice is through the policies and guidelines of newly created disaster management institutions in the region. Following the adoption of the HFA, almost every country of the Asia-Pacific either has revised or created new legislation, policies and institutions for disaster risk management. While there has been some progress towards a more explicit risk reduction strategic orientation in some countries, many of these institutions remain primarily dedicated to disaster preparedness and emergency response or relief responsibilities at the time of a crisis. Efforts need to continue to encourage more systematic planning and extended relationships which can incorporate more socio-economic issues in order to enhance the resilience of vulnerable people.

In principle, all governments in the region have expressed their commitment to integrating disaster risk reduction and development programming to some extent. Nevertheless, there are a number of barriers for which specific policy actions are still required. First, there is a need for data to be disaggregated by vulnerable groups at national and local levels so that more appropriate programmes can be designed. Second, efforts are required to minimize the institutional barriers existing between the various frameworks internationally, notably those addressing MDGs and HFA, and the numerous institutions working for the welfare of vulnerable populations. This implies that more attention needs to be given to engaging specialized agencies in matters of reducing risk. This applies to both governmental and civil society institutions by drawing on the wide variety of their professional disciplines. Third, existing social barriers, including official attitudes and public mindsets, need to be recognized and transformed so that vulnerable groups are prioritized in planning for and managing disasters. Fourth, constraints related to resource availability, the lack of technical skills and related capacities, such as better institutional integration to develop country-specific process guidelines, need to be overcome.

2.11 The need for a common framework: conceptualizing linkages between disaster risk and development

The years of implementing MDGs and HFA have resulted in important progress towards reducing global disparities and the risk of disasters. Nevertheless, with people's vulnerability to hazards remaining widespread and member States' exposure increasing, it is critical to understand how different approaches to development impact disaster vulnerability. There is also the need to create a common framework between the HFA and MDGs so that essential linkages can be realized to advance their respective objectives. Such a common framework which can link the MDGs and resilience would benefit from synergies and accelerate progress towards sustainable and inclusive development.

Figure II.X **A combined association of both MDG and HFA framework objectives**



Source: ESCAP

Recently, the outcomes of the Rio+20 conference further emphasized these links and have set the tone to pursue a common framework. A key component of Rio+20 is the creation of sustainable development goals (SDGs) for beyond 2015, building on the progress of the MDGs.

A current challenge is to devise a common framework that would allow meaningful comparisons across the MDGs and HFAs numerous goals, targets and indicators by taking account of their linkages, while also being mindful of the ongoing process to develop SDGs. The current approach which consists of measuring performance against targets is silent about indicating the most effective policy strategies to reach those goals. This approach would be the most effective only if the achievement of one goal is independent of accomplishing other goals, but that is not the case in practice.

It is also important to recognize that MDGs have been sector-specific and most of the monitoring indicators are quantifiable ones tied to specific targets. The HFA's priorities for action and their key performance indicators are multisectoral. However, there are linkages between them and understanding those more fully could assist policymakers establish priorities in allocating scarce resources for the most effective means of achieving both the MDGs and HFA objectives. In this regard, an approach is proposed (details will be published in a background working paper on a MDG and HFA framework) that considers the multiple dimensions of development. Instead of dealing with the many elements of each framework separately, the proposed approach addresses the commonalities among selected elements and the capacities required to deliver them. Based on capacities that have been assessed as being available through demonstrated activities or accomplishments in Asia-Pacific countries, the more productive linkages between MDGs and HFA are considered.

This discussion conveys what such a common framework could look like by presenting an analysis of the combined association of the MDGs and the HFA frameworks. The approach considers MDG and DRR capacities as part of the same global domain of capacities required for fulfilling resilient development, which is built on inclusiveness and sustainability. To accomplish that, MDG- and DRR-related deliverables can be jointly considered as components in a larger set of critical relationships among countries. This is represented in figure II.X.

Using such a method, it is possible to rank the deliverables based on the number of capacities required to produce them. Table II.4 presents the five highest and lowest ranked HFA-related deliverables in terms of those that require the highest level or most demanding capacities and the lowest rank of least demanding capacities, respectively. Accordingly, micro-insurance, national and sectoral public investment systems incorporating DRR, catastrophe bonds, employment guarantee schemes, conditional cash transfers and other social protection mechanisms require more capacities to be implemented. The deliverables considered to be the ones that are easier to accomplish or which can be more swiftly implemented are those related to the development of plans and strategies.

Despite the previous confirmation of the method and international and national efforts that have gone into seeking more consistency in assessments, the results are affected by the quality of the self-assessment process. As with any similar qualitative judgments, one needs to be aware of the potential for imprecise, subjective and uneven reporting. Nevertheless, the analysis provides useful indicative information regarding the individual, nationally perceived differences in capacities' efficacy among the countries across the region.

The analytical approach focuses on what selected elements of different development agendas have in common, including the capacities required to deliver them. In this broader policy context, the proposed framework can facilitate the analysis of the relationships between the achievements of the MDGs and the HFA. It could also support the development of SDGs which are a key outcome of Rio+20. The analysis of both frameworks, in terms of the underlying capabilities required to achieve their goals, strongly suggests an opportunity to pursue a common framework. However, there are also important requirements remaining to learn how the frameworks are linked and the synergies that can be exploited.

The discussion and further refinement of such an approach would present further opportunities to boost international and national efforts seeking more

Table II.4 **The most and least demanding HFA-related deliverables, in terms of capacities required to produce them**

Rank	Top 5 – most demanding deliverables	HFA priority area
1	Micro-insurance	4
2	National and sectoral public investment systems incorporating DRR	4
3	Catastrophe bonds	5
4	Employment guarantee schemes	4
5	Conditional cash transfers	4
Rank	**Bottom 5 – least demanding deliverables**	**HFA priority area**
86	Participation in regional or subregional DRR programmes, projects	2
87	Poverty reduction strategy papers	1
88	DRR included in development plans and strategies	1
89	Specific allocation for DRR in the national budget	1
90	Common Country Assessments / UN Development Assistance Framework (UNDAF)	1

Source: ESCAP.
Note: See Annex II.2 for the complete list of deliverables.

consistency in definition of indicators, assessments, and data collection related to the MDGs, HFA and SDG frameworks. Better data will result in more relevant information regarding the individual, nationally perceived differences in capacities' efficacy among the countries concerned. Additional improvements could become useful when applied to guide and inform technical cooperation activities that aim to accelerate progress already made towards achieving the MDGs and HFA accomplishments. They may also serve as a platform for future work coming out of Rio+20 and leading up to future strategic development planning in 2015.

Perhaps more importantly, discussions of this and similar approaches that combine the MDGs and HFA frameworks can serve as means towards creating a common integrated development agenda such as the SDGs, built upon the knowledge and expertise of MDGs, sustainable development, the DRM and DRR communities of practice.

Rio+20 reiterated the importance of the HFA and the interlinkages between DRR, disaster recovery and long-term development planning. The outcome document of Rio+20 called for "coordinated and comprehensive strategies to integrate DRR and climate change adaptation considerations into public and private investment, decision-making and the planning of humanitarian and development actions" (United Nations, 2012).

As the Rio+20 outcome encompasses efforts needed to reduce social inequities and support social development, raising the basic standards of living for all, this chapter provides examples and analysis of how people and economies in Asia and the Pacific are vulnerable to disasters that threaten those very outcomes. The size of economies, the proximity to hazardous zones, the structural composition of the developing economies that lack diversity, and their available financial opportunities, affect vulnerability across the region. Rapid urbanization also plays an important role in this cycle. The key to reducing disaster risks is recognizing the fundamental importance of social protection policies and related investment strategies to protect the most vulnerable people in societies and build their capacity to become less vulnerable. Without addressing these various issues described, strategically and integrated fully in development practice, the effects of whatever other resources are committed to emergency response and recovery efforts following disasters will be marginal if the self-reinforcing cycle of increasing vulnerabilities is allowed to continue.

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Annex II.1
Notes on statistical data and methodologies used in Chapter 2

1. Cumulative impacts on GDP

Data on Gross Domestic Product (GDP, constant 2000 US$) was derived from World Development Indicators (WDI), the World Bank for Maldives and Pakistan from 1995 to 2010. The annual data is disaggregated by month using the method of "Stock Last" in ECOTRIM[1]. This time-series dataset is further analysed based on natural disaster information available from EM-DAT, the OFDA/ CRED International Disaster Database.

In terms of disaster events the 2004 Indian Ocean Tsunami effects on Maldives, and Pakistan's earthquake in 2005, cyclone and subsequent flooding in 2007 and extensive floods in 2010 were chosen for analysis considering the fact that those disasters had the largest estimated damage during 2000-2010 in each country. The GDP data sample insofar as 2008 to 2010 is insufficient for identifying the GDP gap created by the impacts of natural hazards.

Autoregressive integrated moving average model, also called ARIMA (p, d, q) is utilized as a method for forecasting GDP in the event of no disaster. This has been used because of its historical success in providing relatively accurate forecasts compared to other methods obtained from traditional econometric modelling or more sophisticated computations. The selection of the appropriate ARIMA model for the data is achieved by an iterative procedure based on the steps outlined below.

The first step is to ensure the model is stationary and time-invertible for forecasting. Therefore, a stationary test is conducted by plotting the Autocorrelation Function (ACF) and the Partial Autocorrelation Function (PACF). If the model does not satisfy the stationary test, the data series is transformed to a series of stationary time series values through the process of differentiating. The number of times differentiating is used will confirm the order of integration in the ARIMA model. After determining the number of times difference is used for the model to be stationary, the Augmented Dickey Fuller test determines whether the null hypothesis that the tested difference has a unit root (non-stationary) can be rejected or not.

[1] ECOTRIM is a software tool for performing temporal disaggregation techniques developed by Eurostat.

The next step is to choose the ARIMA model that best fits this data. Autoregressive process (1, 2) model turns out to yield the best result for three countries. By taking the second difference Xt of the original series Zt the ARIMA (1, 2, 0) can be expressed in the following manner:

$$Xt = Xt\text{-}1 + \varepsilon t$$

where E(Xt) = 0 and Var(Xt) = (1 – b2)-1 (Variance of) and εt is white noise stochastic error terms.

Diagnostic checking for residuals and parameters is performed before estimating forecasts with the identified model and compared to the observed variables.

2. Cumulative impacts on MDG 2 on education

Data on total net enrolment ratio was derived from the official MDG indicators website[2] from 2001 to 2009 (latest available year) for Pakistan. Based on the collected data, an adequate imputation method for missing data is applied. Since the ratio is in the form of a percentage, the original value Yt is converted to yt, which is between 0 and 1, by dividing Yt by 100. A logit transformation is performed on yt so that they are on the scale of real numbers.

$$Lt = \log\left(\frac{yt}{1-yt}\right)$$

The rate of change rt, can be estimated through the linear equation (below) using the OLS method:

$$Lt = r0 + r1 * t + \varepsilon t$$

In terms of disaster events, the earthquake in 2005, the cyclone and subsequent flooding in 2007 and the flood in 2010 were chosen for analysis considering the fact that those disasters had the largest estimated damage (US dollars in millions) and casualties during 2001-2010.

Based on its historical trends, two projections in the event of no disaster scenario are estimated using the above method.

[2] http://unstats.un.org/unsd/mdg/

Annex II.2

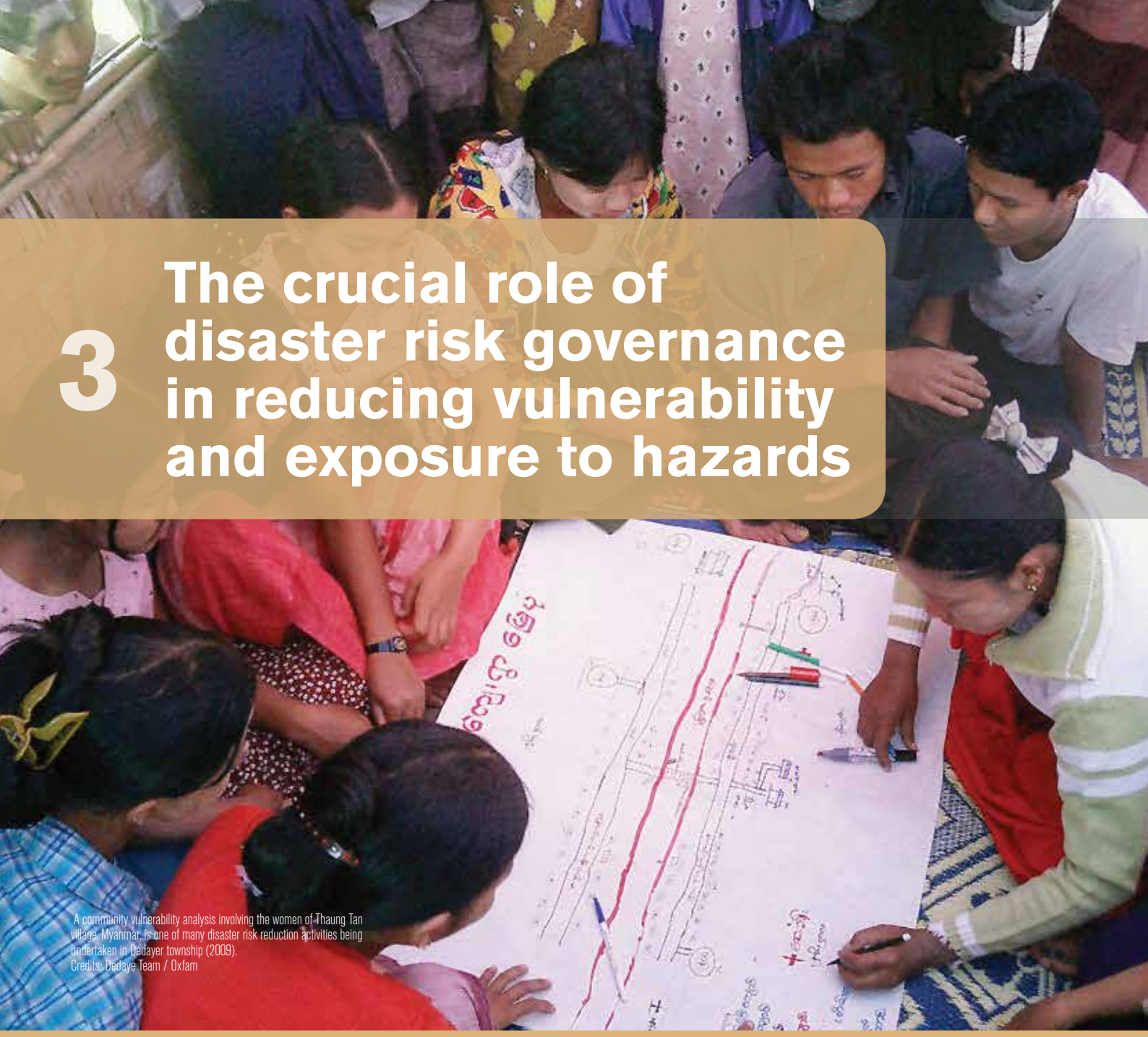
HFA means of verification in terms of capacities required to deliver specific outcomes

Rank	HFA-related deliverables	HFA priority area
1	Micro-insurance	4
2	National and sectoral public investment systems incorporating DRR	4
3	Catastrophe bonds	5
4	Employment guarantee schemes	4
5	Conditional cash transfers	4
6	Gender disaggregated vulnerability and capacity assessments	2
7	Post disaster needs assessment methodologies, including gender aspects	5
8	University curriculum	3
9	Agreed national standards for multi-hazard risk assessments	2
10	Crop and property insurance	4
11	Professional DRR education programmes	3
12	Investments in retrofitting infrastructure, including schools and hospitals	4
13	Established mechanisms for accessing DRR information	3
14	Provision of safe land for low-income households and communities	4
15	Training of masons in safe construction technology	4
16	Incorporation of costs and benefits of DRR in public investment planning	4
17	Catastrophe insurance facilities	5
18	Budget allocations for DRR in local governments	1
19	Research outputs, products or studies	3
20	Measures taken to address gender-based issues in recovery	4
21	Slope stabilization in landslide-prone areas	4
22	Research programmes and projects	3
23	DRR aligned with poverty reduction, welfare policies and programmes	4
24	Policies and programmes for school and hospital safety	5
25	Payment for ecosystem services	4
26	DRR inclusion in national scientific and applied research agendas, budgets	3
27	Reports generated and used in planning	2
28	Studies on the economic costs and benefits of DRR	3
29	Existence of social safety nets to increase resilience of risk-prone households and communities	4
30	Communication systems and protocols	2
31	Impact assessments of engineered projects such as dams, irrigation schemes, highways, and commercial sectors like mining, tourism, etc. on disaster risk	4
32	Emergency preparedness training and drills in school and hospitals	5
33	Action plans addressing transboundary issues	2
34	Dedicated provision for women in relief, shelter and emergency medical facilities	5
35	Disaster loss databases	2
36	Damage and loss assessment methodologies and capacities	5
37	Contingency plans with gender sensitivities	5
38	National programmes or policies to make schools and health facilities safe	5
39	Publicly available national disaster information system	3
40	Impacts of disaster risk accounted for in Environment Impact Assessments	4
41	Microfinance	4
42	Web page of national disaster information system	3
43	DRR incorporated and budgeted in post-disaster recovery programmes	4
44	Post-disaster need assessment methodologies	5
45	Investment in drainage infrastructure in flood-prone areas	4
46	Investment to reduce the risk of vulnerable urban settlements	4
47	Secure medical facilities	5
48	Identified and trained human resources	5
49	Adoption of an agreed method and procedure to assess disaster damage, loss and needs	5
50	Early warnings effectively acted on	2
51	Information on DRR practices available at the community level	3
52	Integrated planning (for example coastal zone management)	4
53	Multi-hazard risk assessment	2
54	Secondary school curriculum	3
55	Assessment of disaster risk impacts of major development projects	4
56	Local level preparedness	2

Rank	HFA-related deliverables	HFA priority area
57	Public education campaigns	3
58	Legislation	1
59	Active involvement of media in early warning dissemination	2
60	Inclusion of DRR in national educational curriculum	3
61	Planning and development decisions informed by national multi-hazard risk assessments	2
62	Training of local government	3
63	DRR public education campaigns provided for risk-prone communities	3
64	National contingency funds	5
65	Disaster losses are systematically reported, monitored and analysed	2
66	Financial arrangements are in place to deal with major disasters	5
67	Operations and communications centre	5
68	Protected areas legislation	4
69	Local governments have legal responsibility and budget allocations for DRR	1
70	Sector strategies and plans	1
71	Environmental impact assessments	4
72	Primary school curriculum	3
73	Risk-prone communities receive timely and understandable warnings of impending hazard events	2
74	Climate change adaptation projects and programmes	4
75	National development plan	1
76	Mechanisms exist to protect and restore regulatory ecosystem services	4
77	Search and rescue teams	5
78	Climate change policy and strategy	1
79	Programmes and projects addressing transboundary issues	2
80	Stockpiles of relief supplies	5
81	Shelters	5
82	Contingency plans, procedures and resources are in place for major disasters	5
83	Regional or subregional monitoring and reporting mechanisms	2
84	Civil society organizations, national planning institutions, key economic and development sector organizations represented in the national platform	1
85	Regional and subregional strategies and frameworks	2
86	Participation in regional or subregional DRR programmes, projects	2
87	Poverty reduction strategy papers	1
88	DRR included in development plans and strategies	1
89	Specific allocation for DRR in the national budget	1
90	Common Country Assessments / UN Development Assistance Framework (UNDAF)	1

Source: ESCAP
Note: A higher rank (1, 2, 3, etc.) indicates greater efforts or correspondingly more capacities are required to achieve the specific deliverable indicated.

3 The crucial role of disaster risk governance in reducing vulnerability and exposure to hazards



A community vulnerability analysis involving the women of Thaung Tan village, Myanmar, is one of many disaster risk reduction activities being undertaken in Dedayer township (2009).
Credits: Dedaye Team / Oxfam

The exercise of governance and particularly the explicit attention it gives to risks in a society greatly influences the nature of socio-economic vulnerabilities and the extent of people's exposure to hazards in the region. Some elements of governance covered in this chapter include legislative and policy frameworks, decentralization of authority and capacities, assigned and recognized accountabilities and adaptive governance. These elements share common traits while also reflecting the contexts and implementation particularities of individual countries and areas. Although there is substantial work already undertaken in the region for improving risk governance, more efforts are still required to ensure that policies and practice actually reduce the risks facing people and economies. If not addressed, they can certainly lead to ever more serious impacts of disasters.

3.1 Introduction

The importance of good governance in reducing disaster risks is widely acknowledged by commentators and practitioners. Effective governance is recognized as a critical factor for the achievement of the MDGs. The first *Global Assessment Report on Disaster Risk Assessment (GAR)* (UNISDR, 2009) identified urban governance as one of the three main drivers of disaster risks.

There are several levels of governance, extending from international to local responsibilities, often interacting with and encompassing social, economic, and environmental issues. The most contemporary thoughts on this are presented in the Rio+20 outcome document, "The Future We Want". It calls for "disaster risk reduction and the building of resilience to disasters to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication, and as appropriate, to be integrated into policies, plans, programmes and budgets at all levels and considered within relevant future frameworks." It further invites "governments at all levels as well as relevant subregional, regional and international organizations to commit to adequate, timely and predictable resources for disaster risk reduction in order to enhance the resilience of cities and communities to disasters, according to their own circumstances and capacities" (United Nations, 2012).

This chapter explores key elements of governance that are able to reduce the socioeconomic risks that enable natural hazards to become destructive disasters. It then reviews some examples of governance models considering their respective merits, accomplishments and lessons.

This chapter first reviews national foundation legislative and policy frameworks for reducing disaster risk. It then proceeds to consider the more particular practices related to decentralization and local risk governance, accountability for reducing risks, adaptive and inclusive governance approaches before concluding with observations about strengthening risk governance in the future.

3.2 Legislative and policy frameworks for disaster risk reduction

As disaster risk reduction (DRR) programmes and development strategies of countries and areas in Asia and the Pacific have evolved, they invariably have aimed to address national capacities and to empower local action. In this region, the first HFA priority area for action (making disaster risk reduction a policy priority and strengthening institutions) has progressed the most, in comparison to the framework's other priorities, with an average score of 3.3 on a scale of 5. However, progress indicators show that despite the development of national policy and legal frameworks, limitations remain in translating these legislative instruments into actions. Figure III.I shows that ensuring the adequate availability of dedicated resources for risk reduction activities and the extent of multi-stakeholder participation in DRR have been less accomplished. By mid-2012, only seven countries in the region have formally announced the formation of a national platform for DRR.[1]

3.2.1 Disaster risk management legislation

A legislative act can be considered the most definitive statement of policy upon which the formulation of all other disaster risk management (DRM) plans, policies, and decisions must be based. It provides the basic legal mandate for DRM practice and sets the tone for how DRR should be pursued. Legislation identifies the overarching principles, basic objectives, and specific entities of the State responsible for designated functions required to reduce disaster risks, and in many cases for managing emergencies.

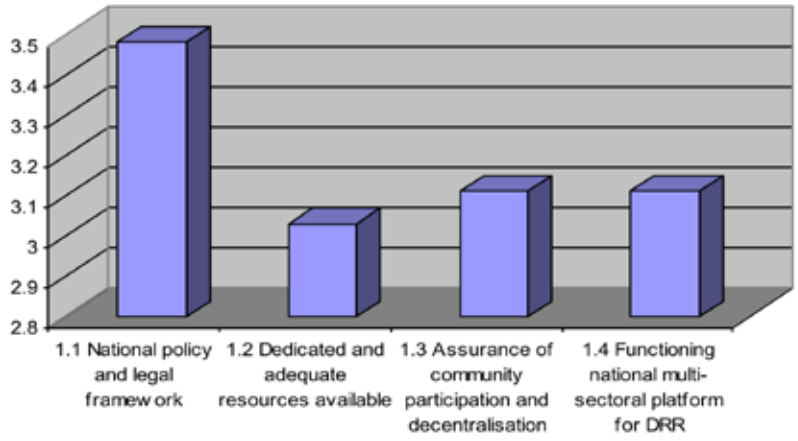
Of the 61 countries and areas in Asia and the Pacific, 30 have enacted national or central legislation that specifically deals with disaster risk management, as shown in table III.1. The documents cited do not include policies or directives that are without overarching legislative mandate, such as regulations or directives issued by individual ministries.

Eighteen countries or areas had legislation stipulating their respective authority and responsibilities in relation to disasters resulting from natural hazards prior to 2004 (figure III.II). These legal instruments were adopted over an extended period from1959-2004, a pace that would change following the 2005 World Conference on Disaster Reduction, after which 12 central legislative actions on disaster management were accomplished in the following seven years.

Of the 30 laws addressing disaster risk management issues, 23 were analyzed with regard to the HFA priority areas for action (figure III.III). The review revealed that

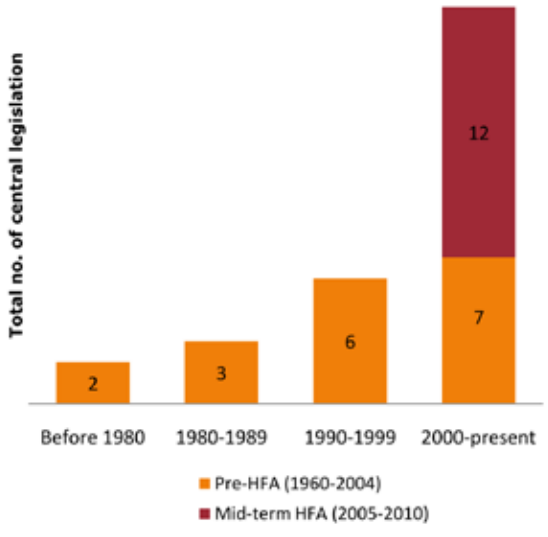
[1] The countries are: Afghanistan, China, Indonesia, Islamic Republic of Iran, Japan, Philippines and Sri Lanka. More countries have similar coordination mechanisms on DRM in place, but they have not yet formally announced these as "national platforms" to UNISDR.

Figure III.I **Progress indicators for HFA priority area 1, Asia-Pacific 2009-2011**



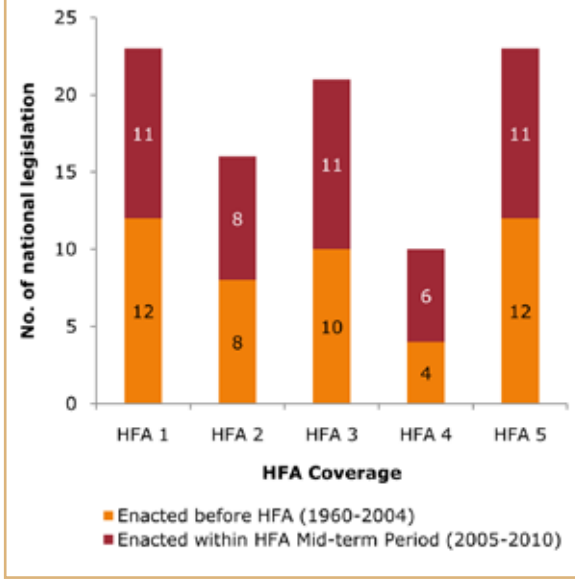
Source: Berse, "Analysis of National Legislation, Agenda, and Development Plans from Asia and the Pacific: A background paper for the Asia-Pacific Disaster Report 2012" (Bangkok, Thailand, UNISDR, 2012).
Note: Scores range from 1 to 5 as:
1- Minor progress with few signs of forward action in plans or policy.
2 - Some progress, but without systematic policy or institutional commitment.
3 - Institutional commitment attained, but achievements are neither comprehensive nor substantial.
4 - Substantial achievement attained but with recognized limitations in capacities and resources.
5 - Comprehensive achievement with sustained commitment and capacities at all levels.

Figure III.II **Growth of central legislation on disaster risk management in Asia and the Pacific, 1959-2012**



Source: Berse, "Analysis of National Legislation, Agenda, and Development Plans from Asia and the Pacific: A background paper for the Asia-Pacific Disasters Report 2012" (Bangkok, Thailand, UNISDR, 2012).

Figure III.III **Selected legislation on disaster risk management in Asia and the Pacific, with reference to HFA priorities**



Source: Berse, "Analysis of National Legislation, Agenda, and Development Plans from Asia and the Pacific: A background paper for the Asia-Pacific Disasters Report 2012" (Bangkok, Thailand, UNISDR, 2012).

Table III.1 **Central legislation on disaster risk management in selected Asia-Pacific countries or areas**

Country or area	Title of legislation	Year enacted
Armenia*	Law on the Protection of the Population in Emergency	1998
Australia	Disaster Management Act 2003	2003
Cook Islands	Disaster Risk Management Act	2007
Fiji	Natural Disaster Management Act, 1998	1998
India	The Disaster Management Act, 2005	2005
Indonesia	Law of the Republic of Indonesia Concerning Disaster Management	2007
Japan	Disaster Countermeasures Basic Act	1961
Kazakhstan*	Decree No. 4511 on Measures Aimed to Prevent Disasters in the Territory of the Republic	2004
Kiribati	National Disaster Act 1993	1993
Kyrgyzstan*	Decree on Protection of Population and Territory from Natural and Man-Made Emergency	2000
Marshall Islands	Disaster Assistance Act 1987	1987
Mongolia	Law of Mongolia on Disaster Protection	2003
Nauru	Disaster Risk Management Act 2008	2008
Nepal	Natural Calamity Relief Act 2039 B.S.	1982
New Zealand	Civil Defence Emergency Management Act 2002	2002
Pakistan	National Disaster Management Ordinance, 2007	2007
Papua New Guinea	Disaster Management Act	1984
Philippines	Philippine Disaster Risk Reduction and Management Act, 2010	2010
Republic of Korea*	Act on Disaster Risk Management and Reduction	2008
Samoa	Disaster and Emergency Management Act, 2007	2007
Solomon Islands	National Disaster Council Act, 1990	1990
Sri Lanka	Sri Lanka Disaster Management Act, No. 13 of 2005	2005
Tajikistan*	Decree No.400 on the Establishment of the Committee for Emergency Situations and Civil Defense	1994
Thailand	Disaster Prevention and Mitigation Act, B.E. 2550	2007
Tonga	Emergency Management Act, 2007	2007
Turkey*	Natural Disaster Law No. 7269	1959
Tuvalu	National Disaster Management Act	2007
Vanuatu	National Disaster Management Act No. 31 of 2000	2000
Viet Nam	Ordinance on Flood and Storm Control	1993

Source: Berse, "Analysis of National Legislation, Agenda, and Development Plans from Asia and the Pacific: A background paper for the Asia-Pacific Disasters Report 2012" (Bangkok, Thailand, UNISDR, 2012).
Note: *Not included in analysis due to lack of information at the time of the study.

HFA priority areas 1 (official policy commitment) and 5 (disaster preparedness) were addressed to varying extent in all 23 documents. All but one of the laws provide for the creation of a national or other central authority's comprehensive plan, the establishment of a national or central disaster risk management committee or unit, and the revision of related laws.

Fifteen of the laws have specific sections devolving particular aspects of disaster risk management including the development of related plans and enhancement of local capacities to subnational governments. The provision of financial and human resources to support disaster risk management and DRM-related work has been cited in 12 of the legislative instruments. However, only nine laws explicitly refer to the participation of communities in reducing and managing disaster risks. Associating DRR with national or other central strategic policies and integrating it with operational plans continues to be a matter of weak policy association. Only 6 of the 23 laws, and surprisingly none from Pacific States where there are such strong community bonds, reflect these specific provisions.

HFA priority area 2 (risk assessment and early warning) has been addressed in two thirds (16 of 23) of the legislation. Strikingly, risk assessment and

Table III.2 **Duration of DRR strategies in selected Asia-Pacific countries**

Country	Realization Period	Timeframe			References
		Short-term	Medium-term	Long-term	
Afghanistan	2011-2015	○			Action Plan/Strategy, DM Plan
Bangladesh	2010-2015	○			DM Plan
Cambodia	2008-2013	○			Action Plan/Strategy
China	2007-2012	○			DM Plan
Cook Islands	2009-2015		○		Action Plan/Strategy
Indonesia	2010-2012	○			Action Plan/Strategy
Lao People's Democratic Republic	2003-2020			○	Action Plan/Strategy
Maldives	2010-2020		○		Action Plan/Strategy
Mongolia	2006-2015		○		DM Framework
Myanmar	2009-2015	○			Action Plan/Strategy
Nepal	2008-	–	–	–	Action Plan/Strategy
New Zealand	2007-	–	–	–	Action Plan/Strategy
Pakistan	2007-2012	○			DM Framework
Papua New Guinea	2005-2015		○		DM Framework
Philippines	2009-2019		○		Action Plan/Strategy, DM Framework
Sri Lanka	2005-2015		○		Action Plan/Strategy
Thailand	2010-2019		○		Action Plan/Strategy
Timor-Leste	2008-2012	○			Action Plan/Strategy
Vanuatu	2006-2016		○		Action Plan/Strategy
Viet Nam	2007-2020			○	Action Plan/Strategy

Source: Berse, "Analysis of National Legislation, Agenda, and Development Plans from Asia and the Pacific: A background paper for the Asia-Pacific Disasters Report 2012" (Bangkok, Thailand, UNISDR, 2012).
Note: (S) short-term 1-5 years, (M) medium-term 6-10 years, (L) long-term 11-20 years.

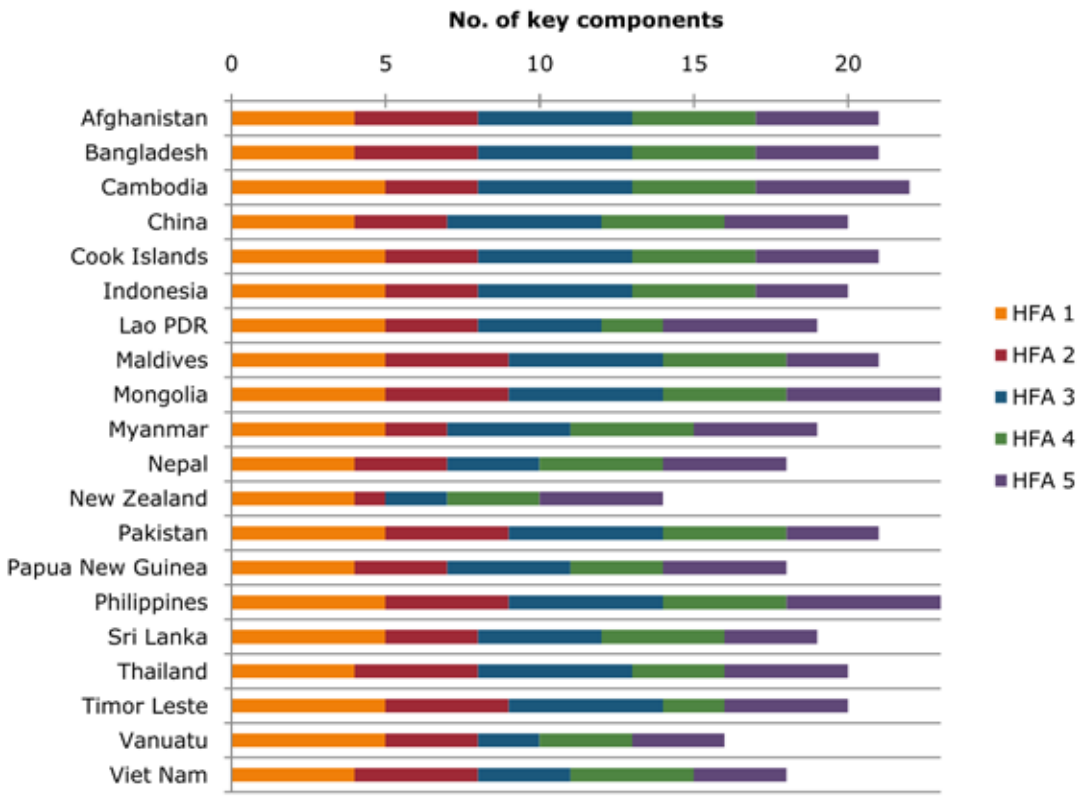
early warning were absent in the relatively recent foundation documents of Australia, Cook Islands, Samoa, Sri Lanka, Tuvalu and Vanuatu. HFA priority 3 (information and education) has been considered in 21 of the 23 laws, except for the Solomon Islands' and Vanuatu's programmes, which were both enacted before the HFA was adopted. The fourth HFA priority area (addressing underlying risk elements) has received the least attention among all the HFA priorities, cited only by ten countries or areas. Most laws enacted since the adoption of the HFA in 2005 have maintained a strong focus on disaster preparedness for effective response to disasters identified as HFA priority area 5. Judging from the relative emphasis conveyed by these laws, for many politicians DRR appears to remain a supplemental rather than a fundamental principle in lawmakers' considerations about the protection and well-being of their societies.

3.2.2 National strategies for disaster risk reduction

Of the 61 countries and areas in Asia and the Pacific, 20 were included in an analysis of how their official DRR strategies address key elements of disaster risk management. With 16 from Asia and four from the Pacific, these selected countries or areas have clearly identified their DRR priorities in one or more official documents. The DRR strategies are variously cited in national disaster risk management policies, other central authority or area action plans or in a Strategic National Action Plan (SNAP) for DRR, prepared with support from UNISDR.

Table III.2 shows that more than three quarters of the countries have couched their DRR plans in short- to medium-term intentions. Indonesia has adopted a short-term agenda through its SNAP, which covers only a two-year period from 2010-2012, succeeding

Figure III.IV **HFA coverage in disaster risk reduction strategies of selected Asia-Pacific countries**



Source: Berse, "Analysis of National Legislation, Agenda, and Development Plans from Asia and the Pacific: A background paper for the Asia-Pacific Disaster Report 2012" (Bangkok, Thailand, UNISDR, 2012).

its first action plan for 2007-2009. Lao People's Democratic Republic has adopted the longest realization period among the plans reviewed, with both its national disaster risk management plan and its development strategy looking forward to 2020. Activities in Nepal and New Zealand were identified from the countries' respective strategies although neither agenda refers to specific time periods for programme realization.

Figure III.IV shows that the HFAs priorities for action have been covered in all 20 of the strategies, although each HFA priority has been elaborated differently in the various country documents. This most likely reflects the relative urgencies of one HFA priority subject area compared to others given different governance structures, institutional mechanisms and DRR capacities in place in each country. For instance, HFA priority area 4 has been covered least in Pakistan and Lao People's Democratic Republic, while the second HFA priority received the least attention in the New Zealand and Myanmar strategies. This does not suggest that a country's DRR strategy is necessarily lacking in a particular HFA priority, as for example New Zealand made significant progress in early warning and capacity building for risk assessments since the late 1990s. The development of "a comprehensive understanding of New Zealand's hazardscape" has been singled out as an outstanding objective in New Zealand's current National Civil Defence Emergency Management Strategy (2007).

3.2.3 Disaster risk reduction and climate change adaptation in national development strategies

A review of legislation and central DRR and national climate change adaptation (CCA) strategies was conducted to determine the extent to which DRR is being successfully integrated or "mainstreamed" into development plans. The content of 41 long-term national development strategies from 33 countries or areas in Asia-Pacific was reviewed to determine the extent that there was clear reference in the strategies to DRR and CCA. More specifically, if the subjects were mentioned, the degree to which each was treated separately or they were expressed in

Figure III.V **Inclusion of disaster risk and climate change issues in long-term official development strategies of selected Asia-Pacific countries or areas**

Country or area	DRR	CCA
Armenia	●	●
Australia	●	●
Bangladesh	●	●
Bhutan	●	●
Brunei Darussalam	●	●
Cook Islands	●	●
Fiji	●	●
Guam	●	●
Hong Kong, China	●	●
Israel	●	●
Japan	●	●
Kazakhstan	●	●
Lao People's Democratic Republic	●	●
Malaysia	●	●
Marshall Islands	●	●
Nauru	●	●
Nepal	●	●

Country or area	DRR	CCA
New Zealand	●	●
Norfolk Island	●	●
Pakistan	●	●
Palau	●	●
Papua New Guinea	●	●
Philippines	●	●
Republic of Korea	●	●
Singapore	●	●
Solomon Islands	●	●
Sri Lanka	●	●
Tajikistan	●	●
Thailand	●	●
Timor-Leste	●	●
Tonga	●	●
Tuvalu	●	●
Vanuatu	●	●
Viet Nam	●	●

Source: Berse, "Analysis of National Legislation, Agenda, and Development Plans from Asia and the Pacific: A background paper for the Asia-Pacific Disaster Report 2012" (Bangkok, Thailand, UNISDR, 2012).

Note: ●DRR and CCA are explicitly and directly considered
●DRR and CCA are neither clearly nor directly considered
●Neither disaster risk issues nor climate change issues are considered at all

a combined relationship was considered as the approach would provide insight into the strategic risk analysis relationships being employed in the countries concerned. If there were no explicit mention of DRR and CCA, nor were the subjects implied elsewhere in the document, that would also be a reflection of prevailing risk governance orientations.

In this respect, figure III.V indicates that although 13 of the 33 countries or areas surveyed have explicitly addressed both DRR and CCA in their respective long-term development strategies, frequently these professional domains have been considered separately. In a noteworthy exception, Bangladesh's Outline Perspective Plan distinguishes itself by effectively integrating DRR and CCA into national development strategies as complementary and related concerns. Bangladesh views DRR as a primary adaptation feature "to address economic development and climate change issues in an integrated fashion" (Bangladesh, 2010). This is an approach from which other countries could benefit, even as the particular consequences in their own environments would differ.

Six countries and one area have not considered disaster risks and climate change in their development plans. The fact that the countries or areas which did not include DRR and CCA issues in their strategic development plans are States or areas where strategic policies tend to give predominant focus to economic objectives with less evident reference to environmental policies and relationships, suggests that a commitment to public risk concerns may not currently be a significant motivating political interest.

Some of the plans identified relatively comprehensive approaches to address disaster risks (e.g. Tajikistan, Tonga and Vanuatu), in contrast to disaster prevention concerns emphasized elsewhere, as in Hong Kong, China. For a few countries such as Australia and New Zealand, their fundamental national commitments to DRR and CCA are embodied in other overarching strategies such as environmental protection and management or sustainable development. The fact that both countries' long-term sustainable development plans were formulated in response to the 1992 Conference on Environment and Development before the concepts and practice of DRR and CCA had yet gained international recognition is a testament to the foresight given to institutionalizing the principles of risk reduction.

There were eight countries which took disasters into account, but not in the specific context of DRR. Their long-term plans either addressed disasters primarily as a concern for preliminary preparedness and contingent emergency response planning or considered disaster risks as a "development issue". With a more generalized view of disasters, such development plans neither provided significant

direction and guidance nor specifically designated resources to pursue efforts for identifying, mitigating or countering distinctive disaster risks.

Timor-Leste's Strategic Development Plan (SDP) provides a more positive commitment that indicates a nascent but growing awareness of DRR. Although DRR was not mentioned specifically nor developed fully in the country's primary concerns about emergency management operational issues, the SDP does refer to broader DRR approaches that can be strengthened or built upon in future planning activities. Such positive examples of expanding awareness and wider developmental relevance certainly are to be encouraged.

In addition to associated CCA or environmental considerations, public safety is another strategic approach that is used by some countries to increase the visibility and wider engagement for addressing matters of disaster risk. In Pakistan, safety is framed as a public value that the State must ensure and provide to its citizens, so it has become the basic foundation for addressing disaster issues in the country. While Brunei Darussalam's "National Vision 2035" (Brunei Darussalam, 2008) strategy does not directly refer to DRR in those words, its objectives are expressed in terms of securing the safety of its people by means of the highest international standards. As elsewhere, public safety is additionally related to concepts of political stability and social harmony.

These various observations suggest that there are numerous political, policy and cultural issues that determine the relative commitments able to be expressed or demonstrated through risk governance planning and legislation. The common variance between "intended policies and actual practice" may be more a matter of insufficient focus on the knowledgeable implementation of practical and local action than one resulting from a more common assumption or unexamined expression of "administrative or bureaucratic delays".

3.3 The attributes and challenges of decentralization in risk governance

There are different approaches to risk governance and decentralization in the Asia-Pacific region as suits the wide variety of local interests and the range of relevant capabilities. Disaster risk reduction is frequently expressed as having its greatest relevance at the local level, but in practice institutional authority can be uncertain about how decentralization either empowers or hinders local actors to take local actions that actually do reduce disaster risks. Although local knowledge is recognized as being significant, the availability of human, material or technical resources for the activities required may be less so. The fact that differing views and contrary interests exist in local communities is often too easily deflected by assumptions that the implementation of DRR practices are best realized simply through "participatory approaches".

"Subsidiarity" is the guiding principle for decentralization in governance practice, in its representation of matters that should be handled by the lowest administrative, managerial or technical level, or by the most locally competent authority.[2] Decentralization involves the practice of delegating decision-making authority from a central authority and is grounded in the expectation that people working or living closest to the issues involved have the greater understanding or the best interests in accomplishing the matters concerned. Decentralization can also be understood as the transfer of authority and responsibility for public functions from a central government authority to subordinate or local organizations. These may include either governmental or other private and commercial entities often referred to collectively as "the private sector" (Jain (ed.), 2005; De Mello and Barenstein, 2001; IULA, 2001; Litvack, Ahmad, and Bird, 1998; Manor, 1999).

A closer consideration of decentralization in the region (FAO, 2004; Gonzalez and others, 2002; Crook and others, 1998) indicates a range of efforts, sometimes experimental or innovative, that vary across countries in trying to address different problems or needs. These efforts do however reflect a common characteristic in their searching for effective means that can structure interests and roles through shared powers and resources. Administratively, decentralization involves the transfer of national or central government functions to subnational levels, partial control over financial decisions from higher to lower authorities and resource allocations to lower levels of governance and authority (United Cities and Local Governments, 2007).

3.3.1 Local risk governance in practice

The experience of policy and legislative involvement in DRR has shown that there are three key drivers for

[2] The Oxford English Dictionary defines subsidiarity as the idea that a central authority should have a subsidiary function, performing only those tasks, which cannot be performed effectively at a more immediate or local level. The concept is applicable in the fields of government, political authority, science, cybernetics, and management. Subsidiarity is ideally, or in principle, one of the features of federalism.

increasingly decentralized disaster risk governance. They are the internalization of disaster risk reduction concepts in Government policy and planning, the institutionalization of DRR processes and responsibilities in political, economic and development functions, and the implementation of policies, plans and projects through practice. The success of disaster risk governance depends on the satisfaction of all of these criteria.

It is relevant that both Indonesia and Pakistan embarked upon reforms in disaster risk governance after the 2004 tsunami and 2005 earthquake, respectively. International thinking and policy expression at the time influenced these developments in both countries, however despite changes in national approaches in both instances motivated by a more developed appreciation of DRR, both initiatives remain works in progress. Challenges remain in matters of legislation, policy and implementation, as may well be expected in the realization of any significantly altered strategic concepts that have to evolve over a period of time. The following case examples will elaborate both the accomplishments as well as continuing challenges against initial, broadly similar intentions.

Indonesian experience in disaster risk governance

The Indian Ocean Tsunami of 2004 was a decisive international event, but one with even greater local impacts. Strong advocacy from local and global civil society organizations stimulated significant DRM reforms in Indonesia.[3] In response to a wide and definitive demand, the Indonesian House of Representatives passed Law No. 24/2007 Concerning Disaster Management with the conviction of the need to alter previous and dated approaches of disaster management practice. The shift in thinking and institutional arrangements proceeded from a previous centralized and sectoral approach that had focused on emergency response to a new vision emphatically expressed as one of a wider, more inclusive joint responsibility among all interested parties. This necessarily was based on the engagement of more localized and decentralized affiliations at all

[3] Local Indonesian experts expressed a view that the resulting reforms were first designed at the central level with little input from provincial, regional and district levels of the country. They thought that the influential advocacy for the reforms was steered predominantly by urban-based NGOs and academics without the wider mobilization of the official management and communities of hazard-prone regencies and districts. Some experts have characterized it as a "top-down" reform process in Indonesia. Interview with H. Iskandar Lama et. al. by Bhatti, Amjad, Executive Director, School of Political and Strategic Communication , Islamabad, Pakistan for the study on "Decentralized Disaster Risk Governance", Jakarta, 4 March 2012.

Box III.1 **Legislative and regulatory frameworks on disaster risk governance in Indonesia**

1. Law No 24/2007 on Disaster Management
2. Law No 26/2007 on Spatial Planning
3. Law No 27/2007 on the Management of Coastal Areas and Small Islands
4. Government Regulation No 21/2008 on Disaster Management Operation
5. Government Regulation No 22/2008 on Funding & Management of Disaster Assistance
6. Government Regulation No 23/ 2008 on Participation of International Institutions and Foreign Non-Government Institutions in Disaster Management
7. Government Regulation No 26/2008 on National Spatial Planning
8. Government Regulation No 64/2010 on Mitigation on Coastal Areas and Small Islands
9. Government Regulation No. 40/2006 on the Procedures of Formulating National Development Plans.
10. Government Regulation No. 90 /2010 on Preparation and Scrutiny of Working Plan and Budget of Ministry/Agency and Ministry of Finance
11. Presidential Decree No 8/2008 on the Establishment of BNPB
12. Presidential Decree No 26/2010 on Central Government Budget 2011
13. Head of BNPB Regulation No 3/2008 on the Establishment of BPBD
14. Mid-term National Development Plan 2010-2014
15. Minister of Home Affairs Regulation No 46/2008 on BPBD Organization and Works Mechanism
16. Minister of Finance Regulation No. 93/PMK.02/2011 on Guidelines of the Preparation and Scrutiny of Working Plan and Budget of Ministry/Agency
17. Government Regulation No. 20/2004 on Government Working Plan
18. Regulation of the Minister of Home Affairs Number 46/2008
19. Regulation of the Head of BNPB Number 3/2008 on the Establishment of the Regional Agencies for Disaster Management (BPBD).
20. Bappenas (various years), Government Working Plan 2007 to 2012

Source: Bhatti Amjad, UNISDR, "Decentralized Disaster Risk Governance, a background paper for the Asia-Pacific Disaster Report 2012 (UNISDR, 2012)

levels of activity and authority, and it was driven by a multidimensional focus on DRR (Indonesia, 2010).

Three key issues inspired these DRM reforms in Indonesia (Indonesia, 2010). First, DRM would transcend the previous emphasis given to emergency response at the time of a disaster and maintain a broader focus on the consideration of risk management. Second, the Government's protection of the community from disaster hazards is the embodiment of people's human rights and is not simply a Government obligation. Third, DRM would be a responsibility of the entire community, and not only that of the government (Indonesia, 2010).

At the national level, the ground-breaking Indonesian law provides the basis for DRR. During the period 2006-2009, Indonesia formulated a National Action Plan for Disaster Risk Reduction (NAP-DRR) 2006-2009 which was motivated by the HFA and devoted to elaborating the five HFA priority actions. The NAP-DRR was created at the national level involving many political parties, government officials, local communities and private sector interests which were all represented at central, subnational and often local administrative levels of the country (Indonesia, 2010).

As a result, DRR has been integrated into policy frameworks at national and subnational (i.e. Indonesian regional) governments for matters of disaster preparedness, emergency response and post-disaster recovery. Expanded policies related to disaster risk management have been developed and included in the 2004-2009 and 2010-2014 national medium-term and annual development plans.

Indonesian Law 24/2007 (Indonesia, 2007) addresses 12 specific DRR functions assigned to subnational and local authorities. These functions include:

- Integration of DRR into development programmes,
- Allocation of sufficient disaster risk management budgets in the Public Policy Budgets (APBD)
- Development planning that include elements of disaster risk management policy,
- Regulation of the use of technologies with potential disaster threats or danger to an area,
- Formulation of policies for preventing natural resource control and depletion beyond ability of recovery,
- Establishment of a Regional Disaster Risk Management Local Agency.

The tasks of disaster risk management local authorities include:

- Stipulating guidelines and directions in accordance with local government and Disaster Risk Management National Agency policies on disaster risk management, which include disaster prevention, emergency response, rehabilitation, and reconstruction in a fair and equitable manner,
- Reporting disaster risk management to heads of local government on a monthly basis in normal conditions and at any time in disaster emergency circumstances,
- Disaster risk management planning,
- Fulfilling disaster risk analysis requirements,
- Integrating disaster risk management into development planning,
- Implementing and enforcing spatial structure plans.

This progressive approach to local risk governance in Indonesia faces some challenges including operational inadequacies between the enactment and enforcement of DRR intentions. This includes the lack of a predictable budget allocation that sufficiently corresponds to meeting the legal responsibilities for DRR at subnational and local levels. Gaps also remain in knowledge and information management among and within the three tiers of governance. There are overlapping regulations at central, regional and local levels of responsibility where central authority, policy development and fiscal control are unable to assist the local implementation of DRR. Although there are clearly determined roles for both central and local authorities, the intermediate tier of regional government is not yet provided with an effective role in DRR.

Pakistan experience in disaster risk governance

In the case of Pakistan, analysis indicates (UNISDR, 2012) that stand-alone, episodic and isolated reforms in disaster risk governance between 2005 and 2012 have compounded problems of promoting local DRR activities instead of resolving them. The issues of political and institutional ownership of a national strategy and a continuing search for wider commitment to implementing disaster risk management reforms remain impediments in Pakistan. As a result of these intermittent commitments, unmet DRM needs of the country have led to uncoordinated legislative experimentation in disaster risk management.

Pakistan has tried to devise suitable country-specific DRM reforms consistent with the intentions of the HFA,

but contextual inconsistencies, institutional overlaps and operational limitations have adversely affected their realization and consequently hampered the implementation of DRR in practice. As one instance, the process of reforming the national approach to DRM following the 2005 earthquake remained exclusive, as the efforts were limited to only the traditional disaster risk management establishment and the prevailing authority structure.

Matters of ownership and the understanding of institutional reforms in DRM within Pakistan have continued to be major issues in planning, resource allocation and programme implementation. Although the Government has adopted a governance reform process which devolved functions and resources to local authorities, disaster risk governance has been treated as an exception with its functions remaining centralized. The particular preventive and mitigation aspects of DRR have been considered in isolation from the wider disaster risk governance process and without a necessary integration into DRM policies and frameworks.

There are additional underlying legislative issues and operational constraints that have frustrated efforts to integrate a more sustained national commitment to disaster risk governance into the strategic interests of Government. These issues equally impede efforts to integrate DRR concepts and policies into established national development planning. In a more fundamental respect, the lower levels of government currently lack a legislative mandate, fiscal resources or technical capacities either to integrate or to implement DRR more fully into primary government objectives and responsibilities.

Despite these political challenges and institutional difficulties, the introduction of the 18th Constitutional Amendment in 2010 promoting a federalist model of devolution in Pakistan to expand provincial autonomy provided a legislative opportunity to reconsider the centralized model of disaster risk governance. In practice, the demands of disaster risk governance are essentially provincial concerns, therefore any reforms would need to be initiated and pursued in the provinces with strong linkages to other policy, planning and implementation authorities.

Existing disaster risk governance implementation arrangements are subjected to constraints imposed by local practices and a variety of location-specific policy directives. These could be addressed by the Government's Council of Common Interests, instead of relying on a single federal body such as the National Disaster Risk Management Agency, which currently has limited provincial representation and capacities. As this section suggests, a four-pronged strategy to improve decentralized risk management capacities generally may be beneficial in addressing issues such as those being encountered in Pakistan. Disaster risk governance requires four solid cornerstones of clear policy, effective legislation, institutional capacities and fiscal commitments if it is to succeed in any country, regardless of individual or localized variations.

3.3.2 Lessons for effective local risk governance

To be effective in empowering local action, any subsidiary authorities need to be supported with adequate financial, human, material, technical and financial resources. The various tiers of government responsibilities and the linkages between them from central authority to local engagement need to be clearly determined. Implementation mechanisms certainly are required to be in place, be empowered and resourced. Institutional coherence is the most crucial element to ensure that productive disaster risk governance results from well-considered legislation, informed DRR policies, sustainable institutions, and competent and dedicated implementation. As with any other strategic Government function, risk governance cannot exist in isolation from other critical services nor without regard and close integration with national development objectives. In the specific case of managing disaster risks, the engagement of primary development sectors are essential, so the establishment and maintenance of reliable relationships and confident communications linkages are crucial at all levels of governance.

3.4 Accountability in reducing exposure to risk

Much of a community's exposure to disaster risk results from the consequences of public policies and investments in development planning. For example, urban land-use planning and its management have implications on future risk scenarios. In several cities in Asia, such as Kathmandu, Manila, Mumbai, Karachi and Jakarta among others, poor planning and weak enforcement of local zoning and building laws have worsened risk conditions. This has resulted in major catastrophes in recent years.

Community officials and individual residents exposed to high levels of risk have a right to know, indeed to demand, what is planned and actually being pursued

Box III.2 **Accountability through participation of civil society**

In the 2009-2011 HFA review cycle, only 16 countries of the 36 which reported their progress in risk reduction noted that civil society organizations, national planning institutions, key economic and development sector organizations are represented in their national platforms for DRR. Of those 16, only nine noted that civil society organizations are part of the national platform, while only three had women's groups represented in the platforms. Nepal and Sri Lanka reported 35 civil society representatives participating in their national platforms, while Indonesia reported 16 civil society representatives being involved in theirs.

Source: Analysis by UNISDR, 2012, based on HFA progress reviews submitted by countries in May 2011. http://www.preventionweb.net/english/hyogo/progress/ (accessed June 2012).

by the State to ensure they are safeguarded against natural hazards. Social engagement, public knowledge and opportunities to participate fully in a manner that can influence decisions for their own safety and security are necessary prerequisites for realizing any substantive DRR endeavours. Communities need to be at the centre of efforts to identify, design and monitor risks in their local environment even though the process involves commitments from many other essential collaborators.

Accountability has been defined as a relationship between an actor and a forum in which the actor has an obligation to explain and justify his or her plans for action or conduct; the forum may pose questions, require more information, solicit other views and pass judgment; and the actor may see positive or negative consequences as a result (Olson, et al, 2010). The Busan Forum on Aid Effectiveness embraces accountability as one of the four common principles for effective international development. It recognizes that accountability to citizens, organizations, constituents and shareholders is critical for delivering results (Republic of Korea, 2011). Unfortunately, several cases exist where communities have been exposed to risks because governments' decisions for large public investments have not taken account of local concerns and public safety.

In the Asia-Pacific region there are examples of people and communities voicing their expectations to government officials to provide timely warning and to enable evacuation, when hazard impacts are imminent. In one example in the Philippines (Sun. Star Cagayan de Oro newspaper, 15 February 2012), an administrative complaint was filed against the Cagayan de Oro (CDO) city mayor by members of the Save CDO Now Movement. The complaint alleged that the mayor was negligent in protecting the population of the city from Tropical Storm Washi in December 2011 when more than a thousand people were killed. A similar case was filed in August 2012 against the mayor of Minamisanriku, Miyagi prefecture in Japan claiming that professional negligence caused the deaths of town officials during the March 2011 tsunami because he failed to direct them to safety (The Japan Times, 26 August 2012). Such explicit public concern has not yet been demonstrated to reduce the exposure or vulnerability of entire segments of population to hazards that could potentially lead to disasters in the future.

The perils of nuclear power facilities located in areas vulnerable to hazards and in proximity to human settlements were dramatically exposed by the 2011 Fukushima disaster in Japan. The incident highlighted similar exposure elsewhere in Asia and throughout the world, although it was not for the first time. A nuclear power plant was built in Bataan, Philippines on an active seismic fault nearly 20 years ago, although public pressure eventually forced the plant's permanent closure before it was commissioned, even though the equivalent of two billion dollars of public funds had been spent (Transparency International, 2005). There are other nuclear power plants being built in Asia, such as one in Kalimantan, Indonesia and another in Kundakulam, India, which are facing growing public concerns about their safety and possible future risks from natural hazards.

Learning from past disasters has been slow. With a limited scope of community involvement in decision-making, even long-term disaster recovery programmes can provide opportunities for building back better, and safer. Successive evaluation studies after major disasters have revealed examples of poor accountability, such as in Gujarat, India earthquake in 2001 (Sanderson, 2008) or the Indian Ocean

Tsunami in 2004 (Cosgrave, 2007). The delivery of emergency materials and reconstruction promises remained unrealized, actual needs were not always matched by supplies and considerable amounts of assistance failed to produce the intended results because there were inadequate systems available to monitor or regulate resource commitments and use.

When there is a lack of transparency about the use of public funds it easily undermines government credibility and leads to questioning priorities, policy decisions and the rationale for identifying beneficiaries or the distribution of material assistance. The Open Budget Survey[4] (IBP, 2010) reconfirms that the overall state of budget transparency in the 94 countries surveyed remains poor.

The GAR 2011 states, "If it is true that 'political survival lies at the heart of disaster politics', then accountability mechanisms are particularly important in generating political and economic incentives for disaster risk reduction. The risk of being held to account for decisions that result in avoidable disaster risk can be a powerful incentive to make DRM work." Echoing a similar sentiment but in political terms, a politician from a disaster-prone Asian country expressed the view that, "Disaster risk reduction will become my priority only if it can get me more votes in the next election" (ADRRN, 2011).

Despite policy-driven expectations of monitoring and accountability, establishing a direct attribution of effective DRR to good governance is difficult. The consequences of decisions or actions taken or avoided may not become visible until much time has passed. In order to create more tangible evidence within a community and greater visibility among politicians and public officials there is a persistent need for continuing efforts to monitor and provide credible evidence about the benefits of thorough and responsible accountability in reducing risks. This is best accomplished by independent public institutions.

3.4.1 Progress in accountability for disaster risk reduction in Asia-Pacific

While 2011 witnessed a movement for greater transparency as citizens in different parts of the world demanded accountability from their governments (Swardt, 2011) progress in accountability for DRR in Asia-Pacific has been limited. Some countries have started to improve their accountability following disasters largely since the Indian Ocean Tsunami. The need for more transparent accountability has been recognized as being important for Governments by the Incheon Action Plan (UNISDR and the Republic of Korea, 2010) and in the Arab Strategy for Disaster Risk Reduction (Council of Arab Ministers Responsible for the Environment, 2010). Both of these declarations call for improved accountability in DRM at subnational and local levels through the greater involvement of local communities. Additional efforts by the Disaster Law Programme (IFRC, 2012) of the International Federation of Red Cross Societies (IFRC) also have stimulated interest in the subject through sector-wide discussions in the region. A task force of civil society organizations working through the UNISDR Asia Partnership is currently tracking the political commitments for DRR being made by Governments in Asian ministerial meetings and related international mechanisms, including the HFA.

National legal frameworks for improved accountability with strong enabling environments can be found in India, Indonesia and Philippines. Indonesia's legislation makes official authorities directly responsible for disaster losses. In the Philippines, the Disaster Risk Reduction and Management Act of 2010 calls for greater responsibility and resources to be provided for stakeholders' involvement at local levels. New risk-focused legislation is currently under discussion in Bhutan, Cambodia, Nepal and Viet Nam (IFRC, 2011).

Mutually accountable partnerships between governments and civil society organizations are creating wider opportunities for expanded ownership and transparency in local level activities. In Bihar, India, the state government is implementing an owner-led reconstruction programme in partnership with civil society organizations, supported by UNDP and the World Bank. More than 100,000 houses are being rebuilt after devastating floods in 2008 with significant participation and monitoring by local communities. Throughout Indonesia, more than 337 local community and 33 provincial platforms have been established with the involvement of multiple stakeholders. Following the Wenchuan earthquake centred in Sichuan, China in 2008, a unique partnership model was devised for "twinning" affected counties and cities with those in other Chinese provinces specifically to assist affected areas with additional resources and personnel for monitoring the recovery process (Hoyer, 2009).

Other mechanisms are being explored to improve accountability in DRR in the region. The Right to Information Act in India grants powers to citizens

[4] In October 2010 the International Budget Partnership released the Open Budget Survey 2010, an independent, comparative, regular measure of budget transparency and accountability around the world (http://internationalbudget.org/what-we-do/open-budget-survey/).

to learn about decisions taken by government departments about development activities. The Lebanon Citizens' Charter has proven to be a useful instrument to pursue accountability issues related to the delivery of public services at local levels (Gostelow L. et al 2010). There is growing interest in some quarters to consider drafting a citizens' charter for DRR in the expectation that it could become effective in forging more beneficial partnerships between governments and civil society in local communities.

The extraordinary spread of mobile communications and the easy access to electronic information from virtually anywhere has stimulated numerous opportunities for citizens to become more conversant and involved in monitoring both evolving and actual crisis situations. As is discussed further in chapter 5 of the present report, by harnessing these technologies at times of threat or need people can express collective views and mobilize pressure as never before. The appearance of "user generated content" has quickly become an additional way to learn and communicate about rapidly developing or critical situations. The fact that the dramatic political changes of the 2011 "Arab spring" were largely fuelled by social media holding governments to account marks an inevitable shift in public influence on power structures. Similarly, in some recent disaster situations like the 2011 floods in Thailand, the rapid expansion of citizen access to information and the public's ability to transmit it rapidly and widely, or to hold governments to account, shows significant promise for a growing voice to reduce disaster risks.

3.5 Adaptive governance for promoting adaptive capacity

The opportunities presented by greater accountability, transparency and partnerships for reducing disaster risk reflect changing socioeconomic conditions and technological advances which provide a positive environment for promoting "adaptive governance". Adaptive governance promotes adaptive capacity, defined by the IPCC in relation to climate change as "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences" (IPCC, 2007).

Adaptive capacity is reflected in the ability of a system to recover from shocks and to pursue goals by reforming the functions of a system in order to meet specific objectives. Adaptive capacity makes transformative change possible following a disaster. Some commentators cite the experience of San Francisco, California in the United States in being transformed into a more modern, efficient, and disciplined city following the devastating 1906 earthquake as an example of the results of adaptive governance (Vale and Campanella, 2005).

Adaptive governance approaches include procedural mechanisms and institutional capacities to monitor early warning indicators and the impacts of specific interventions, and to promote learning by drawing upon knowledge from different types of sources, such as those from indigenous communities and satellite systems. Governance practice also benefits from efforts which can integrate other institutional mechanisms that convey perspectives of multiple stakeholders. These methods introduce considerably more potential for diverse interests to deal effectively with uncertainty and complexity for a common purpose. Adaptive governance places emphasis on social networks that promote learning and organization while enhancing collaboration and conflict resolution. Most simply stated, it provides the flexibility needed to adapt to changing circumstances (ESCAP, UNEP and ADB, 2012).

Examples of where adaptive governance has been employed in the Asia-Pacific region are still few, however they offer some promise in high-profile challenges. One current relevant context is that of learning to manage new climate risks in agriculture, building sustainable human settlements, managing critical ecosystems and sharing scarce water resources. Adaptive and inclusive governance approaches are critically important in the context of water resources management, which has a significant bearing on disaster risks as a majority of economic losses and disaster incidence is related to water, or its absence. The sectors that are projected to be most vulnerable to climate change also are primarily affected by water-related issues, as demonstrated by the food and agricultural sector, industry and settlements located in coastal areas and within flood plains (ISDR, 2008).

Adaptive governance projects the values of social capital in adaptation, for example by sharing water among agrarian societies in times of drought. Its effectiveness also depends on the recognized importance of a trusted intermediary, as occurred in the successful case of a World Bank pilot scheme for agricultural insurance and slum upgrading in Thailand, or in local payments provided to communities for

Photos from Wat Kao community, Nakhon Sawan, Thailand:
L-R: A flood hut constructed on the roof of a house, with a dark flood line high on the wall of the house; A home-made floating toilet; Dark flood line on the upper level of a house shows the extent of inundation.
Photo: Natalia Wehmer.

their environmental services in protecting watersheds in Indonesia. Other examples illustrate how the integration of local and scientific knowledge can improve the effectiveness of programme implementation and provide opportunities for enhancing local livelihoods through participatory methods, as in the Sloping Land Conversion programme in Yunnan, China.

3.5.1 A practical case of adaptive governance, Nakhon Sawan, Thailand

The town of Nakhon Sawan is located at the point where two rivers join and flow into the Chao Phraya River north of Bangkok; the flood reached the town at the end of August 2011. While small floods occur every year, this time the flood reached four to five metres and lasted for four months. Wat Kao community located by the river was one of the most serious affected locations with 75 per cent of its land area inundated and water reaching the upper floors of many houses. For many residents, the raised location of the temple was the only dry place for evacuation.

Wat Kao community is a proud member of the Thai government's Baan Mankong slum upgrading programme, which is being implemented nationwide by the Community Organizations Development Institute (CODI) under the Ministry of Social Development and Human Security. The design of this programme provides an example of a governance approach that builds adaptive capacity.

The Baan Mankong approach places residents of the communities into the primary decision-making roles, provides opportunities for networking with and learning from other poor urban communities and from professionals provided by CODI. The institute also provides infrastructure grants and soft housing loans if required, and acts as an intermediary between local authorities and communities as may be needed. The institutional support by CODI through the Baan Mankong programme allows communities to access knowledge and resources to assess their situations and define solutions that fit their needs. This way they develop the confidence and skills to manage their own community improvements or resettlement.

The relocation of Wat Kao had been discussed after the serious flood in 2006, but considering that most residents depended on the river for their livelihoods and no suitable land could be identified nearby, the community and the local government decided to pursue on-site upgrading of housing and infrastructure instead. The community also decided to invest in flood preparedness and improved response measures with the well-founded expectation of future floods.

The local government passed a regulation that all housing in flood-prone areas needed to be built on stilts. Many residents of Wat Kao also invested in a second floor for their house, where they could stay during times of flooding. Aside from their normal collective savings which each household can withdraw when needed, the community also set up a community disaster fund into which members pay 30 baht ($1.00) each month. At the time of the flood it had grown to a respectable 300,000 baht. The community also has a separate welfare fund.

This decision improved the financial security of the community but it also bound them together, a prerequisite for the success of their other initiatives.

As the floods approached, the community organized the placement of sandbags together with the local government. People also took pictures of their houses for potential damage claims after the floods.

During the floods, the community organized its disaster centre which not only served Wat Kao, but several other nearby communities which united for that purpose. The disaster centre was located on the raised temple mountain and consisted only of a tent supplied by the local government and a communal kitchen. It was staffed by community volunteers who were aware of every family's situation and needs; they also supervised the efficient distribution of food, medical and other provisions delivered by the local government.

Through CODI's national network, Wat Kao also received donations from other poor urban communities that had not been affected by the floods. Loud speakers were used to inform the community regularly about water levels, areas flooded and recent government announcements. A team of community volunteers routinely patrolled the community by boat to distribute goods to residents who had remained in their houses and to check on the houses of people who had to evacuate. Once the floods had subsided, community members cleaned up and helped each other with repairs and reconstruction, including building two welfare houses for very poor families who had lost their homes but could not afford to pay for their own reconstruction materials.

While both the community and the local government see room for improvement, overall they were satisfied with the outcomes of the collaboration. It demonstrated communities could effectively organize their own flood preparedness and response while allowing local government and other official agencies to focus on their respective higher-level functions. This shared recognition and cooperation also showed that even in flood-prone areas, resettlement does not have to be the only option, but that a lot can be done to increase people's resilience right where they are. The Wat Kao community learned to live with flooding by preparing and responding as best they could, working together and with local government. For the near-term after the floods, discussions are under way for the local government to improve the settlement's situation by building a flood barrier that would elevate and strengthen the riverbank.

3.6 Strengthening risk governance

The GAR 2011 notes that it is easier to reduce risks from smaller and more frequent disasters than the bigger but less frequent ones (UNISDR, 2012). It also notes that actions that reduce risks in development investments such as through land-use planning are more effective than corrective actions like retrofitting buildings, when risks are already present.

The governance elements discussed in this chapter enable the reduction of risks but some of them provide better preparation for more intense disasters rather than the prior reduction of future risks. For example, in terms of policy guidance, more than three quarters of the countries in the region have focused their DRR efforts in the short- to medium-term making it difficult to deal with larger issues of reducing exposure through land use and spatial planning or post-disaster reconstruction which require more time and sustained efforts to be realized. In terms of policy guidance for governance, most laws and many policies in the region can still be strengthened by making the implementation of risk reduction more explicit.

Requirements also remain for empowering local risk governance to ensure that capacities and resources are provided to decentralized units of government, along with more clearly expressed expectations about the responsibilities related to pursuing risk reduction at the local level. A similar emphasis needs to be given to expanding the opportunities and effectiveness of accountability for reducing risks. While there is now a growing recognition of the values to be gained by reducing people's vulnerability to hazards, much more can be done to promote accountability in order to reduce the still growing human and economic exposure to disasters. Promoting more extensive community participation in longer-term issues to reduce exposure is a crucial commitment that needs to be expanded throughout the region.

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4 Reducing disaster exposure

Unplanned urbanisation directly increases people's vulnerability to disasters. The economic, social and environmental consequences can be enormous (2010). Credits: Marco Dormino / UN Photo

The increasing disaster risks in the Asia-Pacific region are driven by the growing exposure of its people and its rising economic assets. There are many contributing factors to these developments, but this chapter will discuss five primary conditions. They have been selected because each represents threats of increasing socio-economic exposure to disasters, and they each provide significant opportunities to manage existing conditions for multiple benefits. They address particularly the communities of practice involved with ecosystem services management, spatial and land-use planning, financial investment in disaster risk management, global supply chain management and post-disaster recovery. Turning related threats into strategies to reduce disaster exposure associated with these issues would ensure that development of the region remains inclusive and resilient in the years to come.

4.1 Introduction

Countries in the Asia-Pacific region and particularly their fast growing cities and urban areas are engines of growth and wealth accumulation. This growth has positive results in social improvements, increased economic opportunities, educational, cultural and other beneficial impacts. However, the *Global Assessment Report 2011 (GAR 2011)* notes that between 2002 and 2011, the number of people exposed to floods increased by 28 per cent while the resulting exposure to GDP increased by 98 per cent (UNISDR, 2011). In the Asia-Pacific region most flood risk is concentrated in countries such as China and India, which have increased their GDP by 420 per cent and 185 per cent respectively.

In the higher-income countries of the region, economic assets and jobs are growing but so are the risks of losing economic assets and destroying livelihoods because of a disaster. The absolute value of the losses is highest in the wealthiest countries, but the loss of economic assets and jobs from disaster consequences has even greater impact on low- and middle-income countries.

If States are to protect their development accomplishments while maintaining their populations' expanding opportunities, they need to determine how best to promote the combined social and economic values, or "values at risk" when considered in terms of reducing their possible erosion because of risks from natural hazards. This requires concerted and continuing efforts to reduce the social and economic impacts of disasters. To do this, Governments as well as commercial and other private interests need to focus on reducing the exposure of their shared "values at risk" through a variety of means.

This chapter explores the basis for understanding several selected areas of increasing socioeconomic exposure to natural hazards, and then considers how the combined asset values of risk can be reduced. It begins by discussing the importance ecosystems hold for the sustenance of all societies, but also the critical roles which ecosystem services provide for altering people's exposure to disaster risks. The combined interaction between ecosystem services and economic systems further establishes the corresponding importance these services hold for assessing risk, making them crucial contributors for reducing future exposure to hazards and consequent disasters.

The role of land-use planning in reducing the exposure of people and economic assets is then considered, with a particular emphasis given to how spatial and land-use planning can be instrumental in promoting more encompassing investment decisions in disaster risk reduction (DRR). These strategies are based upon a multidisciplinary, integrated approach spanning the various sectors reflecting social needs, economic growth, environmental protection and infrastructure development. The chapter proceeds to discuss another significant driver of disaster exposure in the region, the increasing risks that hazards pose to supply chain disruptions which have become critically important for the thriving economies of the region. The chapter concludes with concrete examples of measures that have been pursued during crisis and disaster recovery periods to reduce future exposure to disasters.

4.2 Ecosystem services and disaster exposure

Ecosystem services are services that nature provides which support human life and provide the basic materials for economies. The Millennium Ecosystem Assessment (MA) (Millennium Ecosystem Assessment Board, 2005) categorized these services as provisioning (such as food and fibre), cultural (such as a sense of place or tourism), and regulating (such as climate moderation or flood reduction). The MA found that the supply of 15 of 24 ecosystem services is in decline, including those for natural hazard regulation (table IV.1).

The demand for ecosystem services in the Asia-Pacific region is driven by the rapidly growing economies and demographics that have resulted in dynamic urban centres, rapid expansion of infrastructure and changing lifestyles. The supply of ecosystem services such as food and fuel certainly can increase resilience and decrease vulnerability of people to hazards. However, the increasing demand for these services, along with the migration of more people into hazard-prone areas, have led to changes in land use which reduce the self-regulating functions naturally provided by ecosystems. This results in greater human exposure to hazards such as floods, landslides and droughts. For example, the expansion of the main road from Thimphu to Paro in Bhutan resulted in an increase of landslides along the road and also increased the threat of possible flooding of the airport runway (Choden, 2012).

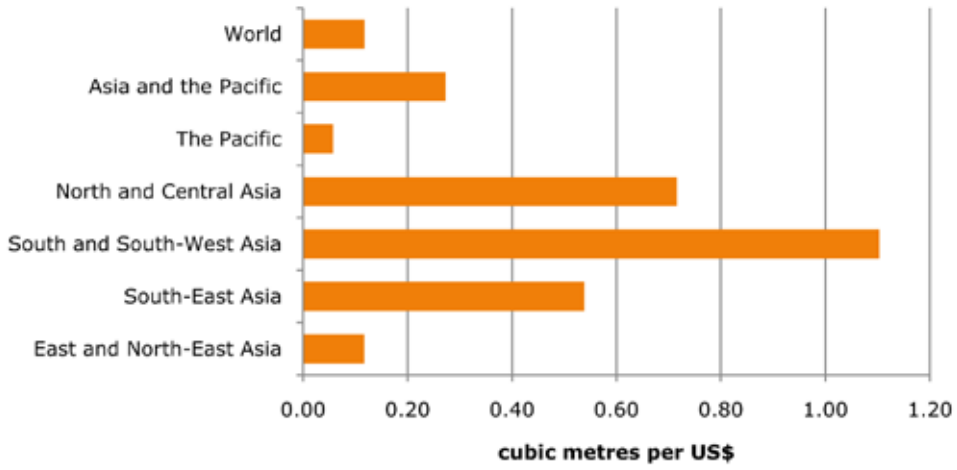
Another example of this interdependence between ecosystem services and development is growing water use and the incidence of drought. Between 2000 and 2011, an estimated 668 million people were affected by drought in Asia and the Pacific (CRED, 2010). The

Table IV.1 **Use and supply of ecosystem services**

Provisioning ecosystem services		Regulating ecosystem services		Cultural ecosystem services	
Crops	+	Air quality control	+	Spiritual and religious values	+
Livestock	+	Global climate regulation	+	Aesthetic values	+
Capture fisheries	–	Local climate regulation	+	Recreation and ecotourism	+
Aquaculture	+	Water flow regulation	+		
Wild foods	–	Erosion control	+		
Timber	+	Water quality regulation	+		
Cotton	+/–	Disease control	+		
Wood fuel	+/–	Pest control	+		
Genetic resources	+	Pollination	+		
Biochemicals	+	Natural hazard regulation	+		
Freshwater	+				

Source: Millennium Ecosystem Assessment Board, *Millennium Ecosystem Assessment* (Washington, Island Press, 2005).
Notes: Numeric sign shows change in use. Colour shows change in supply: green = increasing supply, red = decreasing supply, yellow = generally stable supply.

Figure IV.I **Water intensity (water use per GDP), 2000**



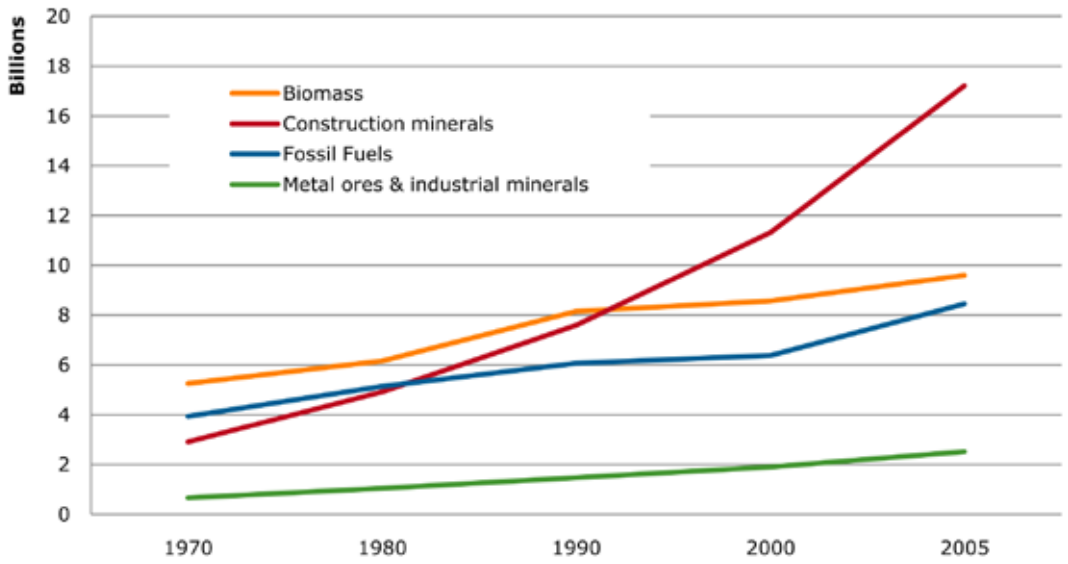
Source: CSIRO and UNEP Asia-Pacific Material Flows database http://www.cse.csiro.au/forms/form-mf-start.aspx

implications of increased frequency and intensities of droughts in Asia and the Pacific are substantial. They will certainly affect food and water security and economic growth, as agriculture and many industries depend on water for production. With almost 377,000 people in Asia and the Pacific already without access to clean water, the implications of worsening droughts, heat waves and water shortages are dire, particularly for the poorest and most vulnerable people. Already, the heavy dependence of economies of the region on agriculture has resulted in a water intensity for most Asia-Pacific subregions which far exceeds the global average (figure IV.I).

4.2.1 Valuation of ecosystem services

The lack of recognition for the role ecosystem services provide in reducing disaster exposure is a particular problem faced by the region; it creates a difficulty for placing an economic value on the services. A common perception is that investment in restoring ecosystem services like replanting forests has a high replacement cost and a low market price, making them less attractive when comparing options for development investments. To the contrary, an example from Sri Lanka indicates that one coastal wetland provides an economic value of $1,907 per hectare/year in minimizing flood risks (ESCAP, ADB and UNEP, 2012).

Figure IV.II **Material use trends in Asia and the Pacific, 1970-2005 (by primary categories, in billions of domestic extraction tons)**



Source: The United Nations Environment Programme, *Resource Efficiency: Economics and Outlook for Asia and the Pacific* (Bangkok, Thailand, UNEP, 2011).

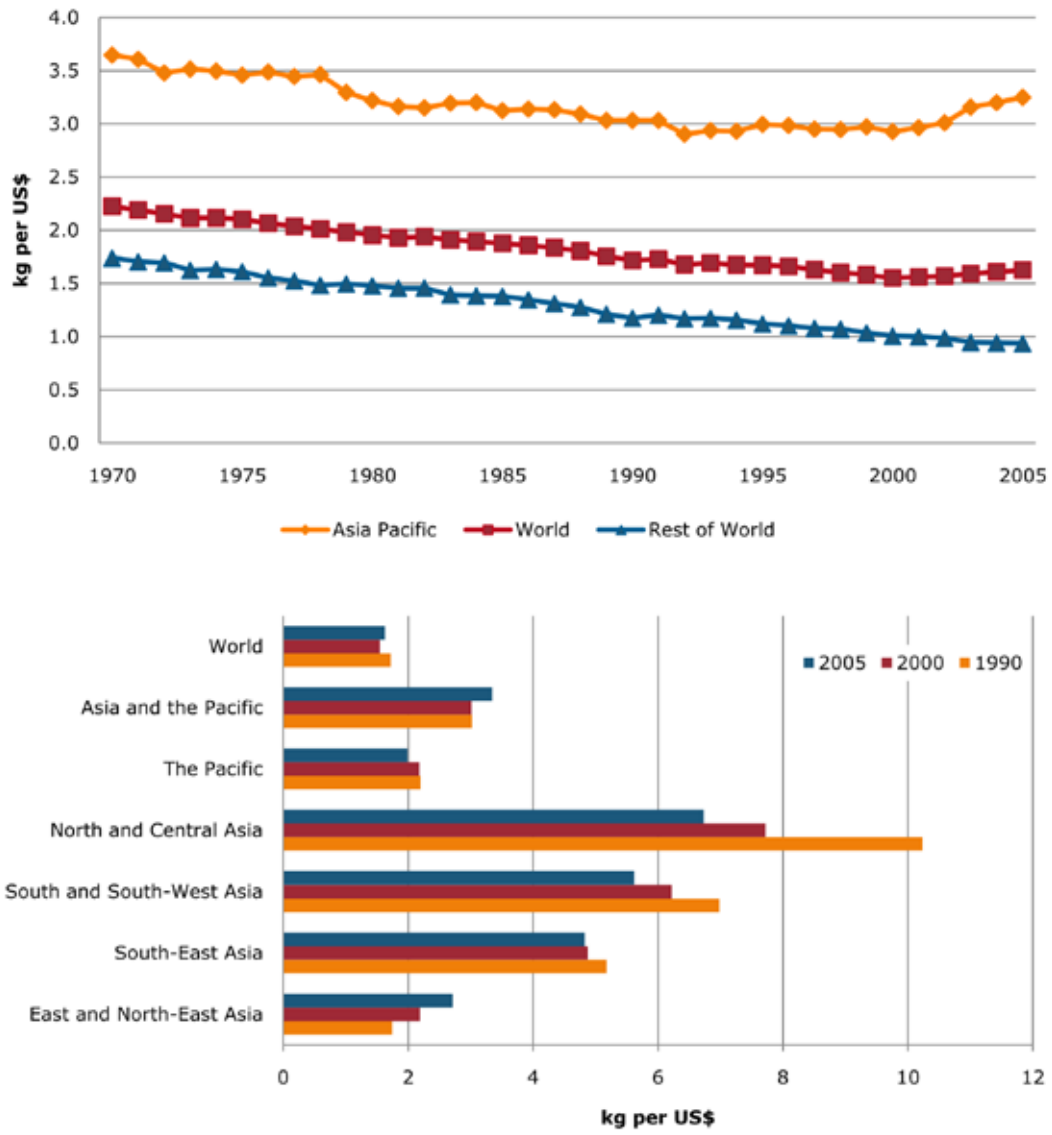
Recognising the importance of ecosystem services and integrating them into land-use management plans can result in benefits that will reduce costs over the long term. When faced with rising demands for investment in storm water management and pollution control, New York City decided to invest in natural infrastructure instead of the more expensive physical infrastructure of large drainage and storage solutions. Ecological-based approaches and hydrological modelling were used to plan and manage "a low-maintenance network of natural lands, plantings and permeable surfaces that can capture rainwater before it enters the sewer system" as part of a sustainability plan for the city. This plan includes a "Green Infrastructure Plan" as a major component, with a proposed investment of more than $1.5 billion over 20 years. The strategic plan would coordinate the city's roadway and building construction with a consideration of the natural infrastructure to reduce sewerage system overflows at significantly lower cost in comparison with traditional approaches (The Gotham Gazette, 19 May 2011).

Viet Nam's 3,260 km coastline is vulnerable to multiple natural disasters including typhoons, flooding, storm surges and drought. Since 1994, the Viet Nam Red Cross initiated a project of restoration, rehabilitation and management of mangrove forests along the coastline with the support of donors with both environmental and financial interests. In a recent analysis of the costs and benefits of this restoration activity, it was found that the mangrove forests had a substantial impact on reducing disaster risk and had enhanced communities' livelihoods. The mangroves were able to provide additional income for coastal communities through an increased yield in aquaculture products and other economic activities such as honeybee farming (International Federation of Red Cross and Red Crescent Societies, undated). The overall cost of the project spanning 17 years was approximately $8.8 million, but the value of disaster damage avoided by the communities was found to be approximately $15 million.

4.2.2 Resource-intensive development drives the loss of ecosystem services

A study done by UNEP and CSIRO assessed biomass use in the region (UNEP, 2011). Biomass reflects the use of timber, agricultural products, and other organic materials and serves as the biological component of ecosystem services which could be provided in the form of crops, biofuels, timber, medicines or other organic products. Figure IV.II shows the trends in resource use for primary categories of materials including biomass. The study found that although biomass use has decreased as a proportion of the total resources used from 48 per cent in 1970 to 28 per cent in 2005; the total amount of biomass used has increased by a factor of three during the same period.

Figure IV.III **Domestic material consumption intensity, Asia and the Pacific, its subregions and the world, 1970-2005**



Source: CSIRO and UNEP Asia-Pacific Material Flows database. http://www.cse.csiro.au/forms/form-mf-start.aspx

Biomass, together with other resources such as construction materials, fossil fuels, metal ores and other industrial materials, compose natural materials provided by provisioning ecosystem services. The region is dependent on these materials to support the growth of its economies, but their use is often inefficient and wasteful. The ESCAP, ADB, UNEP publication, Green Growth, Resources and Resilience (2012) points out that the region has a resource-intensive growth pattern, which translates into economies with higher exposure to risk because of the subsequent reduction of regulating ecosystem services. The region as a whole uses three times the resources to create one unit of GDP when compared to the rest of the world, as of 2005, although this measure varies across subregions (figure IV.III).

Water management in Singapore provides a useful example where resource-intensive development has been addressed with positive benefits (ESCAP, 2012). Singapore has long been heavily dependent on imported water and experienced chronic water shortages, so the provision of sufficient clean water for the entire population in a sustainable manner has been a major concern for the Government. By integrating ecological costs, the country has been able to improve both the assured availability and quality of water while effectively addressing the

problem of water scarcity. In the process of doing so, it has also been able to make its water industry more economically competitive. Singapore has been making significant efforts to create a comprehensive water management system since the 1980s; this has included carefully designed water pricing structures, resulting in the solution to its chronic water shortage and heavy dependence on imported water. The percentage of water imported has declined from over 50 per cent in 1994 to 33 per cent in 2008. Domestic per capita water consumption has been reduced from 176 to 160 litres per day from 1994 to 2005.

4.2.3 Promoting ecosystems management as a cost-effective strategy for reducing exposure to disasters

There is no doubt that promoting the restoration of regulating ecosystem services in general, and particularly in natural hazards regulation, water regulation, and carbon regulation will have a direct effect on improving countries' DRR strategies. A fundamental principle for doing so is to ensure that accepted forms of economic growth do not necessarily increase people's exposure to disasters; what is critical is the need to decrease the current intense levels of resource use.

New growth strategies need to be encouraged and indeed pursued following the conclusions of the IPCC SREX report (IPCC, 2012), which recognize the close interaction among climate change mitigation, adaptation and disaster risk management. The Rio+20 outcome further calls for "coordinated and comprehensive strategies to integrate DRR and climate change adaptation considerations into public and private investment, decision-making and the planning of humanitarian and development actions" (United Nations, 2012). Good land-use management and planning is one mechanism that can be used to protect ecosystem services and foster the interrelated benefits of linking disaster risk reduction with other development needs.

4.3 Spatial and land-use planning

The widely recognized relationships between disasters and development necessarily raise the relative risk implications between spatial development or land-use plans and sectoral development policies. Too often each concern is addressed in isolation from others, with related costs and benefits calculated by different professionals using different measures of value. For instance, decisions on land use and spatial development in urban areas either can create additional types of risk or significantly reduce inhabitants' exposure to existing risks.

This challenge frequently occurs in cities where informal settlements are usually tolerated as they expand without restraint or regard in hazard-prone areas. Once investments in housing, infrastructure and other facilities have been made in hazardous locations, the accumulated risk becomes locked in place almost permanently, unless necessarily forceful counter-measures are taken. This is likely to be associated with strong political and social consequences even if relocating informal settlers to a safer area is motivated by favourable intentions. In nearly all such cases, the resettlement of vulnerable informal communities or even upgrading existing settlements requires huge investments by both local and national governments.

This costly social dilemma raises a fundamental question: if spatial development or land-use plans are to be sensitive to risk or if sectoral development policies embrace disaster risk reduction as a policy objective, can these motivations encourage decisions that favour investments committed to managing disaster risks? Stated more simply, can the "needs" be translated into a productive investment opportunity that also creates a safer environment for people? In Asia-Pacific, while some countries have established national policies for land-use planning and also have passed legislation assigning specific responsibilities to local governments, others either lack required technical capacities to plan settlements adequately or fail to take account of risk parameters such as known natural hazards. Even fewer countries have explored the potential public investment values in doing so. Figure IV.IV illustrates a sequence of opportunities.

Many countries in the Asia-Pacific region have established national policies for spatial or land-use planning and have passed land-use and land management legislation assigning specific responsibilities to local governments. However, countries incorporate risk information in their spatial and land-use plans in different ways, making them risk-sensitive to varying degrees. Generally, spatial and land-use plans seek to order and regulate the use of land and provide a geographical expression to social, economic, environmental, and infrastructure development policies in a political territory.

Spatial and land-use planning is a government responsibility as well as a comprehensive mechanism to attain efficient and sustainable use of land according to the needs of the society. When it is judiciously applied, it can achieve orderly physical organization of space, and provide the geographic dimension to an

Figure IV.IV **Planning from broader land-use systems to specific project investment**

Source: United Nations International Strategy for Disaster Reduction, *Global Assessment Report on Disaster Risk Reduction 2011* (Geneva, Switzerland, United Nations, 2011). Available from http://www.preventionweb.net/english/hyogo/gar/2011/en/home/download.html

overall development strategy as implied in figure IV.IV. Through a risk-sensitive spatial or land-use planning process, potential exposure and current vulnerability to hazards can either be prevented or minimized, if the plan is effectively implemented. At the same time, by exploring the type and nature of hazards to which a particular population or societal asset is exposed; assessment of possible impacts may help resolve the fundamental development-disaster risk dilemma.

While specific or limited risk factors may be considered in particular commercial activities or professions such as civil engineering, comprehensive risk calculations are seldom integral to development policy planning or project implementation. By incorporating risk awareness into spatial development and land-use planning both current and projected exposure and vulnerability to physical hazards can be prevented or minimized.

However, a challenge remains as to how risk-sensitive spatial development plans and policies can be translated into actual investment decisions. What factors motivate or influence decisions to invest in DRM? More specifically, to what extent can risk-related information gathered from land-use and development planning be used in an expanded professional environment to inform investment decisions enhanced by the inclusion of DRM values?

To address these questions, this section reviews land-use plans, sectoral development policies and strategies of 15 countries in the Asia-Pacific region. It first examines the extent to which risk sensitivities are evident in the selected plans and policies, and then considers the substance of the initiatives, the circumstances of their timing and the stimulus for their formulation. This extended analysis of spatial planning leads to the following section where various investment possibilities are reviewed and their roles in advancing DRM by means of risk-sensitive plans and policies are discussed.

4.3.1 Sectoral development policies and land-use planning

Government sectoral development policies and spatial or land-use plans are instruments that define the principles for decision-making and the management of land and resources in a country. A development plan identifies specific development goals and establishes long-term strategies to achieve those goals. A land-use plan establishes detailed policies regulating land allocation or recommends how land may be used. When plans or policies are more refined they determine how specific proposals for development should be evaluated for a particular geographic area and even what activities or use can be authorized. When taken together, these documents provide a framework for comprehensive development and provide guidance or regulation for the recommended use of resources intended for the most beneficial effect of the landscape and communities concerned.

Overall development and specifically spatial and land-use planning are important functions of government at all levels and they have far-reaching, and often lucrative, implications. The formulation of land-use plans is primarily regulated by a country's legal and planning systems, which are both backed by legislation. Most of a country's sectoral development and spatial planning is done at different levels of government, so national development and spatial plans primarily address an entire country but may include subnational or subsidiary provincial/state jurisdictions or distinctive geographical territories. Local development and land-use plans generally address more specific local needs and contexts.

In developing national spatial plans, some countries adhere to a "bottom-up approach" by drawing inputs from local levels of interest to develop a comprehensive plan at the central level. India consolidates plans proposed by each of the state governments and

Box IV.1 **Risk-sensitive spatial plans of the Philippines**

In the Philippines, there are two national plans which provide a strategic policy direction for DRM in the country. One is the long-term National Framework for Physical Planning (NFPP) 2001-2030. This is complemented by the Philippine Development Plan (PDP), which is revised every six years and coincides with the political term of the country's president. An important supplemental plan to the PDP is the Philippine Investment Plan (PIP) which guides national-level investments related to DRR and management. Nearly all development sectors in the PDP incorporate policy objectives for risk reduction by mainstreaming DRR and CCA in all sectoral development strategies and plans.

Both the PDP and PIP are guided by the National Framework for Physical Planning. The NFPP provides the parameters for the planned allocation, use and management of the country's land and other physical resources. As a national spatial framework, it is risk-sensitive in its land-use policy guidelines including those for the development of settlements, productive land use, protective land use, and infrastructure. For the development of settlements, it emphasizes the impacts of urbanization trends and the stresses the necessity to identify disaster-prone areas. It also guides the identification and management of environmentally critical areas, matching land uses and occupation densities with environmental and service infrastructure capacities. For productive land use, the NFPP identifies appropriate locations for production activities with regard for respecting protected and hazard-prone areas while considering other potential environmental impacts. The framework also requires the adoption and implementation of land-use and zoning regulations that encourage the use of disaster mitigation, environmental protection, and rehabilitation measures through the resulting economic commitments.

These spatial policies and strategies were established in the 2006-2010 Medium Term Philippine Investment Plan and in its budgetary allocation for what were termed "super-regions". Using the NFPP and the previous national development agenda, super regions were established by an informal grouping of parts of regions and provinces identified for their economic strengths. The investment plan was guided by the NFPP's risk-sensitive approach and mandates specific investments in DRM and CCA with the identification of funding sources and the allocation of budgetary resources. The MTPIP implements the land-use policy guidelines of the NFPP through substantial government resources for high-impact programs and projects in DRM and CCA.

Sources: Philippines, National Economic Development Authority, National Framework for Physical Planning 2001-2030. Neri, R. L. Medium-Term Public Investment Program 2006-2010 (22 August 2006). http://www.neda.gov.ph/progs_prj/mtpip_2006-2010/mtpip_2006-2010.pdf. "5-year public investment projects to cost government" P4.2T, (23 January 2012). http://www.businessmirror.com.ph/home/top-news/22356-5-year-public-investment-projects-to-cost-government-p42t

other central agencies and ministries. Proceeding differently, countries like Japan, the Philippines, Republic of Korea and Thailand prepare a general spatial framework plan at the national level, which is then replicated at regional or subnational scales and tailored to accommodate locally distinctive contexts and vision.

Most Asia-Pacific countries have not established national comprehensive spatial or land-use plans. Instead, they have adopted land-use policies, legislation or specific local land-use plans. For example, although Armenia does not have a national spatial or land-use plan, the Government has reflected comprehensive spatial policies in the Law on Urban Development (Armenia, undated) and in the Land Code of the Republic of Armenia (Armenia, 2011). These laws provide guidelines for the management and development of land and other natural resources in the country.

The establishment of legal and institutional bases for the formulation of spatial and land-use plans have embedded planning in government functions and practice. The period when some countries in Asia and the Pacific began drafting national laws and other legal requirements for spatial and land-use planning goes back to the reconstruction period following the Second World War. Japan's National Spatial Planning Act (Act No. 205 of 1950) (Japan, 1950) which is the legal basis for the formulation of the country's National Spatial Strategies, was formulated in 1950. It was last revised by Act No. 89 of 2005. Japan's City Planning Act (Japan, 1968) which provides the basis for the development of city plans was drafted in 1968.

Other more recent examples of spatial and land-use plans include China's 15-year Overall Land Use Plan for 2006-2020 (China, 2010), the Republic of Korea's 20-year Comprehensive National Territorial Plan for 2000-2020 (revised by the Comprehensive

National Territorial Corrective Plan, 2011-2020), the Philippines' National Framework for Physical Planning for 2001-2030 (Philippines, 2001), and Bangladesh's Outline Perspective Plan for 2010-2021 (Bangladesh, 2010). These long-term spatial and land-use plans provide overall geographic frameworks and locational policy directions to guide countries' national development strategies. The plans and policies are commonly updated or revised at regular intervals typically established by the corresponding legal and institutional systems involved.

A strong awareness of the importance of land for social and economic growth and development has motivated countries to adopt legislation and establish institutions to govern spatial development and the considered use of land and other natural resources. Countries like Bangladesh, Indonesia, Nepal, the Philippines, Solomon Islands and Thailand drafted their spatial and land-use plans to address governance reform, poverty reduction as well as DRR.

Historically, international development perspectives have influenced the development of specific frameworks and visions for national spatial and development plans. This can be seen in the national development plans formulated in the 1990s which adhere to the principles of sustainable development. More recently, development plans and spatial strategies have been influenced by the concepts of resilience, climate change adaptation and in countries like China, India, Indonesia and the Philippines "inclusive growth" are being pursued as a means to address the challenges of poverty reduction and the inequitable distribution of wealth between the rich and the poor.

4.3.2 Risk-sensitivity of national spatial plans and policies

Despite the existence of development policies and spatial plans in most countries in the region, shortcomings of land management systems have become obvious under the influence of internal and external factors in rapidly changing socioeconomic contexts. The present pace of population growth and rapid urbanization can easily overtake the expressed intentions of many development plans and planning strategies. As human systems become vulnerable to social and economic challenges, they also become more exposed to natural hazards and their impacts.

Particularly in a growth driven environment, the poorly considered use of land creates and accumulates new or additional risks. The case of informal, individually-built housing in hazardous areas is only one example seen in many cities throughout the region. The organic and often uncontrolled growth of many of these increasingly dense cities lacks the benefit of urban planning. There are many haphazardly constructed and substandard buildings, non-engineered dwellings and unregulated land use which generate more risk. Insufficient or unsafe infrastructure, the absence of basic human services, environmental degradation and worsening poverty further exacerbate existing urban vulnerability for an increasing number of inhabitants.

The established systems of land-use planning offer many opportunities and options to reduce human, economic, and physical losses due to disasters caused by natural hazards (Reyes, 2004). Risk-sensitive spatial planning can mitigate the root causes of disaster risk that are entrenched in current land development practices. It provides a systematic and rational basis for land-use decisions that can reduce risk and prevent its accumulation, while also introducing opportunities for sustainable development activities (Reyes, 2004). If pursued consistently and steadily over time, risk-sensitive planning can reduce existing vulnerable conditions of people and their exposure that has accumulated through the years.

The national spatial or land-use plans and policies of 21 Asia-Pacific countries were reviewed to analyse the extent that risk parameters or risk assessment results were used as a basis for planning. The analysis also considered the degree to which risk sensitivity and explicit risk assessment information contributed to the formulation process of the spatial or land use plans and policies (table IV.2). By reviewing the existence of information from disaster risk assessments in spatial and land use planning frameworks a basis can be established for estimating the potential to reduce risks, particularly exposure, through these land-use strategies. Using more sophisticated processes such as characterizing exposure, assessing vulnerability and capacity and estimating potential damage and losses can further increase the risk sensitivity of the plans (Deyle, French, Olshansky and Paterson, 1998). The review also examined land-use measures and strategies specifically included in the spatial plans or policies that for the purpose of reducing disaster risks in order to see how their analysis of risk was translated into actual land use strategies or practice.

Among the documents considered from the various countries, 10 are national spatial or land use plans, while 11 are national policies or legislation on land management, allocation, and development. Sixteen of these 21 planning documents include references

Table IV.2 **Levels of risk sensitivity of national spatial and land-use plans and policies**

Country	Planning documents reviewed		Information derived from risk assessment					
	Plan or framework	Policy or legislation	Hazard identification	Exposure characterization	Vulnerability assessment	Capacity assessment	Loss estimation	Land-use measures for DRR
Afghanistan		●						
Armenia		●	●	●				●
Australia	●		●	●	●			●
Bhutan	●		●	●	●			●
Brunei Darussalam	●			●				●
Fiji		●	●	●	●			●
Indonesia		●	●	●	●			●
Japan	●		●	●	●			●
Kazakhstan		●	●	●				●
Lao People's Democratic Republic		●	●					●
Malaysia	●		●	●				●
Mongolia		●	●	●				●
Nepal	●							●
New Zealand		●	●	●	●			●
China		●	●	●	●			●
Philippines	●		●	●	●			●
Singapore	●			●	●			●
Republic of Korea	●		●	●	●			●
Sri Lanka	●		●	●	●			●
Tajikistan		●	●	●				●
Viet Nam		●		●	●			●

Source: Reyes, M.L. and Pulmano, N.B. *Risk-Sensitive Spatial Plans in Asia and Pacific: Enabling Investments in Disaster Risk Management*, (UNISDR, 2012).

to hazard identification[1] and mapping, so results of this type of assessment usually are presented in the form of hazard maps. However, while most of the 16 countries have integrated hazard identification in their spatial plans or policies, some countries like the Republic of Korea (Republic of Korea Fourth Comprehensive National Territorial Corrective Plan of 2011-2020) and the Philippines (National Framework for Physical Planning 2001-2030 (Philippines, 2001) have further emphasized the need for "surveillance" or monitoring and delineation of hazard-prone areas or hazard mapping in their respective spatial plans.

With the exception of Afghanistan, Lao People's Democratic Republic and Nepal, all of the planning documents reviewed either directly or indirectly referred to exposure, which could be of people, property, and other elements located in hazardous areas that are thereby subject to potential damage and losses (UNISDR, 2009). The documents have characterized the elements that are exposed to hazards such as population, communities, ecosystems, property and assets, critical facilities, lifelines, and infrastructure, among others that are located in hazard zones and which could sustain potential damage and losses due to disasters.

Significantly, only 13 of the 21 national spatial planning documents have references to actual vulnerability or vulnerability assessment. Vulnerability in this context is defined as the sum or characteristics and circumstances of a community or system that make it susceptible to the adverse impacts of a hazard (UNISDR, 2009). Discussion of physical, social,

[1] Including the technical characteristics of hazards such as their intensities, frequencies, and probabilities in specific geographic areas (UNISDR, 2009).

economic, and environmental vulnerability of various exposed elements are integrated into these plans. Some of the vulnerability assessment information which was factored into the plans includes intensive urbanization, concentration of population, building density, land degradation, declining agricultural productivity, lack of institutional linkages, poverty, and limited access to basic services, among others.

Other aspects of risk sensitivity also were analysed in the documents. By understanding capacity as the combination of strengths, abilities, and resources available within a community, society, or organization to achieve common goals (UNISDR, 2009), and accepting in the context of disasters that capacity includes the ability to respond, cope with, and adapt to different impacts of disasters, then an increase in capacity can reduce vulnerability to risks. However, none of the planning documents reviewed has cited or integrated capacity assessment information as an element of the plan or policy formulation process.

Damage and loss estimation involves the understanding how a system or population can be affected by a hazard event. This type of risk assessment focuses on the analysis of exposure and vulnerability, including the physical, social, health, economic, and environmental dimensions (UNISDR, 2009). To make informed choices, decision makers must know, for instance, how many people could die or be injured, how many structures could be damaged, or how much infrastructure could be lost, as well as the likelihood that such impacts would occur (Deyle, French, Olshansky and Paterson, 1998). However, based on the review, none of the national spatial plans or policies has used damage and loss estimation as a basis for planning.

Nevertheless, all of the 21 documents have specifically identified land-use planning measures, tools, or strategies intended to reduce risk and protect vulnerable populations and other exposed elements. For example, China's Land Administration Policy (1999), has a provision mandating that all land use within areas of rivers, lakes, and reservoirs, along with flood storage management and protection areas, should conform to plans for comprehensive lake and river-harnessing necessary for flood diversion, storage and water distribution. China's planning strategies further stipulate that analysis of land desertification should be made throughout the country with periodic monitoring information released to inform the public for policy decision-making.

The National Physical Plan of Sri Lanka (2010) recommended relocating the development of coastal towns to inland areas in the country to minimize risks from tsunami, cyclone and rising sea levels. Nepal's Vision 2007: New Physical Infrastructure – Foundation of the New Nepal (2007) proposed the strict enforcement of building by-laws as well as conducting training programs to disseminate earthquake safety, knowledge, and skills to masons in the country.

Overall, the spatial plans or policies reviewed exhibit a basic level of risk-sensitivity. Information from hazard identification and mapping, and the characterization of exposure is most widely used (table IV.2). Hazard characteristics and an inventory of exposed elements tend to provide the foundation for risk sensitive spatial and land-use strategies for most countries in the region. Results of hazard identification and mapping and the documented inventory of exposed elements such as hazard maps, population density maps, road maps, etc. are easier to understand and can be used as a basis for planning.

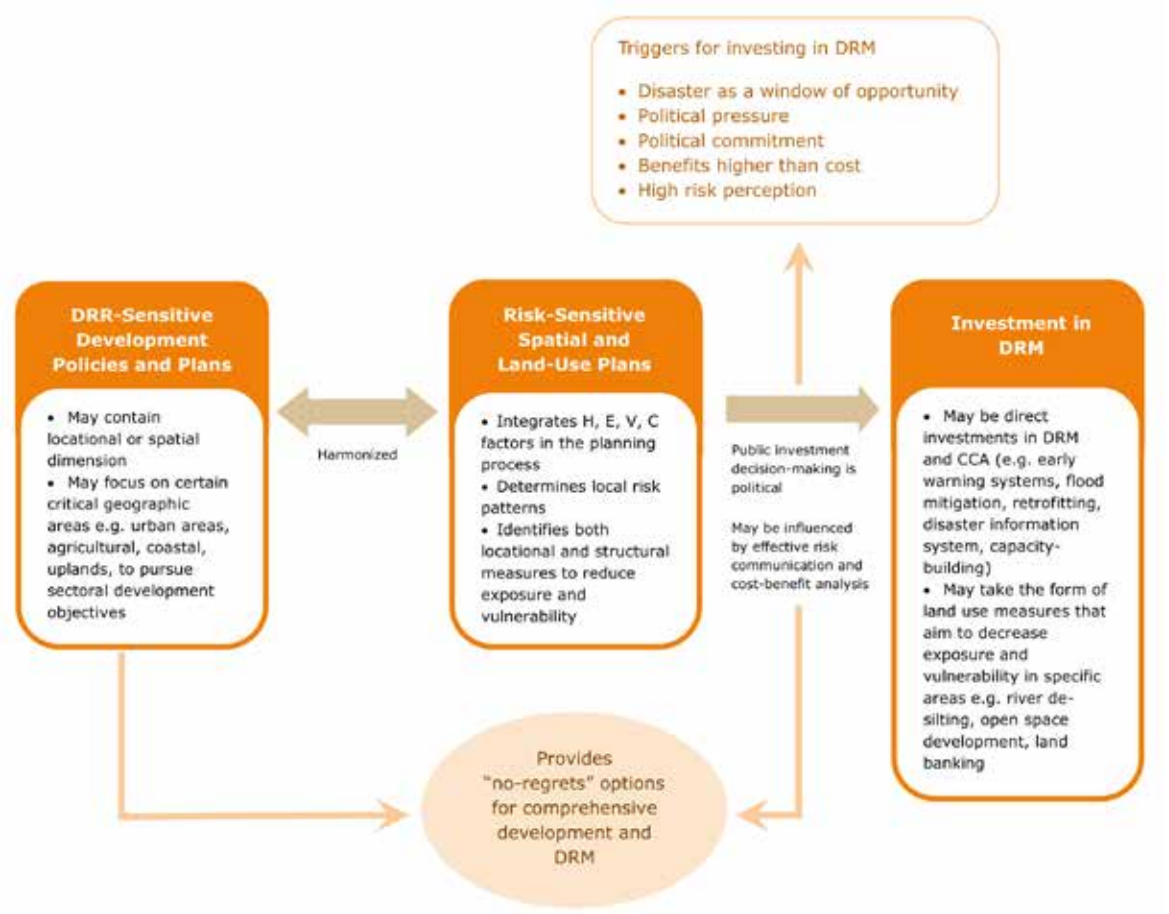
A little more than half of the spatial plans can be considered to be more risk-sensitive as they have used information produced by vulnerability assessments, a crucial attribute when building support for DRR initiatives. Notably, none of the national documents express further comment about utilizing capacity assessments or damage and loss estimations as part of the planning process. Assessing capacity, particularly in a quantitative manner is a difficult undertaking requiring additional knowledge and other analytical skills, requirements also needed for damage and loss estimation in a full-scale risk analysis.

4.4 Risk-sensitive spatial plans enable investment decisions in disaster risk management and climate change adaptation

Reducing disaster exposure particularly involves translating risk sensitive plans into investment actions. Ideally national planning that takes account of disaster risks should inform decision makers throughout government and policymakers in development sectors about the combined social benefits and economic opportunities that are possible. A persistent difficulty has been experienced in translating the conceptual values of risk-sensitive planning strategies into actual investment opportunities.

A major obstacle to be overcome in enabling investment decisions in disaster risk management is the need to further an understanding that many sectoral development projects being planned can benefit from becoming disaster risk-sensitive. This

Figure IV.V **Risk-sensitive spatial plans as an enabler of investments in disaster risk management**



Source: Reyes, M.L. and Pulmano, N.B., Risk-Sensitive Spatial Plans in Asia and Pacific: Enabling Investments in Disaster Risk Management. (UNISDR, 2012)

is a common problem when sectoral issues are considered separately from broader development requirements and the benefits of integrating multiple development needs are not sufficiently recognized. An important consideration in deciding to make investments in DRM is the intention to maximize the projected benefits compared to the additional costs involved. There are various factors which influence such investment decisions, but ultimately they rely on an understanding by government officials of the risks involved relative to the costs and benefits of the options available to manage or reduce those risks. Because disaster risk reduction investments are frequently still perceived as incurring additional costs, or the benefits of such investments are not easily quantifiable and may require time to materialize, investments in DRM are usually still not considered a priority in economic planning.

With the limited resources and the many competing concerns of different sectors in most countries, this deliberation often becomes a highly politicized process. As a result, successful DRM investment becomes more likely when official authorities are able to promote projects convincingly in a way that serves the wider public interest and as representing unquestionable social and economic benefits. The best way to promote disaster risk reducing investments is to ensure that they are also understood as advancing other development objectives. A commitment to public interests is essential if these choices are to prove to be truly beneficial.

Figure IV.V illustrates the process of risk-sensitive spatial plans as one particularly conducive strategy that is grounded in disaster risk management and which can lead to productive investments in national growth and development projects.

Since risk-sensitive spatial plans can provide vision and the basis for a strategic framework for the comprehensive development of a country, they can crystallize specific development objectives, which in turn create investment opportunities. A risk-sensitive

Box IV.2 **Jakarta urban planning and flood mitigation initiative**

Jakarta is a rapidly urbanizing region of 23.7 million people extending over 7,300 kms2 of land area, making it one of the largest metropolitan areas in the world. As Indonesia's primary urban centre, it contributes about 25 per cent of the country's non-oil GDP; as an economic magnet it attracts about 250,000 migrants from rural areas every year. The rapid population growth and inadequacy of basic services contribute to numerous and related urban problems, including perennial flooding.

In recent years, floods have become severe and widespread, affecting millions of people. Floods in February 2007 killed 70 people, affected more than two million overall and displaced 340,000 residents. Economic losses were estimated to be $900 million. Another flood in 2008 seriously disrupted Jakarta's activities when an airport toll road was forced to close, resulting in more than a thousand cancelled flights.

Surrounded by an upstream catchment area with 13 rivers, Jakarta's urbanization itself is considered to be a central cause of flooding. Encroachment into the urban centre has resulted in increased rainwater runoff and the deterioration of natural storm water retention areas in the city and catchment areas. Inadequate solid waste management, lack of maintenance for drainage, and accumulation of sediment in the waterways and canals aggravate the flood problems. Deep-water extraction within the city also causes land subsidence, resulting in increased vulnerability to flooding.

To address these urban flood problems, the national government applied DRR concepts and began to implement the Jakarta Urgent Urban Flood Mitigation Project early in 2012. Its primary aims are to improve the operation and maintenance of Jakarta's flood management system. The major components to accomplish this include dredging flood channels, canals and retention basins; rehabilitating and constructing embankments; and establishing institutional coordination among the agencies involved in the flood management system. This latter function is being pursued by strengthening the capacities of the responsible agencies to improve the operations, maintenance and management of the flood management system. The project is to be completed in 2017 at an estimated cost of $189,850,000

Source: World Bank, Indonesia-Jakarta Urgent Flood Mitigation Project: Project Appraisal Document. (2011) http://www.worldbank.org/projects/P111034/jakarta-urgent-flood-mitigation-project?lang=en

spatial plan informs planners about the local risk patterns in one's area of responsibility. This enables the formulation of land-use management measures that can target areas of primary risk, reduce exposure and vulnerability, and mitigate potential impacts of disasters (Reyes, 2004). Risk-sensitive spatial plans that are backed by systematic risk analysis are also necessary to establish sound, evidence-based DRM. Knowledge of the risks and understanding how it can influence decision-making are crucial for assessing the potential effectiveness of land-use plans and management strategies for reducing exposure and vulnerability in any specified area or locality (Deyle, French, Olshansky and Paterson, 1998).

Aside from situational measures aiming to reduce risk in specific locations, a risk-sensitive spatial plan also provides decision makers with the option of alternative strategies for land use and management which can represent various economic objectives. This is an effective way for social and environmental conditions to be viewed in order to select and adopt the best land-use options, or to consider the various attributes among them. These are risk-sensitive land use considerations represent "no-regrets" options that combine development objectives of a society with those that also reduce disaster risk, including climate risks.

This has been demonstrated by the implementation of the Flood Mitigation Project in Indonesia (Indonesia, 2011). The project was stimulated by the priority emphasis and strategies identified in Indonesia's national spatial planning law under which spatial management is required to be carried out with primary regard to the physical conditions of the country that are at risk to disaster (Indonesia, 2007). Understanding the country's exposure to hazards and risks has been used as a basis for spatial management plans' inclusion of disaster prevention

Box IV.3 **Sri Lanka Metro Colombo Urban Development Project**

Adhering to Sri Lanka's National Physical Plan's priority of developing metro regions, which is justified by a comprehensive understanding of the country's exposure to hazards, vulnerability, and risks, the Government of Sri Lanka initiated the Metro Colombo Urban Development Project in early 2012. The Colombo Metropolitan Region (CMR) comprising the cities of Colombo, Gampaha, and Kalutara is the major urban agglomeration in Sri Lanka. As the financial and commercial centre of the country, the CMR is the primary driver of Sri Lanka's economic development. With the intention of capitalizing on the importance of the region's competitive advantage to accelerate growth in the country, the Government decided to address a number of obstacles preventing the CMR from realizing its full economic potential. These impediments included the region's vulnerability to damaging floods, inadequate infrastructure and services related to drainage, sewerage, solid waste management and urban transport. Limited financial and human resources available to local authorities needed for the operation and maintenance of these services was an additional concern.

As a response to these problems, the Metro Colombo Urban Development Project is proceeding to advance the Government's urban development program by reducing the physical and socioeconomic impacts of flooding in the capital city of Colombo, strengthening the capacity of local authorities in the Colombo Metropolitan Area to rehabilitate and manage the region's infrastructure and services, and building capacities for metropolitan development strategies and planning.

The project is to be completed by 2017 at a cost of $320.6 million. Project funding is financing three components of the project: flood and drainage management, urban development and infrastructure rehabilitation for Metro Colombo local authorities, and support for implementation.

Source: World Bank, Sri Lanka Metro Colombo Urban Development Project: Project Appraisal Document (2012). http://documents.worldbank.org/curated/en/2012/02/15873173/sri-lanka-metro-colombo-urban-development-project

and mitigation measures to ensure people's safety and well-being. This integration of hazard, exposure, and risk assessment in the planning process helped in the identification of root causes and feasible solutions to counteract urban flooding, which has been a major development problem for Jakarta, Indonesia's capital city (box IV.2).

Sri Lanka's recently approved National Physical Plan has identified the development of metropolitan regions to be a national priority so that populations from fragile areas such as coastal zones, mountain locations national parks and protected natural environments can relocate (Sri Lanka, 2010). The Metro Colombo Urban Development Project (Sri Lanka, 2012) demonstrates the multiple benefits to be gained by mitigating several disaster risks. The project (box IV.3) aims to reduce the social and economic consequences on people, their property and livelihoods, while also advancing safeguards for the immediate environment with additional transboundary administrative benefits.

These cases illustrate that countries are using DRM investments based on risk-sensitive spatial plans and land use strategies to good effect in accomplishing equally important development objectives. However, the success of these DRM-driven investments depends on the initial identification of joint values which can be realized through risk-sensitive decision-making. These beneficial attributes can be clarified by effective risk communication extended throughout the planning processes and across individual development sector interests. A clear understanding of risks and sustained commitments among decision makers is needed to address the unavoidable links that risks represent between disasters and development. This is a pre-requisite to foster growth in DRM investments and for them to become integral to national strategic planning and development processes.

4.5 Global supply chains are a crucial link for sustained productivity

Globalization has transformed business environments worldwide, including in the Asia-Pacific region. Global supply chains typically composed of firms, suppliers, distribution links and labour are cross-border business and production networks. Their growth and rapid expansion has enabled firms to allocate scarce

resources more efficiently than ever before. Rapid global expansion of information and communications technology (ICT), the development of international logistics systems and the reduction of trade barriers have all facilitated the integration of economies through the web of global supply chains.

Global supply chains are also particularly vulnerable to the effects of disasters because the consolidation of production bases, supplier networks and distribution channels concentrate risks in certain locations and decrease possible substitutes in the market. As primary suppliers to the world and mainstays of many economies, the dynamic or disruptive effects which ripple through supply chains affect even smaller companies and individual employees regardless of the physical distances involved. Time-dependent connections and the calculated linkages between multiple complex systems further multiply the consequences of unanticipated events. Recent disasters in Japan and Thailand demonstrate that the development of global supply chains also have changed the risk profile of business, with a significant potential to increase economic vulnerability in Asia and the Pacific through higher direct and indirect disaster risks.

4.5.1 Supply chains as critical infrastructure

Driven by trade and investment liberalization and continued cost reduction pressures from customers, businesses have been extending their activities worldwide to make the most of each location's comparative advantage. Asia particularly has demonstrated many of these beneficial attributes. Many industries have adopted highly integrated global supply chains in which products are supplied, manufactured and distributed across national boundaries through offshore activities and outsourcing strategies.

At the same time, economies of scale have driven the consolidation and agglomeration of firms in the supply chains. This has also promoted logistic consolidation with increasingly more precise operating margins in time and efficiencies. As a result, these highly sophisticated supply chains are becoming more complex with more closely calibrated linkages as they spread with wider geographical coverage. These developments obscure a comprehensive grasp of the extent, the multiple players and even the respective operational relationships involved in global supply chains. Even for parties involved, with their knowledge limited largely to their own most immediate suppliers or clients, it can be very complicated to restore the comprehensive set of systems once a global supply chain has been disrupted.

Offshore activities are those, which utilize facilities located in a country other than where the enterprise is based (or incorporated) and can include production, service and sourcing (Vitasek, 2006). The motivation for offshore activities has primarily been lower costs. These can include lower labour, establishment and on-going costs, higher cost efficiencies with larger production scales, and often lower financial costs such as borrowing costs and tax rates. The overseas production network of Toyota Motor Corporation provides an example of the global extent of offshore activities, as shown in figure IV.VI. Toyota conducts its business in 26 countries and regions, and has 50 overseas manufacturing operations. As of 2011, Toyota's vehicles from these production bases were supplied to more than 170 countries and areas (Toyota, 2012).

Outsourcing represents one of the greatest changes to global business practices in many years. Today, firms do not just procure materials and parts from overseas suppliers, they also outsource various functions such as product design, logistics services (TechTarget, 2002) and third-party warehousing that were conventionally provided in-house. As a result of outsourcing, supply chains have extended around the globe to take advantage of the lower costs in each location as well as to penetrate untouched foreign markets (Christopher, 2011). As described in fragmentation theory, a whole production process is now split into separate nodes in different locations (Jones and Kierzkowski, 1990). Unlike a local or national supply chain, a global supply chain involves transporting large amounts of supplies across long distances, which increases the frequency of using multiple transportation and distribution facilities. Figure IV.VII illustrates national and cross-border supply chains.

Another prevailing trend is supplier consolidation, which refers to firms' efforts to reduce the total number of suppliers they relate to while increasing their business volume with individual suppliers (EIU, 2005). In some cases this corporate strategy has been extended to "single sourcing" whereby only one supplier would supply one business input (e.g. a part, component or module). An example of supplier consolidation can be seen in the automobile industry, in which the number of automotive parts suppliers dropped from over 30,000 in 1998 to around 4,500 in 2008 (KPMG, 2009). Mergers and acquisitions among major suppliers have increased supplier consolidation.

Figure IV.VI **Overseas production network of Toyota Motor Corporation**

Source: Adapted from Toyota Motor Corporation. *Annual Report 2011* (Toyota, 2012). Available from http://www.toyota-global.com/investors/ir_library/annual/pdf/2011/highlights.

A similar trend is production agglomeration, which refers to the geographical concentration of production facilities, activities and therefore assets (cf. Healey and Ilbery, 1990). Firms in the same industry tend to locate themselves close to one another, leading to geographical concentration of the industry. In order to be close to transportation and logistics facilities and to lower transport costs, production centres are often established and developed in coastal areas and river basins with high population concentrations (Clay and Benson, 2005). The benefits derived from production agglomeration include knowledge exchange, labour market pooling, input sharing and lower product shipping costs (Rosenthal and Strange, 2001).

A consequence of production agglomeration is a trend of logistics consolidation, which refers to the combination of two or more shipments in order to realize lower transportation costs. For example, inputs and components from multiple suppliers for one production site can be combined into a single delivery rather than each supplier delivering small quantities separately. This enables the suppliers to share the costs of transportation, warehousing and administration.

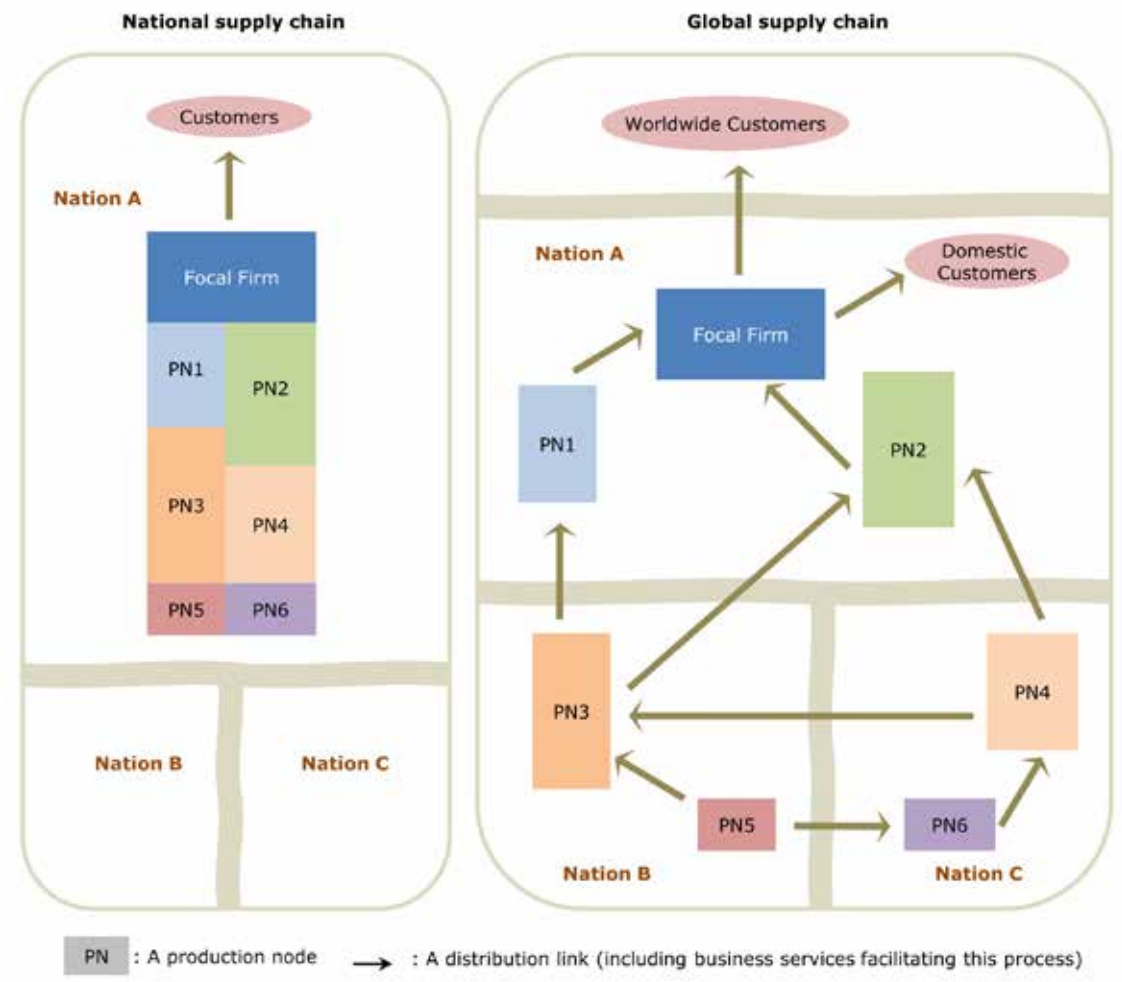
While these efficiency strategies streamline production networks, supplier consolidation and production agglomeration have increased the importance of individual suppliers and particular locations by concentrating physical assets and production facilities. These arrangements typically result in fewer backup, contingency or alternate replacement options in supply chains, but they also become an increased liability at the time of crisis or disruption. At the same time, the structure of supply chains has become more complex, with more individual production nodes and distribution links extending across borders. Consequently, it has become more difficult for individual or even primary firms to identify the risks in the supply chain.

4.5.2 Supply chain disruptions and increasing risks

A supply chain disruption is a major breakdown in a production node or a distribution link that is part of a supply chain. Disasters caused by natural hazards are one cause of disruptions to supply chains, and they can easily result in widespread damage to several firms and facilities at the same time, in a common location. Individual intense hazards and even more severe or widespread disaster events can cause either physical or operational disruption in the logistics and distributions systems (e.g. the cancellation of flights and the collapse or disappearance of a major road link). This has a severe impact on industries as significant time and expense is often required to recover from disasters caused by natural hazards.

With the globalization of supply chains, the exposure of firms to individual hazards and disaster risks more generally has extended across national borders as a

Figure IV.VII **Comparison of national and global supply chains**



Source: Linghe Ye and Masato Abe. *The Impacts of Natural Disasters on Global Supply Chains*, Background Paper for the Asia-Pacific Disasters Report 2012. (Bangkok, Thailand, United Nations, 2012).

disaster in one geographical location can affect firms in other locations. With the prevalence of offshore and outsourcing activities and the critical roles they fulfil, the level of interdependence among firms has increased. This has not only increased vulnerability but multiplied its consequences because disruption of even one part of the global supply chain can result in operational failures in many other parts of the system. Although the primary firm may be able to identify some disaster-prone nodes or less certain links within the supply chain, fragmented production has reduced the degree of total control and complete monitoring by the primary firm over all the production nodes and distribution links (Kimura and Ando, 2005).

At the same time, with supplier consolidation and production agglomeration consequently creating a high density of production assets and economic activities in certain locations, risks also become concentrated in those locations. For example, the supply chains associated with centres or logistics hubs in coastal areas or near rivers potentially subject to storms and flooding can be seriously disrupted. This results in significant structural losses to the entire production network and even to related industries and secondary or subsidiary suppliers. During the disaster and recovery period, other firms in the supply chain may encounter difficulties in obtaining adequate substitute suppliers or customers elsewhere, making the extent and range of the disaster's impact both longer and of wider scope.

Some widely adopted supply chain management strategies also can compound the risks of possible problems in disaster situations. Examples include the "just-in-time" practice and "lean supply" chain management, which require more frequent and precisely timed deliveries of supplies, minimizing

the non-value-added time and inventory. These efficiency models in business increase the level of interdependence between firms and correspondingly raise the chances of a supply chain disruption. The compression of non-value-added time in inventory transfer and storage removes contingent risk buffers between the production nodes, thereby deepening negative impacts when natural hazards or any other shocks interrupt global supply chains.

In such cases, when a disaster affects a supplier or a distribution link disrupting any part of a supply chain, the affected firms employing "just-in-time" practices will quickly experience material shortages that will interrupt production. If the production is dependent on process engineering involving time-dependent conditions or special physical properties such as chemical reactions, the consequences of interrupting a continuous process will be even more costly and disruptive. Any negative effects will proceed quickly downstream and potentially upstream too, with extended consequences throughout the supply chain.

In addition to losses resulting from direct damage and recovery costs, disasters may cause cash flow problems among participating firms if partners in the supply chain cannot settle their accounts in time. While this can pose a threat to a firm's own financial situation, the effects of financial shortfalls also can cascade quickly affecting other firms. Resulting negative financial outlooks may raise the concerns of financial institutions and create later obstacles for firms in obtaining external financial resources during their recovery. If the firm is publicly traded, a supply chain disruption may negatively affect their reputation and cause underperformance in the market (Hendricks and Singhal, 2005). In the longer term, the firm's ability to maintain its existing markets also may be threatened if a competitor is able to meet customers' needs more effectively.

Financial institutions can themselves be affected by serious or extended disruptions to the supply chain caused by disasters. In addition to settlement losses in the insurance industry, financial difficulties of client firms caused by disasters and the subsequent supply chain disruptions may create unexpected problems in the repayment of loans, which in turn could undermine the stability of financial institutions.

An increasing number of small and medium-sized enterprises (SMEs) are involved in global supply chains. SMEs are generally suppliers of labour-intensive parts and components or providers of other basic services, usually on a subcontracting basis (Abe, 2012). Larger partners in the global supply chain often take advantage of the greater flexibility of SMEs and their adaptability to local economic conditions and an ability to respond to orders for smaller quantities.

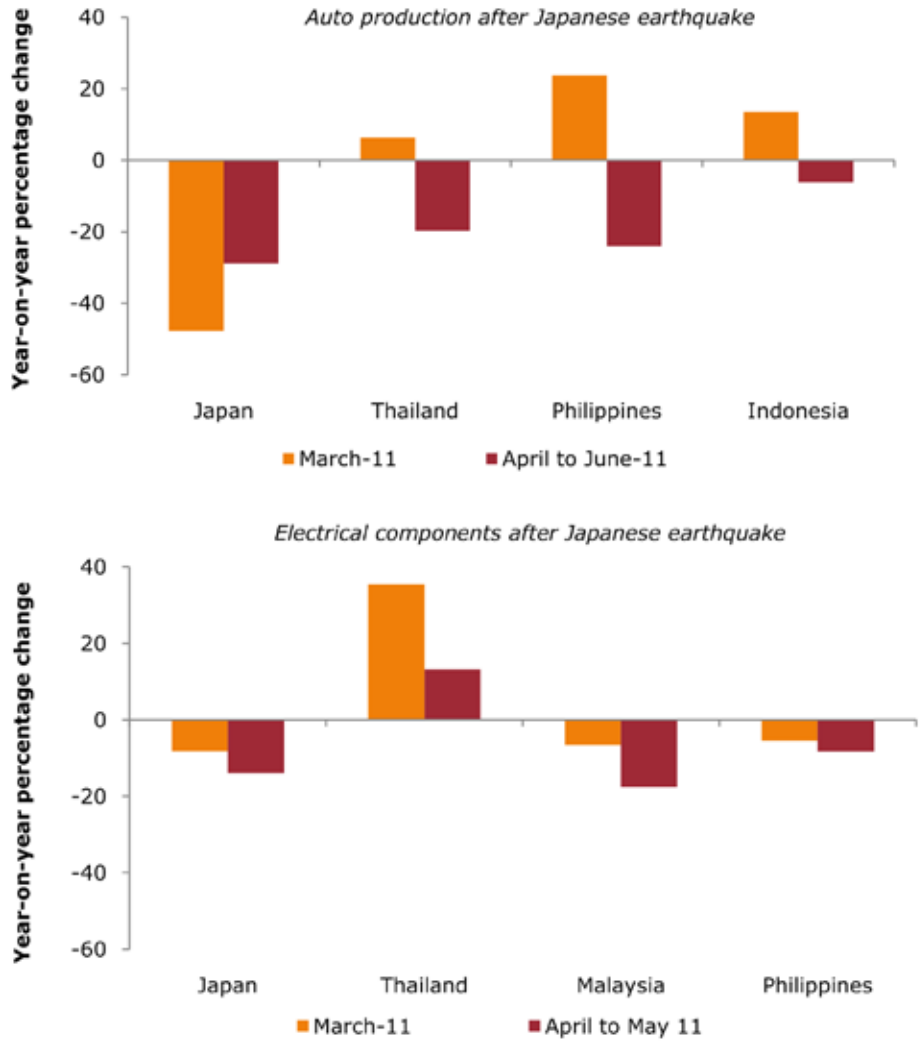
However, SMEs have been identified as being a highly vulnerable group in supply chains because of their more modest production capacities, limited financial or inventory reserves, and smaller workforces. Their small market shares and weak bargaining power of individual SMEs places them at a disadvantage in negotiations with principal supply chain partners to obtain resources and additional or contingent support to withstand the impact of disasters. A lack of diversification and limited surge capacities to increase output also limit the abilities of SMEs to cope with supply and demand shocks and market volatility generated by disasters. Studies have revealed that few SMEs are adequately prepared for natural hazards (Alesch and others, 2001; Wedawatta, Ingirige and Amaratunga, 2010). SMEs have been identified as the primary business group for underinsurance, and they usually do not conduct risk assessments nor implement their own business continuity plans (CERNO, 2010; CII, 2009). This lack of preparation consequently increases their often-difficult recovery after disasters and the subsequent supply chain disruptions (Wedawatta, Ingirige and Amaratunga, 2010).

4.5.3 Case studies: Japan earthquake and Thailand floods

The natural disasters that struck Japan and Thailand in 2011 were the most devastating in the Asia-Pacific region in recent history. In March 2011, a massive earthquake now known as the Great East Japan Earthquake severely affected much of the northeast part of Japan and was followed by the devastating tsunami. Then in late 2011, floods in Thailand caused unprecedented damage, with much of it concentrated in the economic heart of the country surrounding Bangkok. Given the important positions of Japan and Thailand in the global supply chains for many economic sectors, these two disasters caused significant disruption both domestically and worldwide, highlighting the interconnected nature of global production systems, world markets and national economies.

The two cases illustrate the different types of impacts disasters can have on global supply chains. Japan acts as a major supplier in many industries (e.g. automotive parts, chemicals, electronic parts

Figure IV.VIII **Japanese production repercussions following the Great East Japan Earthquake, in auto production, and electrical components**



Source: CEIC Data Company Ltd. http://ceicdata.com/ (accessed 30 March 2012).

and steel) but also produces consumer products for the mass market. As a result, the Great East Japan Earthquake affected both upstream suppliers in developing countries and final customers in many additional countries regardless of their economic standing. As a result, both demands and supply flows were seriously disrupted at considerable cost. By comparison, Thailand is a major supplier in the global supply chain, particularly in the auto and electronic sectors. Therefore, beyond its own economy and workforce which suffered costly consequences from the floods, the country's downstream supply chain clients were adversely affected by being unable to source parts and components from Thailand during the extend disaster period.

The Great East Japan Earthquake

As outlined in chapter 1, the Great East Japan Earthquake struck Japan triggering a devastating tsunami, which led to the meltdown of nuclear reactors in Fukushima. This compound disaster caused a record $210 billion in losses and damage, representing 3.8 per cent of Japan's GDP (CREDb, 2012). Production sites in the affected coastal areas experienced one and half times as much damage as inland areas (Okada, 2011). While many sectors suffered severe damage, the manufacturing and chemical industries were particularly badly affected with the potential for long-lasting impacts on companies' production and delivery of services.

Box IV.4 **Earthquake losses of Renesas Electronics Corporation**

Renesas Electronics Corporation is a Japanese semiconductor manufacturer and the world's largest manufacturer of microcontrollers. The corporation's Naka factory and other manufacturing facilities were severely damaged by the earthquake. In addition to the cost for restoring damaged properties, Renesas had to dispose of damaged stock and other fixed assets as well as to compensate the loss of leasing contracts. The firm also had to continue to cover its fixed expenses regardless of its suspended production. Although the company carried insurance, it recovered less than one quarter of its total losses from the disaster. Renesas' corporate losses are indicated in table IV.

Table IV.3 **Earthquake losses of Renesas Electronics Corporation**

Loss factors	Amount (million dollars)
Repairs to property, plant and equipment (expenses restoring to the original condition)	535.8
Loss on disposal of stock	90.7
Loss on disposal of fixed assets	77.1
Fixed expenses during suspension of operations (loss for inability to operate)	73.3
Loss on cancellation of lease contracts and others	37.3
Total loss on the disaster	814.2
Insurance payments received	(198.9)
Net loss on the disaster	615.3

Source: Renesas Electronics Corporation, *Annual Report 2011* (Japan, Renesas, 2011).
Note: Calculated at $1 .00 = 80.5 Japanese Yen

This case study elaborates the circumstances and types of losses that were incurred as well as some of the consequential effects on Japan's production capacities and overall economy. Examples will illustrate the multiple and far-reaching consequences of the disaster on leading firms in critical global industries. Although other firms were not affected directly by the forces of the earthquake and tsunami, they experienced the indirect impacts because of the extensively damaged infrastructure elsewhere in the country. The power supply in the northern part of Japan was severely disrupted by the failure of the Fukushima nuclear power plant. As a result, the production of many industrial plants stagnated (Davis, 2011). Many roads and railways were destroyed and almost all major seaports in the affected areas were closed (Wassener and Nicholson, 2011). The movement of final products, components and raw materials was very difficult, causing innumerable disruptions to many supply chains.

Beyond the extensive human suffering and personal losses, the catastrophe also affected commercial human resource requirements and the labour market across the country. There was a nationwide impact on the labour market because of increased bankruptcies and loss of employment. Imbalances also resulted between labour demand and supply in terms of altered availability and skills requirements, causing further unemployment. Workers were reassigned within industries or across sectors and to alternate geographical locations (Kirchberger, 2011).

As a positive response to the tragedy, rapid and significant efforts were taken to speed recovery. In the region most directly affected, applications for unemployment insurance rose sharply in the first few months following the catastrophic events (Berkmen, Lam, Steinberg and Tokuoka, 2011). The Government of Japan rapidly implemented employment programmes such as "Hello-works" and "Japan as One" to create jobs and to facilitate job placements or reassignments (Rokumoto, 2012; Japan Ministry of Health, Labour and Welfare, 2012). Many affected firms, and especially those in the manufacturing sector, rapidly regained their levels of employment as they were working to return to their previous production levels (Thompson, 2012). After one year, employment in the finance, insurance, real estate, mining, construction and service sectors exceeded the pre-disaster levels (Thompson, 2012).

As the economy of Japan is highly integrated into the world economy, both direct and indirect supply disruptions caused by the disaster were experienced elsewhere. Japanese automobile production and

Table IV.4 **Impact of the Thailand floods on Japanese enterprises**

Sector	Type of industry	Number of enterprises with direct damage e.g. to buildings, equipment (percentage)	Number of enterprises with direct damage in inundated industrial estates (percentage)	Number of enterprises with direct damage outside inundated industrial estates (percentage)	Number of enterprises with indirect losses from supply chain disruption (percentage)	Number of enter-prises unaffected (percent-age)	Number of company respond-ing
Manufacturing	Food processing	4 (29)	2 (14)	2 (14)	11 (79)	3 (21)	14
	Textiles	3 (33)	1 (11)	2 (22)	5 (56)	2 (22)	9
	Chemicals	1 (4)	1 (4)	..	19 (79)	4 (17)	24
	Steel, other metal	2 (7)	1 (3)	1 (3)	24 (83)	3 (10)	29
	Machinery	5 (42)	5 (42)	..	8 (67)	4 (33)	12
	Electronics	20 (56)	18 (50)	3 (8)	31 (86)	2 (6)	36
	Automotive	7 (13)	6 (11)	1 (2)	47 (84)	8 (14)	56
	Others	9 (24)	7 (18)	2 (5)	26 (68)	7 (18)	38
Manufacturing Subtotal	---	*51 (23)*	*41 (19)*	*11 (5)*	*171 (78)*	*33 (15)*	*218*
Non-manufacturing	Trading companies	5 (11)	4 (9)	1 (2)	45 (100)	9 (20)	45
	Retail	3 (27)	3 (27)	2 (18)	8 (73)	3 (27)	11
	Finance	2 (13)	..	2 (13)	10 (63)	5 (31)	16
	Construction, civil engineering	5 (29)	3 (18)	3 (18)	8 (47)	9 (53)	17
	Transportation, communication	2 (9)	..	2 (9)	18 (78)	5 (22)	23
	Others	1 (4)	..	1 (4)	15 (63)	12 (50)	24
Non-manufacturing Subtotal	---	*18 (13)*	*10 (7)*	*11 (8)*	*104 (76)*	*43 (32)*	*136*
Total		*69 (19)*	*51 (14)*	*22 (6)*	*275 (78)*	*76 (21)*	*354*

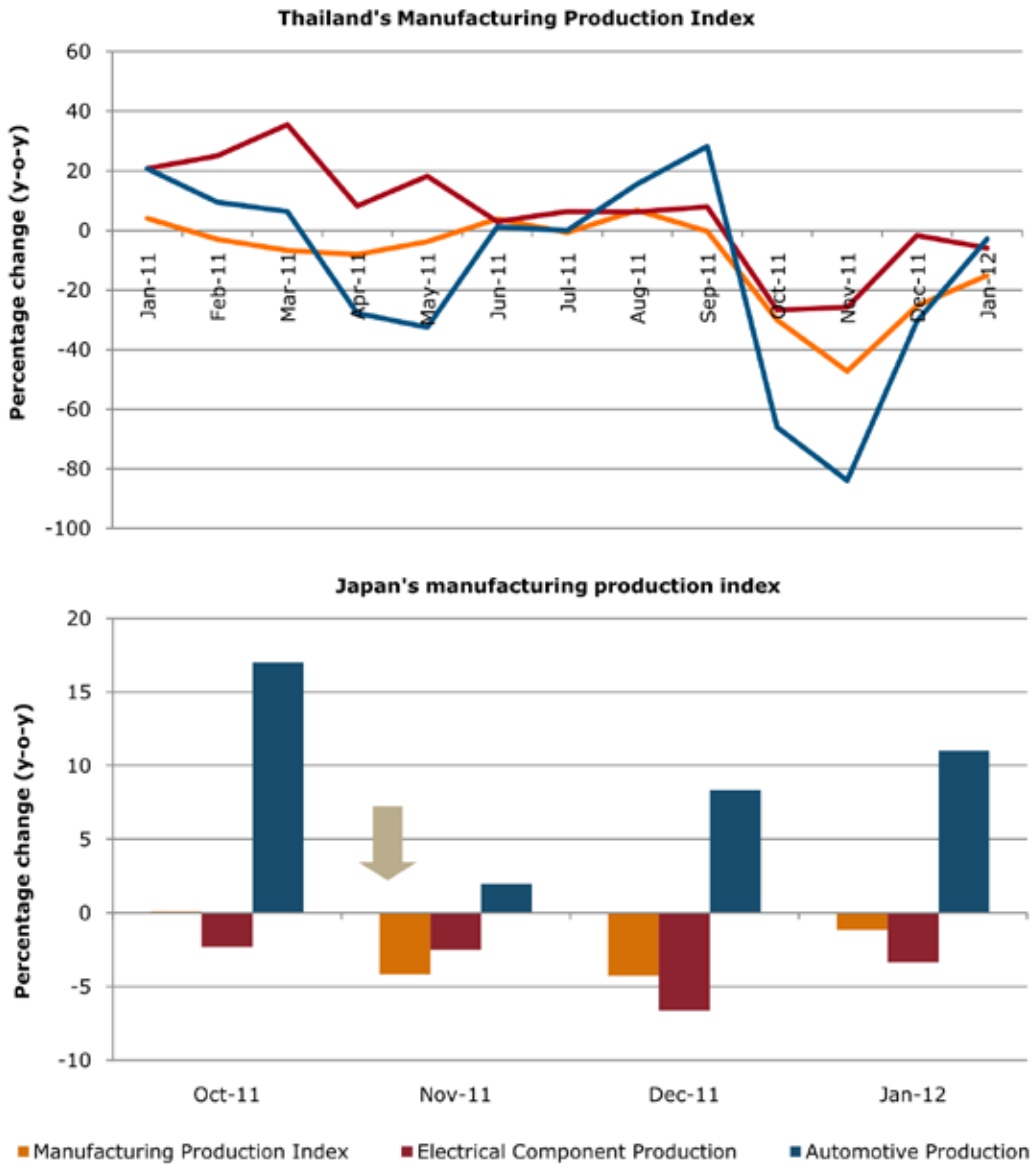
Source: Japanese Chamber of Commerce Bangkok, *Thai Koku Nikkei Kigyou Keiki Doukou Chousa: 2011 Shimoki*, (JCCB, 29 February 2012).
Note: The survey resulted in multiple answers. The unit is the number of enterprises; parentheses indicate percentage of companies responding.

electrical component production declined by 47.7 per cent and 8.25 per cent, respectively (CEICb, 2012). As figure IV.VIII illustrates, repercussions of these declines in Japanese production for three months after the disaster were felt in other Asian countries. For automobile production, they were most clearly evident in the Philippines (-24 per cent), Thailand (-19.7 per cent) and Indonesia (-6.1 per cent). Electrical component production was reduced in Malaysia (-17.5 per cent) and the Philippines (-8.4 per cent). Production was disrupted in the automotive sector for about three months and in the electrical components sector for two.

The disruption caused by the disaster in Japan had major impacts on many supply chains, but particularly on those which rely on only one or few sources for certain inputs. Ethox Chemicals, an American chemical multinational corporation, relies on a key material supplied by only three companies in the world, one of which is located in Japan. After the disaster, Ethox suffered supply shortages, as the other two suppliers in Europe and Malaysia could not meet the shortfall. In the automobile industry the damage done to Renesas Electronic Corporation provides another example (box IV.4). The company is the largest manufacturer of custom-made microchips in the world and is a major critical supplier to the automotive industry. The entire automotive industry in Japan and firms in other parts of the world experienced serious production interruption because Renesas unique user-specific chips were extremely difficult to re-source. The tight "just-in-time" production and delivery management strategy in the automotive industry maintained extremely low material inventories, usually for only a maximum of six hours of production requirements (Endo, 2011).

Supply chain disruptions and the resulting decline in production in several industries, particularly in export-oriented industries, highlighted the risks of potentially losing global market shares. Posco, the world's third-largest steelmaker based in the Republic of Korea, increased their share of the East Asian regional market for shipbuilders' materials, replacing Japanese steelmakers (Narayanan, 2011). Disruptions in the Japanese automobile industry supply chains reduced automobile production in the United States of America and Europe and caused a serious shortage

Figure IV.IX **Disaster impacts of the Thailand floods on manufacturing production in Thailand and Japan**



Source: CEIC Data Company Ltd. http://ceicdata.com/ (accessed 30 March 2012).

of small and mid-sized cars in the world market as well (Snyder, 2011). As a result, automakers which were less affected by the disaster were able to increase their global market share, at least temporarily (Canis, 2011). Data indicate that General Motors overtook Toyota as the world's biggest carmaker by volume in 2011 (Toyota, 2012; General Motors, 2012).

The floods of Thailand

In the second half of 2011, severe floods inflicted heavy damage in several South-East Asian countries. Thailand experienced particularly severe flooding then causing over $40 billion in damage and losses, greatly hampering the country's manufacturing capacity. The flooding in Thailand was attributed to various factors, including a combination of poor urban planning, deforestation, lack of floodwater management systems and failure of previous master plans on flood mitigation.

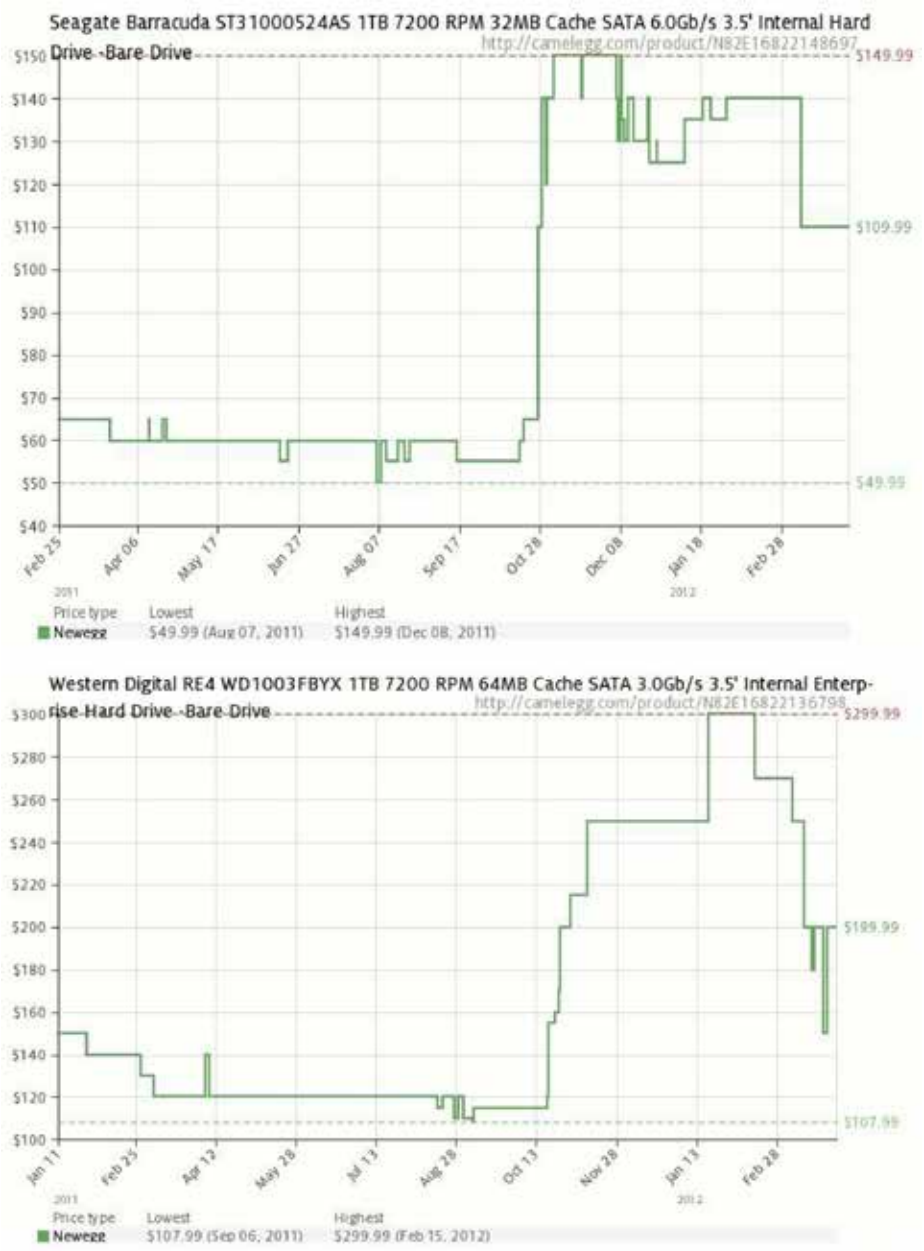
However the severity of the economic consequences is not in any doubt, as one of the most serious impacts of the floods was on Thailand's role in global supply chains. As a result of globalization, Thailand's economy has been thoroughly integrated into global

Box IV.5 **The impact of flooding in Thailand on the price of hard disk drives**

Thailand is the world's second largest producer of hard disk drives (HDD) and is a major supplier of HDD parts. Some of the leading global producers operate in Thailand, including Western Digital, Seagate, Toshiba and Hitachi. As many of them were affected by the floods, the global HDD industry suffered its worst downturn in three years. The world price of these essential components increased dramatically.

According to the price history records of Newegg Inc., a major online retailer of computer hardware and software in North America, the prices of HDDs made by Seagate and Western Digital tripled during the flood period (figure IV.X). In addition to the suspension of HDD production in factories affected by the flooding in Thailand, the HDD price rise was also caused by alternative purchasing strategies pursued by consumers and inventory hoarding by resellers who anticipated the upward trend of HDD prices

Figure IV.X **The price history of two hard disk drive products, January 2011-March 2012**



Source: Price Tracker www.Camelegg.newegg.com (accessed May 2012).

supply chains, a feature that has produced significant inflows of foreign direct investment. Its importance for the country has led to high levels of export activities and correspondingly extensive involvement by transnational corporations (Chongvilaivan, 2012).

Driven by pressures to reduce their operating costs and aided by local incentives, firms and suppliers in Thailand have tended to cluster in a limited number of industrial locations, primarily on the periphery of Bangkok (Chongvilaivan, 2012). Partially because of inadequate urban planning, seven industrial estates in the provinces of Ayutthaya and Pathum Thani were created on low-lying land formerly used to grow rice, located adjacent to the country's major Chao Phraya River. During the flooding these industrial estates were severely inundated to the depth of a metre or more, resulting in huge losses. Manufacturing production losses alone averaged 29.4 per cent between October 2011 and January 2012 (CEICa, 2012).

In addition to the direct losses from damage to physical assets, many firms suffered serious and extended supply chain disruptions. These disruptions also affected other firms whose assets were spared serious physical damages. For example, although neither Nissan nor Toyota's automobile production plants in Thailand were physically damaged by the floods, both companies had to suspend production because of difficulties in obtaining component parts from suppliers which had been directly affected by the floods (Nissan, 2011; Toyota, 2011). In the case of Toyota, the indirect effects of this halt in their manufacturing spread to their other production sites around the world. Their production lines in Malaysia, Pakistan, the Philippines, Viet Nam, and as far away as the United States of America and Canada had to be adjusted in order to respond to the lost outputs in Thailand (Toyota, 2011).

According to a survey of Japanese enterprises regarding the impact of the floods in Thailand, in both manufacturing and non-manufacturing sectors, 78 per cent of all respondents were directly or indirectly affected (table IV.4). Among the affected enterprises, the automotive, trading, electronics, steel and metal sectors accounted for 17 per cent, 16 per cent, 11 per cent and 9 per cent, respectively (JCCB, 2012). Firms directly affected by the floods and located in inundated industrial estates, and particularly manufacturers, outnumbered other affected companies located outside the estates. Indirect damage included supply disruptions (JETRO, 2012).

The majority of the enterprises were covered by disaster insurance for damaged assets and reduced income (JCCB, 2012), but 12 per cent of the respondents carried no insurance. Disruption of production and corresponding financial losses of enterprises led directly to a decrease in employment in the affected areas. The survey indicated that 21 per cent of the affected firms planned to "conduct layoffs" or to "solicit voluntary retirement" (JCCB, 2012). To cope with the supply chain disruptions, more than 60 per cent of the directly affected manufacturers and particularly those in the electronics sector, temporarily relocated their production to other Asian countries. These destinations included other member countries of the Association of Southeast Asian Nations (ASEAN), China and Japan. Some firms indicated they were considering permanent relocation (JCCB, 2012).

The floods in Thailand caused significant impacts on other countries through the global supply chains. With the close economic relationships between Thailand and Japan, the disruption to Thailand's supply chains and its production losses affected Japanese productivity, where the manufacturing production index fell by 2.4 per cent (CEICb, 2012). This decline was led by the reduction in electrical component production, which contracted by 3.7 per cent between October 2011 and January 2012 (figure IV.IX). As Thailand is the world's second largest producer of computer hard disk drives, the reduced production capacity caused by the flood resulted in an increase of their world market prices (box IV.5).

The floods also had a heavy impact on small and medium enterprises (SMEs), which participate in the global supply chains as suppliers to large firms and transnational corporations. At the end of 2010, there were more than 2.9 million SMEs in Thailand accounting for 99.6 per cent of all enterprises (Thailand, 2011); they are responsible for 77.9 per cent of all employment in the country (Thailand, 2011). During the 2011 flood, approximately 550,000 small businesses experienced direct and indirect damage, estimated at 71.1 billion Thai baht (about $2.25 billion) per month during the floods, with at least a temporary a loss of 2.32 million jobs (Thai Business Council, 2011).

These severe impacts of the flood on Thailand's economy and the global supply chains of which it is an important contributor have raised investors' concerns about the long-term viability of Thailand as an investment destination. The inefficient government management of the flood disaster and the country's on-going recovery have raised further questions about the adequacy of the country's strategy to protect its critical industrial infrastructure. Even as flood protection walls are being constructed around the same industrial estates, hydrologists and other

commentators question the appropriateness as well as the viability of such mitigation measures to avoid future costly flood damage to the industries situated in the estates.

According to a survey of 50 transnational firms directly affected by the floods, 38 per cent of the firms reported that they would "scale back" their operations (e.g. production, investment and employment) in Thailand in the future (JETRO, 2012). These firms also expressed concerns about increased production costs because of higher insurance premiums, as well as about the expense of building their own flood defences (Sathirathai, 2012). Even though Thailand serves as an important link in the global supply chains of several critical industries, more attention needs to be paid to mitigating the risks of future flooding and improving water resource management if the country is to remain a significant recipient of international investment.

As an object lesson that applies to all Asia-Pacific countries, it is very much in any country's own developmental self-interest to invest significantly in disaster risk management in order to reduce the exposure of national economies to future disaster risks. As in Japan, following the extraordinary losses and lessons from the Great East Japan Earthquake and the subsequent tsunami and nuclear disaster, the on-going recovery process provides a highly visible and potentially instructive opportunity to restore confidence and greater protection for countries' social and economic values.

4.6 Disaster recovery as a prologue

Disaster recovery can and indeed should be used to reduce the risk of future disasters by building resilience in people and by reducing their exposure to hazards. Increasingly, there is evidence of good, if often partial, examples of how this can be achieved although many times noteworthy efforts either are spontaneous and ad hoc or initially uncertain or delayed. Recovery is an opportunity to correct errors in development that contribute to disasters. They can accomplish in different ways, but only to the extent that forethought is given to reducing future risks.

The present report has emphasized that the risk of loss of life and damage to property from natural hazards is increasing globally. Both public and private institutions can have major influences on developing necessary coping and adaptive capacities in communities, but much leadership from Government remains essential. In East Asia and the Pacific, the risks of people dying from floods and cyclones have decreased by two thirds since 1980 due to disaster reduction efforts. Countries proceed to address social and developmental needs in disaster recovery through different motivations. But as disasters continue to occur, and new risks emerge, recovery following a crisis is an opportunity for all parties affected and concerned to dedicate their efforts to reduce the risk from future disasters.

The importance and the opportunities for reducing risk during recovery were addressed in the *Asia-Pacific Disaster Report for 2010, Protecting Development Gains: Reducing disaster vulnerability and building resilience in Asia and Pacific*. Evidence for what works and what does not, is growing, yet much remains to be tried. The significance of the Great East Asia Earthquake and tsunami and the South-East Asia floods which caused particularly severe damage and losses in Thailand demonstrate that recovery opportunities demand serious and sustained attention of States across the region.

Experience is clear that when DRR is not pursued in recovery from disasters and in development strategies, similar hazards can cause even worse disasters. A disaster changes people's attitudes and their perception of risks, dramatically. People can become more risk adverse, and officials more aware and committed to pursue risk-sensitive strategies, and ideally investments, too. However, these altered conditions have to be capitalized, and the recognized opportunities realized. Still, only few disaster recovery initiatives systematically reduce vulnerabilities and exposure to future hazards.

It is for this reason that the present report revisits some crucial aspects of disaster recovery, citing recent examples where recovery initiatives have been implemented as a prologue to future protection for people and safer communities in the Asia-Pacific region.

4.6.1 Post-disaster assessments

The future fundamentally begins with an assessment, but future protection will only result if the assessment is acted upon. Each Government's sector ministries often conduct their own detailed assessments after a disaster, using either their methods or in some cases the Post- Disaster Needs Assessment (PDNA) methodology. With the support of the World Bank, the European Union, and the United Nations, Governments have conducted thirty PDNAs since 2007. This growing community of practice and experience

Box IV.6 **Creating a disaster-resilient town through public-resident-private partnership**

In 2009, local community residents and private companies came together and planned the Tago Nishi Eco Model Town project in Sendai City as an environmentally conscious urban development project with a substantial commercial district. Plans were modified following the Great East Japan Earthquake in March 2011 and Tago Nishi was reborn as a model disaster-resilient community.

As one of the areas greatly affected by the tsunami, Sendai City had an urgent need to relocate survivors from tsunami-hit areas. Residents naturally wished to be relocated as close as possible to their old neighbourhood, yet somewhere safe from future disasters. The Tago Nishi project area was two kilometres inland from the furthest extent of the 2011 tsunami, so it was deemed ideal for both proximity and potential safety. Sendai City designated Tago Nishi as a relocation area, and residents and developers modified their previous commercially-oriented plan to become more residential with additional apartment-style housing for 180 families and single-family residences for 120 more. Government subsidy programmes were used to provide Tago Nishi with anti-liquefaction measures, built-in countermeasures for utility shortfalls such as blackouts (e.g. shelters and emergency electricity supply systems for residences), renewable energy power sources, and "smart grid" systems. Taken together, these innovations contribute to making Tago Nishi a significant disaster-resilient town. Although the initiative remains at the planning stage, relocation is scheduled to start in the summer of 2013, making Tago Nishi one of the most advanced mass relocation projects in the country.

Source: Sandra Wu, Wen-Hsiu, Kokusai Kogyo Co., Ltd. (2011). From UNECE presentation, "PPP in disaster risk reduction" www.unece.org/fileadmin/DAM/ceci/documents/2012/ppp/ppp_days/Business_Forum/Wen_Hsiu.pdf

provides a basis for building resilience in development and recovery for future hazardous events. PDNAs are led by Governments but conducted jointly with multiple parties; this facilitates collaboration necessary for a successful recovery.

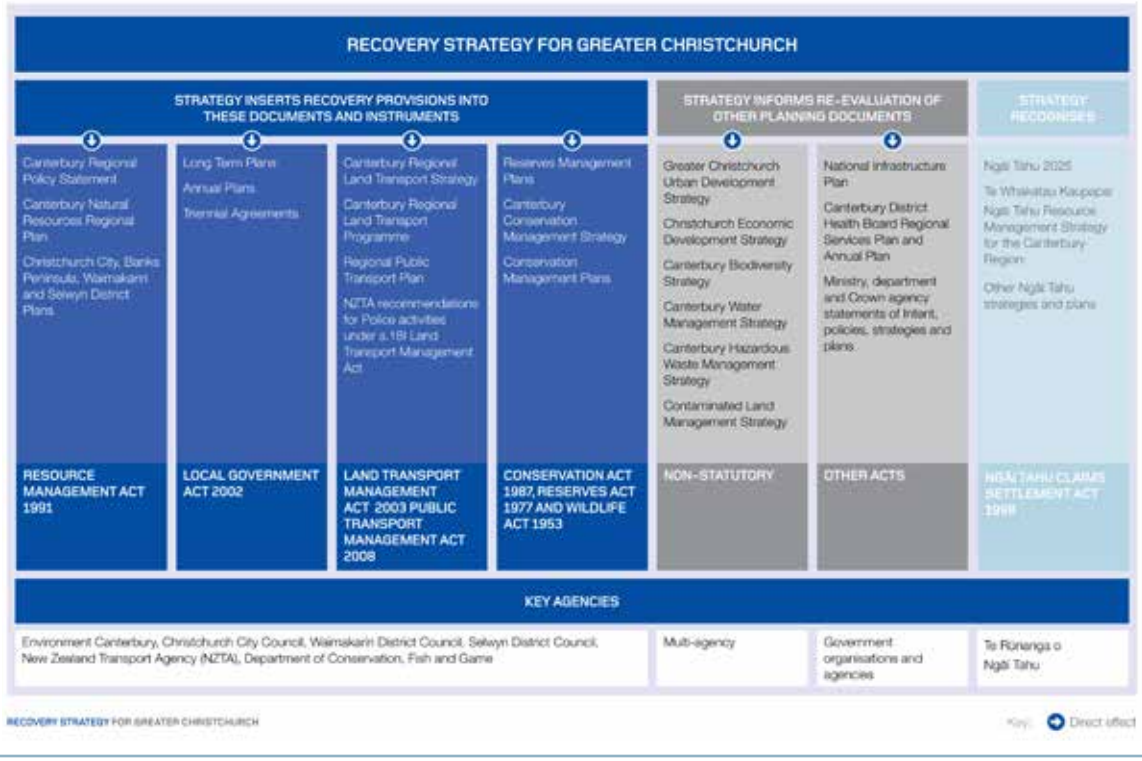
Post-disaster assessments are slowly becoming more effective at setting recovery agendas to reduce the risks people face from future disasters. They are becoming a useful mechanism to engage political leadership and motivate joint sector planning that systematically incorporates risk reduction into all aspects of DRM. To be successful, it is imperative that such assessments contextualize local culture and existing administrative practices with attention to a multi-hazard risk profile.

However, although some beneficial practices are emerging, assessments are challenged to translate risk reduction intentions into firm decisions and action by individuals, businesses, and all levels of government. Turning proposed agendas into reality requires that assistance organizations and Governments maintain the commitment and sense of urgency more typically reserved for emergency response and applies them to recovery strategies based on risk reduction principles.

4.6.2 Disaster recovery planning experience

Political commitment and leadership is needed to reduce risk during recovery. This commitment needs to be expressed in recovery frameworks and plans. Resilient recovery frameworks increasingly review and seek to strengthen existing development planning, policies and activities. Previously unconsidered hazards need to be assessed and incorporated in plans. Resilience can be enhanced through investment in social safety nets and by linking risk-sharing mechanisms like insurance to risk reduction

Figure IV.XI **An integrated earthquake recovery strategy in Christchurch, New Zealand**



Source: Canterbury Earthquake Recovery Authority, *Recovery strategy for greater Christchurch*. (New Zealand, Canterbury Earthquake Recovery Authority, 2012). Available from http://cera.govt.nz/recovery-strategy/overview/read-the-recovery-strategy

measures.

Indonesia was one of the first countries to contextualize the PDNA to meet its own specific needs and working conditions. In December 2011, the Indonesian national disaster management authority, Badan Nasional Penanggulangan Bencana (BNPB) officially launched an Indonesian post-disaster needs assessment tool with support from UNDP. The Indonesian approach includes details of the concept, implementation steps and procedures for data collection, processing, and analysis. The main guidelines cover different aspects of disaster response and recovery in accordance with the principles of better development ("build back better") and disaster risk reduction ("build back safer"). The head of BNPB considers the Indonesian PDNA to be a fundamental starting point for all stakeholders in planning and decision-making policy (Badan Nasional Penanggulangan Bencana, 2012).

Examples follow to illustrate recent recovery strategies where future risks were reduced either by reducing exposure or increasing resilience.

Building back safer for present and future hazard events in Japan

Following the Great East Japan Earthquake, the Government of Japan focused its recovery planning on the national, prefectural, and municipal levels. It issued the Basic Act for Reconstruction (Japan, 2011) and Basic Guidelines for Reconstruction (Japan, 2011), based on recommendations from the Japanese Reconstruction Design Council. The three disaster-affected prefectures developed their own recovery plans. Most of the municipalities developed their recovery plans by basing them on the national and prefectural recovery policies. The municipal approach applies land-use planning to relocate communities, for reconstruction projects and in building consensus among residents. The different geographic and socioeconomic contexts in the various municipalities produced a variety of relocation solutions following this guidance, but all communities rebuilt residential housing in safer areas to protect residents from future tsunamis. One innovative example is Tago Nishi in Sendai City, Japan (box IV.6).

Strengthening existing laws and strategies for recovery and future resilience in New Zealand

An increasing number of recovery frameworks and strategies focus on re-evaluating and strengthening existing laws and procedural arrangements. This focus allows recovery efforts to address weaknesses in development processes to reduce risks of future disasters (ESCAP and UNISDR, 2010). It also

encourages recovery planning to draw on changed attitudes in local government and in communities themselves to seize opportunities to make change a reality.

An example of this is a series of initiatives to strengthen existing laws and regulations in New Zealand following a series of destructive earthquakes in the Canterbury region of the southern island of New Zealand between September 2010 and February 2011. The Canterbury Earthquake Recovery Authority initially developed a recovery strategy for greater Christchurch, the country's second largest city, after a series of earthquakes starting in September 2010. A second, particularly destructive earthquake on 22 February 2011 caused 185 fatalities and serious destruction in Christchurch's central business district, infrastructure and residential neighbourhoods. The recovery strategy was designed to guide the rebuilding and recovery of the city and the area of greater Christchurch with the explicit intention to reduce the risk consequences of future earthquakes. It includes specific provisions to this effect in planning documents and instruments, as indicated in figure IV.XI.

The earlier planning and growth strategies were re-evaluated following the more destructive February 2011 earthquake as the region was faced with the necessity of proceeding with immediate comprehensive recovery and risk reduction needs. The most significant product of the reconsideration was the Greater Christchurch Urban Development Strategy, which was developed primarily through a statutory planning process. It includes coordinated activities expressed in the Canterbury Regional Policy Statement, district plans, local councils' long-term plans, and a regional land transport programme. By using the regional Canterbury Earthquake Recovery Act powers, the government minister responsible for Canterbury's earthquake recovery has been able to expedite welcomed changes to the regional policy statement. This has led to altered land-use patterns, homes not being rebuilt in seismically dangerous areas and government purchase of both land and houses in high-risk zones. Insurance companies have been included in these strategic plans to speed a safer recovery process (Canterbury Earthquake Recovery Authority, 2012).

Balancing the speed of recovery and reducing risk through local initiatives

Institutions and public interests involved in recovery need to balance the demand for rapid recovery with informed decision-making to reduce risks from future hazards. Most communities struggle to get this balance in recovery described as "20 years of development in but a few" (ESCAP and UNISDR, 2010). Good planning, well-designed frameworks, prioritization and incentives can lead a fast and efficient recovery that does not repeat previous errors that led to the disaster. The Chief Executive of the Canterbury Earthquake Recovery Authority Roger Sutton emphasized this when he said, "The pace of recovery is important. We must balance the need to make good decisions quickly against the need to take this unique opportunity to get things right. We need to create certainty as quickly as we can to allow people, communities and businesses to make their own decisions and move on" (Canterbury Earthquake Recovery Authority, 2012).

After the 2004 earthquake and tsunami that totally destroyed Aceh, Indonesia, it was almost two years before a streamlined Environmental Impact Assessment (EIA) could be finalized. This was a crucial first step for reconstruction and investment after the tsunami. Human resources were overwhelmed by the many immediate responsibilities so the German development agency GTZ developed a streamlined EIA process. The Indonesian government also developed a Strategic Environmental Framework (SEF) with the objectives of supporting environmentally sound and timely investments at an early stage in the reconstruction planning process. The SEF was designed to expedite and guide decision-making in the early stages of recovery project cycles by providing a practical tool to mitigate project impacts.

Similar frameworks have been created in India following the 2004 Indian Ocean Tsunami, in China after the 2008 Wenchuan Earthquake centred in Sichuan province and following the 2010 earthquake in Haiti. The governments of Pondicherry union territory and Tamil Nadu state in India also developed an Environmental and Social Management Framework (India, 2005). China also created an Environmental and Social Safeguards Screening and Assessment Framework (China, 2008).

4.6.3 Pre-disaster planning

For recovery to reduce risk from future hazard events, good prior participatory planning and constant communication among concerned groups is essential. Although some few initiatives have been documented, more efforts in similarly informed preliminary work are a requirement for the future. Unfortunately very few countries, local governments or development sectors invest in prior planning for resilient recovery. However, in one positive example Tokyo is developing preliminary plans for anticipated resilient recovery requirements. Learning lessons identified after the 2004 tsunami,

Indonesia also has invested in environmental frameworks, streamlined procedures and anticipated material needs for use during later recovery efforts. These plans are anchored in development processes and include strategies to allocate resources and arrangements that can foster early and informed decision-making and mechanisms for collaboration in readiness for meeting future recovery requirements.

4.7 Reducing Exposure to Reduce Disaster Risks

The Global Assessment Report on Disaster Risk Reduction 2011 (GAR 2011) cites two main drivers for the increase in disaster losses because of exposure. The first is an increase in the movement of people and economic activities to areas prone to floods and tropical cyclones. GAR 2011 established that in the last 40 years, the world's population increased by 87 per cent while the proportion of the population living in flood-prone river basins increased by 114 per cent; the population located along coastlines exposed to tropical cyclones increased by almost 200 per cent. Most of this increase has occurred in low and lower-middle income countries. The second driver for increased losses through exposure is the absolute value of GDP exposed to tropical cyclones has increased from less than $600 billion in the 1970s to $1.6 trillion in 2000. Simply stated, there are many more personal, human and economic assets "able to be lost" which are exposed to future hazards.

Increased populations and the growth of economic activities in areas that are prone to hazards create greater exposure. However, because of global supply chains, one's location in hazard-prone areas is not any longer a prerequisite for creating increased economic exposure. Because of the nature of this combined growth in population, economic activity and the interdependence of the global economy, efforts to reduce disaster exposure after the fact are particularly difficult and expensive undertakings. In many instances, the benefits provided by being near coastlines such as access to roads and ports for economic opportunities, or close to flood plains such as for plentiful water and productive land for human endeavour, outweigh the threats of disasters.

Strategies that are usually used to reduce disaster exposure include making land-use, urban and spatial planning risk-sensitive, ensuring that disaster recovery embodies risk reduction, and developing a better understanding of the potential vulnerability posed by global supply chains. Ensuring that risk-sensitive plans are translated into practice through investments is of the greatest importance.

Although these strategies are showing important progress in reducing disaster exposure, a wider understanding of the intricate relationships involved needs to be disseminated and adopted, and much more work needs to be done. Similarly, multiple commitments will be required throughout societies to ensure that existing opportunities are used and resources marshalled so that strategies already in place to reduce exposure to disasters really can contribute to reducing risks, rather than allowing contrary trends to cause future, and even greater, losses instead.

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5 Harnessing innovative technologies

Satellite image - Lake Saguling, West Java, Indonesia (21 Aug 2012)
Credits: Geoeye-1 Satellite Image © Centre for Remote Imaging, Sensing and Processing, National University of Singapore (2012)

This chapter explores the demonstrated potentials of emerging innovative technologies in relation to disaster risk reduction as discussed in the previous chapters. It illustrates the use of information products from innovative technologies such as near real-time Earth observation satellite images, satellite broadband communications, geo-referenced information systems and social media, among others. In the specific contexts cited, the examples showcase how satellite imagery can assist in analyzing economic impacts of disasters by providing crucial information in the analysis of their disruptions to supply chains. Further information is provided for users to access existing regional and international cooperation mechanisms for assistance and use of applicable products and services emanating from innovative technologies.

5.1 Introduction

As disasters become more frequent and intense, they also are becoming more complex. Information and knowledge emanating from innovative technologies are key resources to convey and address these increasing complexities. The demand for information and knowledge is therefore increasing with unbounded opportunities to save lives, to minimize economic losses and to build resilience over time. Innovative technologies, especially information and communications technology (ICT) and space applications, play important roles among a growing range of practitioners to apply their knowledge and experience in building resilience to disasters. Constantly enhanced and innovative applications such as remote sensing (RS), geographic information systems (GIS), the use of high resolution images, web-based and mobile terminals, all provide enhanced opportunities for more effective and efficient disaster risk reduction (DRR).

This chapter conveys the effective and innovative use of these technologies drawn from recent major disasters the region has experienced. In particular, this chapter highlights the important role of ICT and space applications in filling the critical gaps in essential information chains for DRR and disaster management (DM), new trends of integrated ICT and space applications and efforts for capacity-building for wider access and greater utility of the technologies. The efforts begin by having a more developed understanding about what technological abilities and services are available, the benefits they offer and some practical examples of their successful applications in minimizing people's exposure to hazards and in reducing disaster risks.

5.2 Knowing what is at risk

Mapping, assessment and monitoring disaster risks are the basic technical inputs for formulating DRR policy, planning and practice. In most countries, risk assessment has largely been limited to hazard mapping, showing areas where different hazard occurrence and intensities can be expected. However, as DRR strategies become more common, more fundamental questions of determining what elements are at risk and why that is the case are being pursued. Densely concentrated populations and social or economic infrastructure located in areas exposed to hazards account for what is at risk. When considered together, this includes people and the social, economic, ecological and cultural assets on which they depend for their individual and collective well-being. Capturing what is at risk in their dynamic settings by means of systematic risk mapping, assessment and monitoring systems is the key to address current and future DRM issues.

While remote sensing is an indispensable tool for identifying hazards and evaluating relative exposure, census and survey data need to be integrated and geo-referenced to develop risk maps. There are not many standardized and uniform operational procedures yet available for building social vulnerability aspects into risk information systems, but the need to develop them is certainly evident, particularly at local scales. This limitation is a major reason why risk analysis tools so far have been primarily empirical, country-specific and with limited applicable scales. Despite these challenges, with their wider use remote sensing and GIS-based techniques are becoming indispensable for identifying, mapping and monitoring elements that are at risk. The case studies that follow are based on innovative applications of RS and GIS, as they convey actual situations in determining elements at risk.

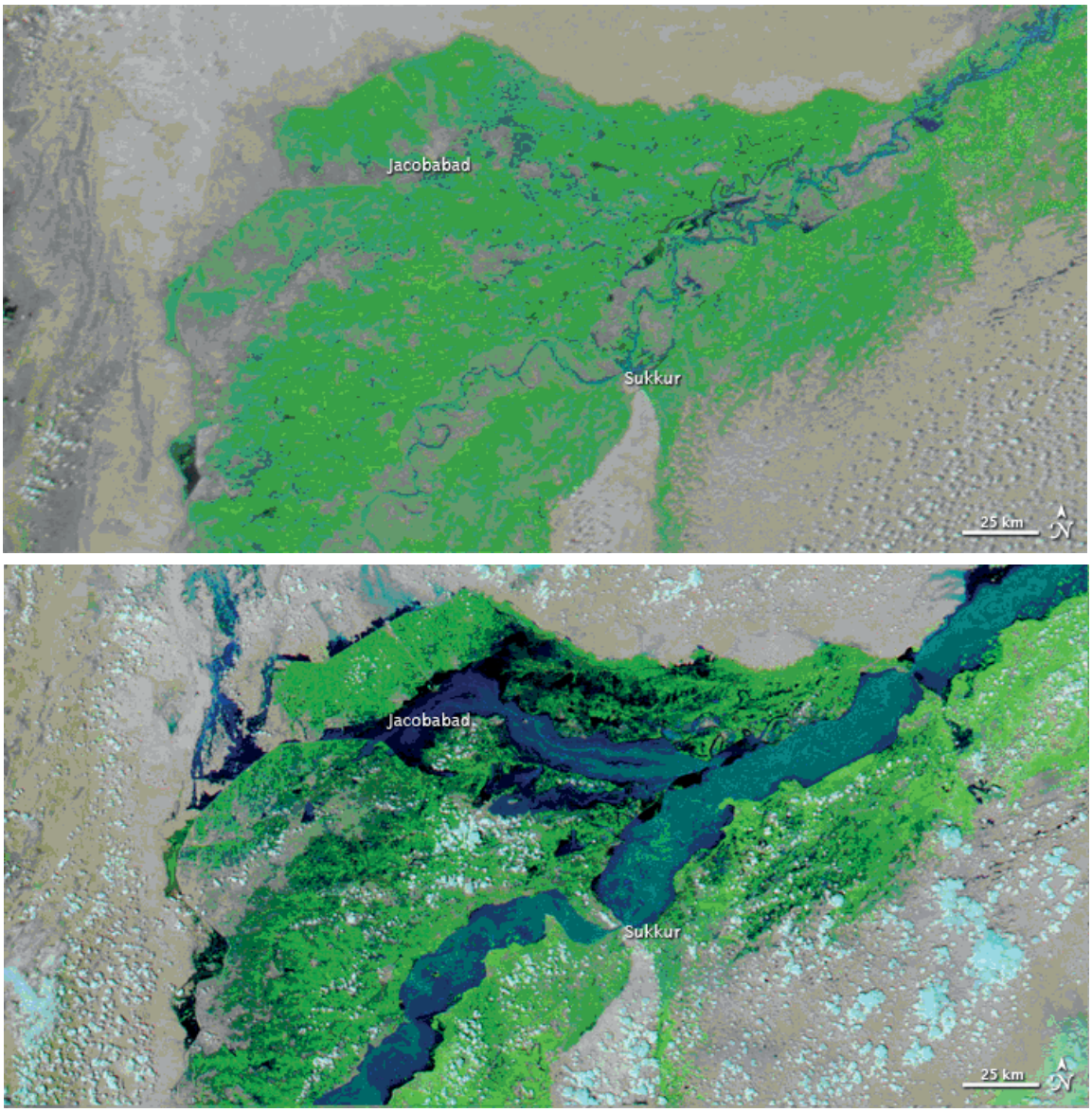
5.2.1 Extensive and intensive risks

While intensive and extensive risks (UNISDR, 2009) have been addressed in chapter 1, understanding their dynamic setting with cause and effect relationships requires geo-referenced information aggregated from various satellite images supplemented by topographic maps, census and survey data, cadastral information and available historical or local knowledge. Satellite imagery captures some components of extensive risks quite well by virtue of having large views and repetitive coverage from a variety of different sensors. These images can provide information about hazards' characteristics and the relative exposure of people and various types of assets, progressively creating a more informed understanding about the risks during a crisis, or relative needs after a disaster has occurred.

In one example, the Indus River basin in Pakistan is characterized through satellite imagery as a densely populated valley with marginal agriculture and a massive discharge of water from tributaries and the main river itself. Given the flat terrain the area is considered to be one of the most flood-prone river basins in South Asia (figure V.I)

Although intensive risks are more difficult to characterize through imagery, risk modelled assessment methods are available to understand this type of risk better. Unfortunately, for some types of hazards and in some locations, the development of risk assessments has been hampered by a lack of adequate data about either the scale of the hazard,

Figure V.I **Indus River valley before and after floods in Pakistan, August 2009 and August 2010**



Source: NASA images. http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=45302 (accessed 10 September 2012).
Note: census and survey data not shown because of limited resolution.

the extent of exposure or existing conditions of vulnerability. In many countries, historical disaster damage and loss databases, such as those maintained in systems like DesInventar[1] are unavailable, making estimation of vulnerability of people and assets difficult to characterize. In some countries, estimation of vulnerability is done using experts' best estimates, or by using damage data from previous hazard events. Also, characterizing hazards is often challenging if hazard maps are not readily available, or if available, are not of relevant or comparable resolution. By contrast, exposure can be developed through statistical data and surveys coupled with GIS mapping software.

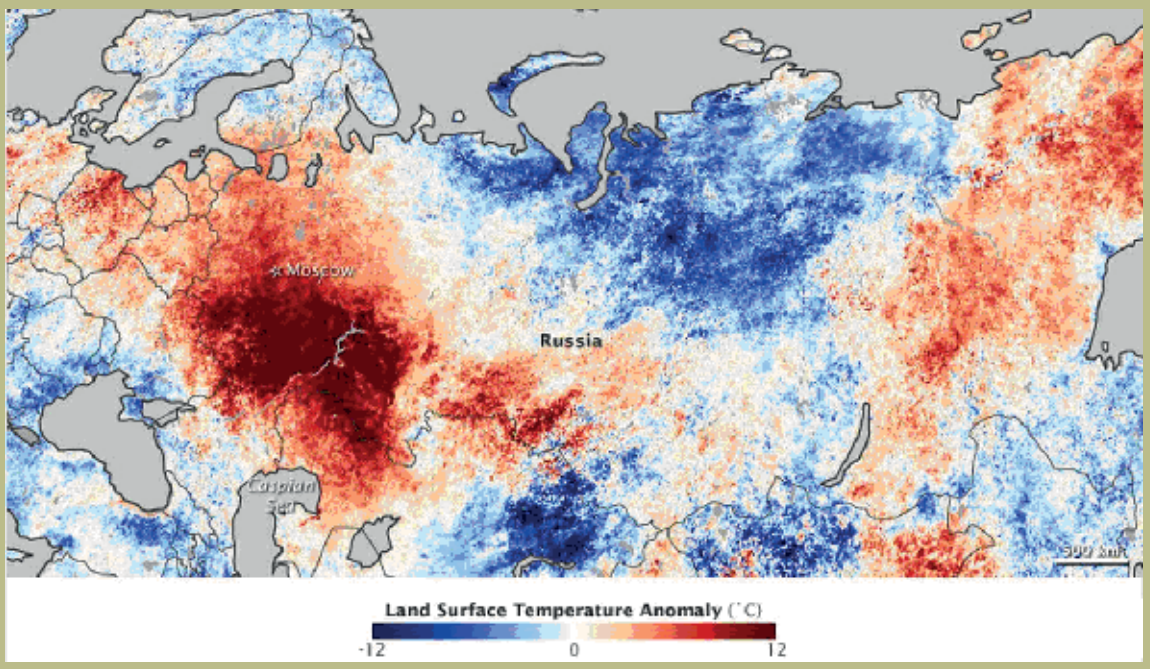
Fortunately, characterizing hazards and exposure can be made easier by using satellite imagery to overcome earlier limitations such as incomplete or dated geographical coverage, unsuitable scales, poor quality, and sometimes, simple unavailability of data. The abilities of RS and GIS tools to visualize different terrain, or interpret climatic and socioeconomic exposures have made monitoring, mapping and modelling risks easier. Some indicative examples include mapping and monitoring the heat waves in

[1] See: http://www.desinventar.net

Box V.1 **Heat wave in the Russian Federation, 2010**

Figure V.II shows the land surface temperature anomalies in the Russian Federation from 20-27 July 2010, as compared to 20-27 July 2000-2008. Spatial and temporal comparisons of satellite imagery allows for highlighting vast expanses with anomalies so that decision makers can send support to the affected areas, while scientists and researchers can better understand the root causes of such occurrences.

Figure V.II **Satellite image of the heat wave in the Russian Federation in 2010**



Source: NASA image. http://earthobservatory.nasa.gov/IOTD/view.php?id=45069

the Russian Federation in 2010 and floods in Fiji in 2012 which are elaborated in box V.1 and box V.2, respectively.

5.2.2 Detecting emerging risks

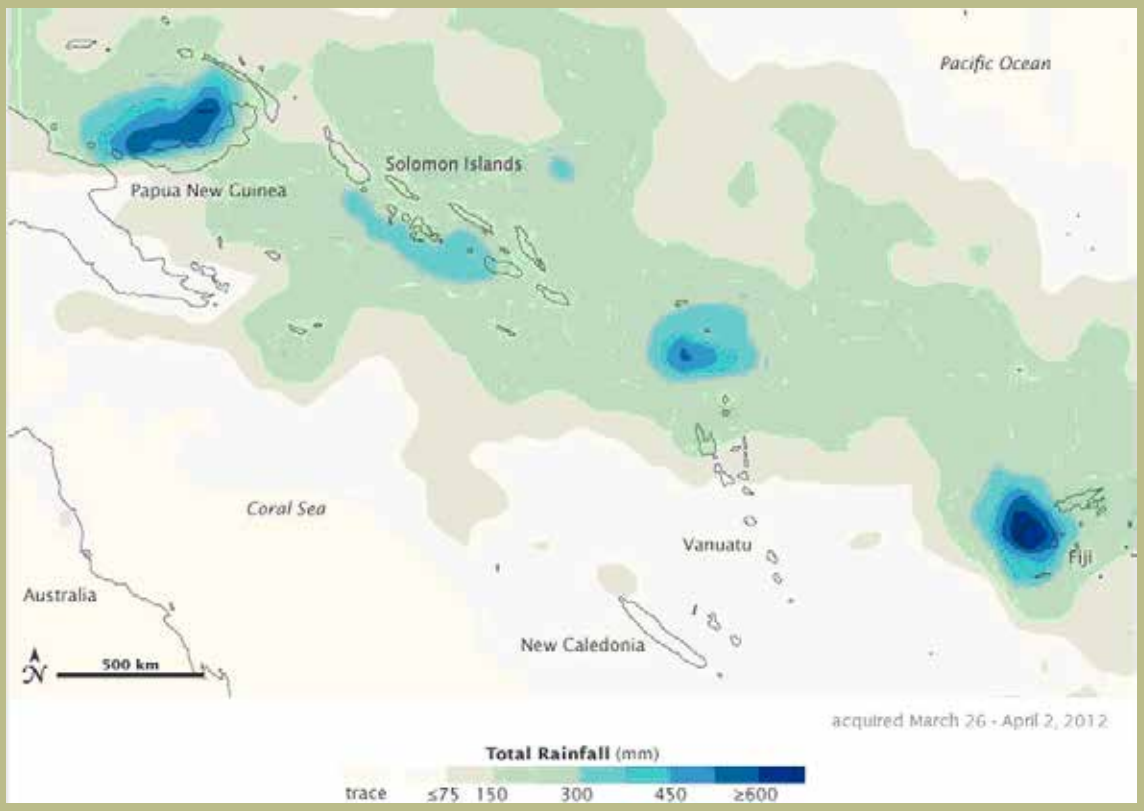
Efforts to identify hitherto unknown hazards and potential risks, and the detection and monitoring of exposure in high risk areas can be supported and the results made more explicit by using RS and GIS technologies. The method is similar when applied to different hazards as a wide geographical scan uses these analytical tools to pinpoint areas of different relative risk, and in some cases such as the movement of a tropical cyclone, differential timing that may be relevant. Once identified, the focus on a particular area can be further refined for more exacting monitoring, preparedness or emergency response activities.

One example of these capabilities is the initial identification and later observation of possible sources of glacial lake outburst floods (GLOF) (figure V.IV). Lakes that are formed from glacial melting can release catastrophically large amounts of water because of the instability of their circumstantial and impermanent damming. If these lakes are not previously identified or are unmonitored, the powerful floods commonly known as GLOF can occur without warning. The GLOF event of Dig Tsho, Nepal in 1985 destroyed a nearly completed hydroelectric plant thereby bringing more attention to such events. The highly remote and inaccessible mountainous areas where these lakes are formed makes remote sensing an effective technique to zoom in for a first assessment of possibly high risk lakes where further mitigation work might be considered (Ives, Rajendra and Pradeep, 2010). Further monitoring of these GLOF hazards can be assisted by the use of other advanced technologies

Box V.2 **Floods in Fiji, 2012**

Figure V.III shows the total rainfall between Papua New Guinea and Fiji from 26 March to 2 April 2012. The intense rainfall in Fiji caused landslides, flooding and much damage to homes and critical infrastructure. It affected the tourism industry as travellers had to be evacuated and the arrival of expected tourists was suspended. The rains in Fiji measured more than 600 mm, as indicated in the map derived from multiple satellites and analysis of the data.

Figure V.III **Satellite image of heavy rains in the South Pacific in 2012**



Source: NASA image. http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=77573

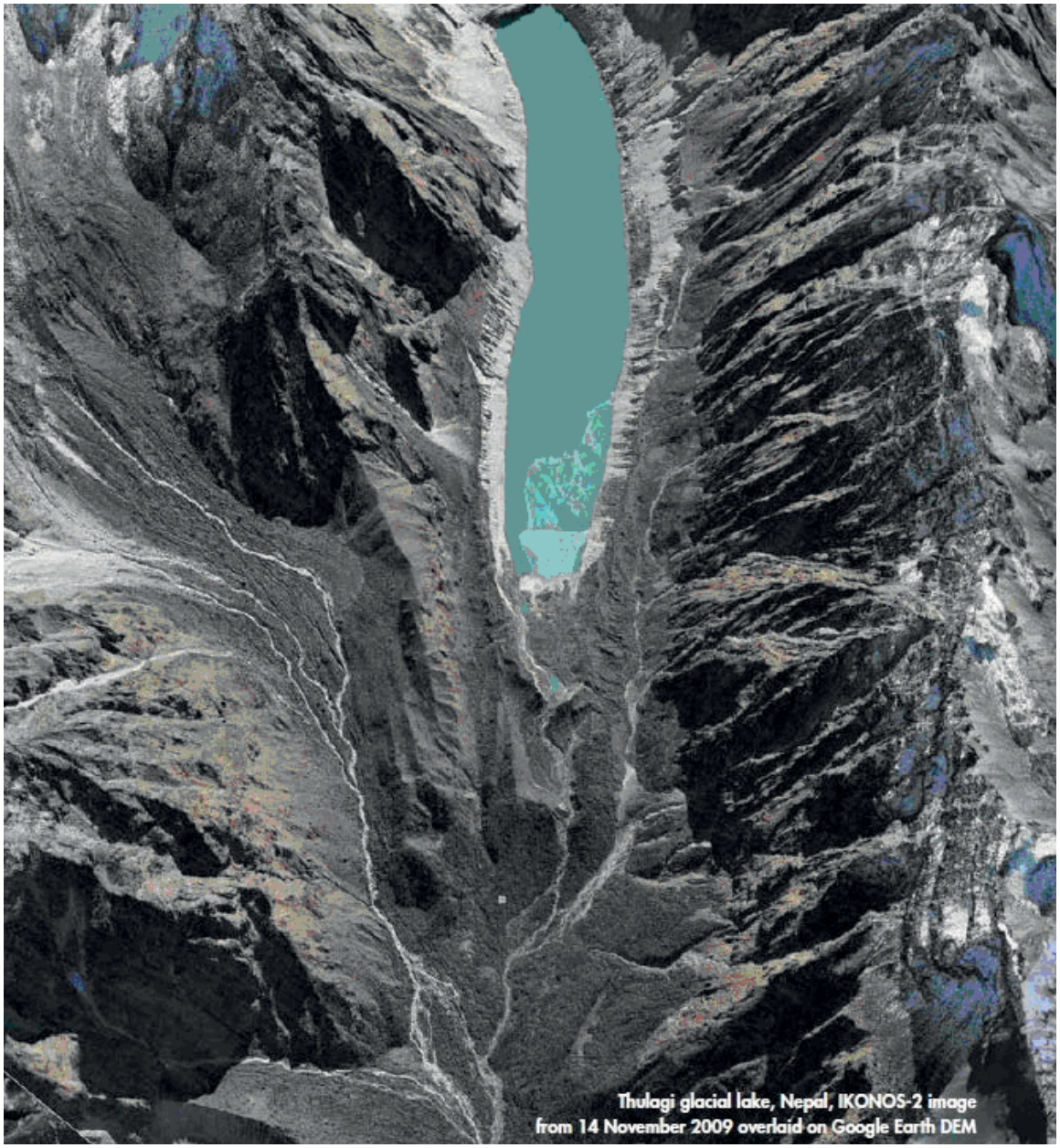
such as solar power, wireless connectivity and the Internet to provide hazard assessment and early warning functions.

5.2.3 Tools and techniques

The rapid development of technology-based tools and techniques and the improved accessibility to them now enables their wider use for DRM purposes. Access is increasing because of the widespread use of mobile telephones coupled with a growing demand for broadband Internet access. The development of additional tools and techniques such as mobile phone-based global positioning systems (GPS) and social networking services such as Twitter and Facebook, are rapidly expanding the adoption and use of advanced technology abilities for various DRM purposes.

The United States Geological Survey (USGS) has begun using the micro-blogging service Twitter to gather information about earthquakes around the world. This Twitter Earthquake Detection (TED) system has been reported (Skynews, 2012) as being even faster than conventional telecommunications methods in conveying the magnitude 7.9 earthquake that struck southern Philippines in August 2012. In addition to early warning and hazard alerts, GPS and satellite imagery are now used for disaster monitoring, disaster risk research and improved knowledge management with new applications now appearing with nearly every major disaster event.

Figure V.IV **Thulagi glacial lake, identifying previously unknown risks**

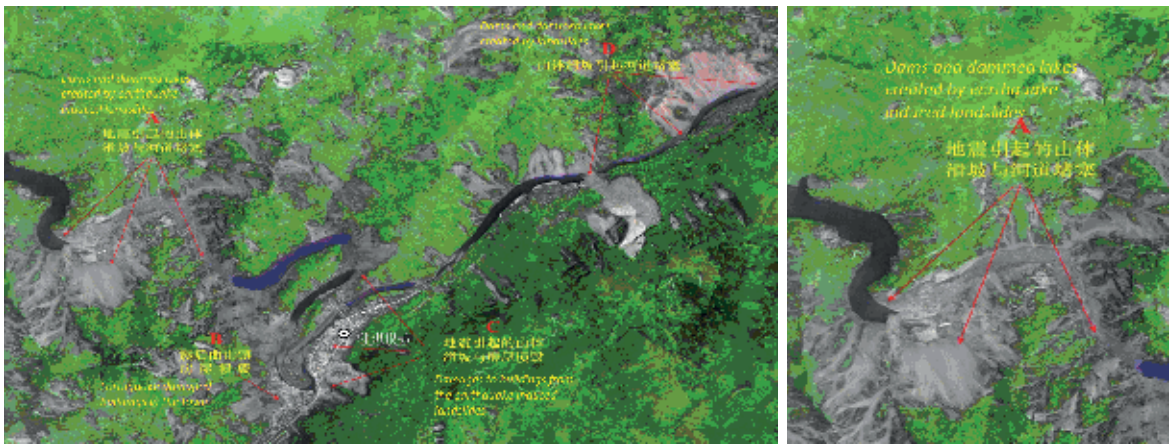


Source: Ives, Jack D. Rajendra B. Shrestha, and Pradeep K. Mool, Formation of Glacial Lakes in the Hindu Kush-Himalayas and GLOF Risk Assessment, (Kathmandu, International Centre for Integrated Mountain Development, 2010). http://www.unisdr.org/files/14048_ICIMODGLOF.pdf

The use of satellite broadband communications provides an effective alternate option for bringing connectivity to high disaster risk areas, including during disaster response and recovery periods. These systems provide Internet-based communications services called Internet protocols (IP) to bridge the gaps in the communications chain, especially when regular modes of communications are damaged or otherwise unavailable, as in post-disaster situations. Various kinds of IP devices such as low-powered radio access nodes called "small cells" have a range up to 200 metres. Other devices include "voice over Internet protocol" (VoIP) telephones, Wi-Fi wireless communications access points and ultra-very small aperture terminal (VSAT), which is a two-way satellite ground station or a stabilized VSAT with a dish antenna that is smaller than 3 metres.

Advances in EO, GIS and geo-referencing techniques mark another turning point in enabling a much wider use of their combined abilities such as in the preparation of maps emphasizing more precise

Figure V.V **Tangjiashan quake lake located by satellite image**



Source: China Centre for Resources Satellite Data and Application.

physical descriptions of geographic areas, capturing hazards, conditions of vulnerability and evidence of likely exposure. These uses allow for better monitoring and assessment of disaster risks, and when necessary, urgent response to crisis situations.

These beneficial uses are displayed by the flash flood that occurred on the Seti River in Pokhara, Nepal on 5 May 2012. Believed to have resulted from an outburst of a landslide-dammed lake, it resulted in 21 fatalities with twice as many people missing. With support from the United States National Aeronautical and Space Administration (NASA) and the Japan Aerospace Exploration Agency (JAXA), the International Centre for Integrated Mountain Development (ICIMOD) obtained access to pre- and post-disaster satellite images of the area. It then was able to use these resources and related spatial techniques for an initial disaster impact assessment. This provided critical information to the Government of Nepal enabling it to undertake a rapid field assessment of the site for rescue and relief which otherwise would not have been possible.

The use of these services and techniques are becoming more comprehensive as an increasing number of "multi-global navigation satellite systems" (mGNSS) become operational, enabling location-based services to produce geo-referenced precision products. Many disaster management authorities and emergency services are using positioning, navigation and timing (PNT) applications more frequently for disaster early warning and response as was done for the Seti River flood. PNT-enabled mobile phones can combine input from built-in cameras and global positioning system microchips. Rescue and logistics vehicles can now be equipped with GPS systems so they can be tracked and monitored for much more efficient route planning and deployment to priority areas.

5.3 Protecting human lives and assets through innovation

Reducing the damaging effects of disasters on human lives and assets has been the most fundamental objective for disaster risk reduction. In this regard, the principle of "the 4 Rs" for providing the "Right information at the Right time and Right place to the Right people" before, during and after disasters holds the key for effective disaster preparedness, response, and recovery. Earth observation (EO) products and services offer innovative and comprehensive solutions which can address critical information needs for mapping and monitoring elements at risk.

5.3.1 Protecting communities and assets at risk

The following case studies highlight the critical importance of timely and precisely focused information in saving lives and protecting economic assets.

Tangjiashan quake lake, Sichuan, China, 2008

Immediately following the Wenchuan earthquake in China, between 12 and 27 May 2008, 728 EO satellite images provided essential information for rescue work and became the initial basis for loss assessment. Using both archived and newly created satellite RS images, officials identified 56 landslides and eight

Box V.3 **ESCAP efforts in realizing "4 Rs" principle during Thailand floods, 2011**

During the peak of the Thailand floods, the Prime Minister of Thailand met with the Under-Secretary-General of the United Nations and Executive Secretary of ESCAP in the command centre of the FROC on 25 October 2011. During a briefing on the preparedness measures taken by the Government to deal with the flood emergency, the Thai Prime Minister expressed interest in obtaining real-time satellite data to enhance the monitoring capacity of the Government and to address the critical information gaps for evacuation, relief and rehabilitation. In response, ESCAP initiated several strategies starting with arranging the collaboration of international partners to provide near real-time satellite data to improve the quality of flood monitoring in the country. Additional arrangements were made to engage networks and to activate partnerships which could provide regular access to satellite data and long-term capacity development for DRM.

By working with Sentinel Asia, the International Charter - Space and Major Disasters and the United Nations Institute for Training and Research (UNITAR), ESCAP could enable GISTDA to access near real-time flood data from various global EO satellites. ESCAP worked through three related strategies: coordinating and aligning United Nations' resources; capitalizing on cooperation frameworks; collaborating and building partnerships for the access of data and long-term capacity development. This international support helped GISTDA access more satellite data, including information from commercial satellites, easily, more frequently and with greater precision for addressing immediate needs.

lakes formed by landslides triggered by the powerful earthquake.[2] The Tangjiashan quake lake (figure V.V) was the largest ever identified by satellite images. Containing 200 million cubic metres of water, it created a significant hazard to downstream cities with more than 1.3 million people, critical infrastructure and economic assets worth billions of dollars. The satellite images provided critical information for decision makers to assess the risk, issue urgent warnings and to arrange early response actions. These efforts contributed to protecting people's lives and economic assets.

Thailand Floods 2011

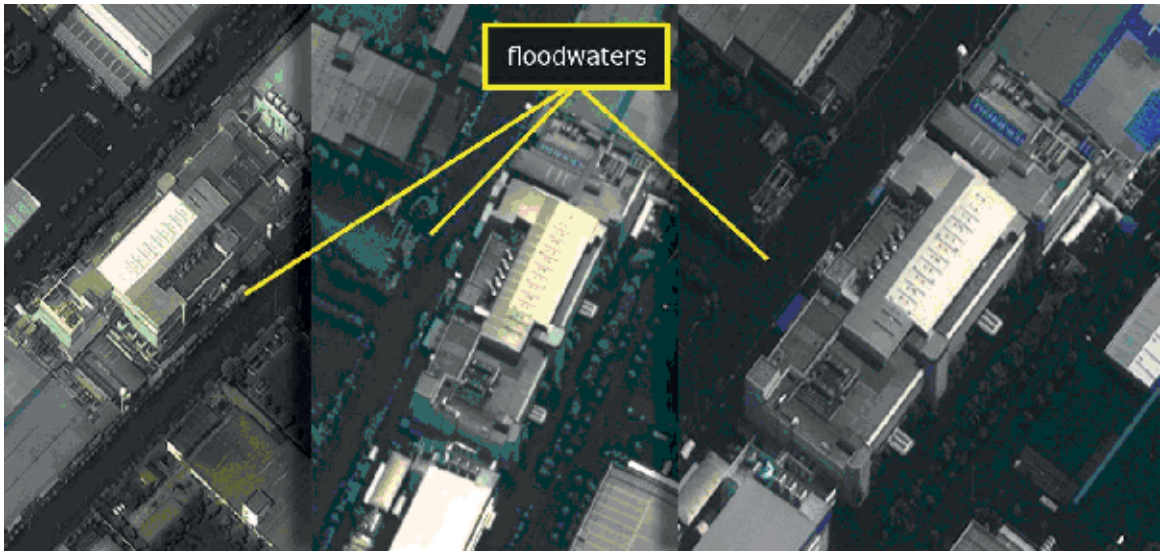
The Thailand floods in 2011 stimulated the extensive use of EO products and services. The actionable and near real-time information products were made possible through the key institutional support provided by Thailand's Geo-Informatics and Space Technology Development Agency (GISTDA) to the Government's Flood Relief Operation Center (FROC). In October 2011, during the peak period of flooding, GISTDA created a geo-informatics operation system and a satellite data centre, with an office located at the FROC to realize the "4 Rs" principle (box V.3). More than 1,500 images from global constellations of satellites were used for near- and real-time flood monitoring and damage assessment.

These information products were used at the FROC for daily reporting and also were provided to the Prime Minister of Thailand for decision-making. The near real-time flood maps derived from satellite data were the major source of information to support decision-making processes. Arrangements were made to acquire daily satellite data and flood map products were able to be delivered within four hours after acquiring the satellite data. These value added, near real-time information products served some of the most urgent needs such as identifying flooded areas, affected villages and populations; locating affected households; land use of the flood-affected areas; and determining the duration of flooding, among others. Actionable and value added satellite maps from GISTDA were also provided for public access online on a near real-time basis at www.flood.gistda.or.th.

There were other additional local, national and regional actors using these products in many ways. The EO products were customized by adding local languages and disseminated by FROC to warn people who were living in the flood risk areas to evacuate. Various channels were used to communicate this information including on the Internet at www.floodthailand.net, a telephone hotline with the easily remembered number, 1111, as well as by text messages that were sent through every mobile telephone service provider in the country. As satellite imagery is not always so easily understood by the public, many experts and public commentators assisted in communicating the

[2] Refer to http://space.cpst.net.cn/china/2009-10/256879725.html

Figure V.VI **Satellite images of a flood-affected location in Bangkok on 15 and 24 October, and 8 November 2011**



Source: Digital Globe Analysis Center. Flooding in Bangkok 2011. Firstwatch Report, Hard Disk Drive Facilities. (Bangkok, Thailand, accessed 16 November 2011).

messages provided by the satellite imagery. They accomplished this by combining satellite observations with other media such as posters and charts (figure V.VI and figure V.VII) and explaining the issues in vernacular language.

5.3.2 Broadband satellite communication platforms for disaster preparedness

Emergency communications continue to demonstrate their critical roles for disaster preparedness. They are often given more priority as it is well established that keeping communications infrastructure ready for disaster preparedness pays dividends in the future. A good example of the usefulness of these platforms was demonstrated when New Zealand Fire Service decided to install a satellite platform in 17 of its rescue vehicles to relay and coordinate information through combined Internet, email, and VoIP services. The high-speed bandwidth capacity of the platform and the nationwide communication coverage enabled the transmission of real-time, high-resolution video and images from any location in New Zealand at any time. When the devastating earthquake struck Christchurch in New Zealand on 22 February 2011, vehicles equipped with this platform were deployed within hours. This enabled the New Zealand Fire Services to provide a dedicated channel of communications at any time and from any place.

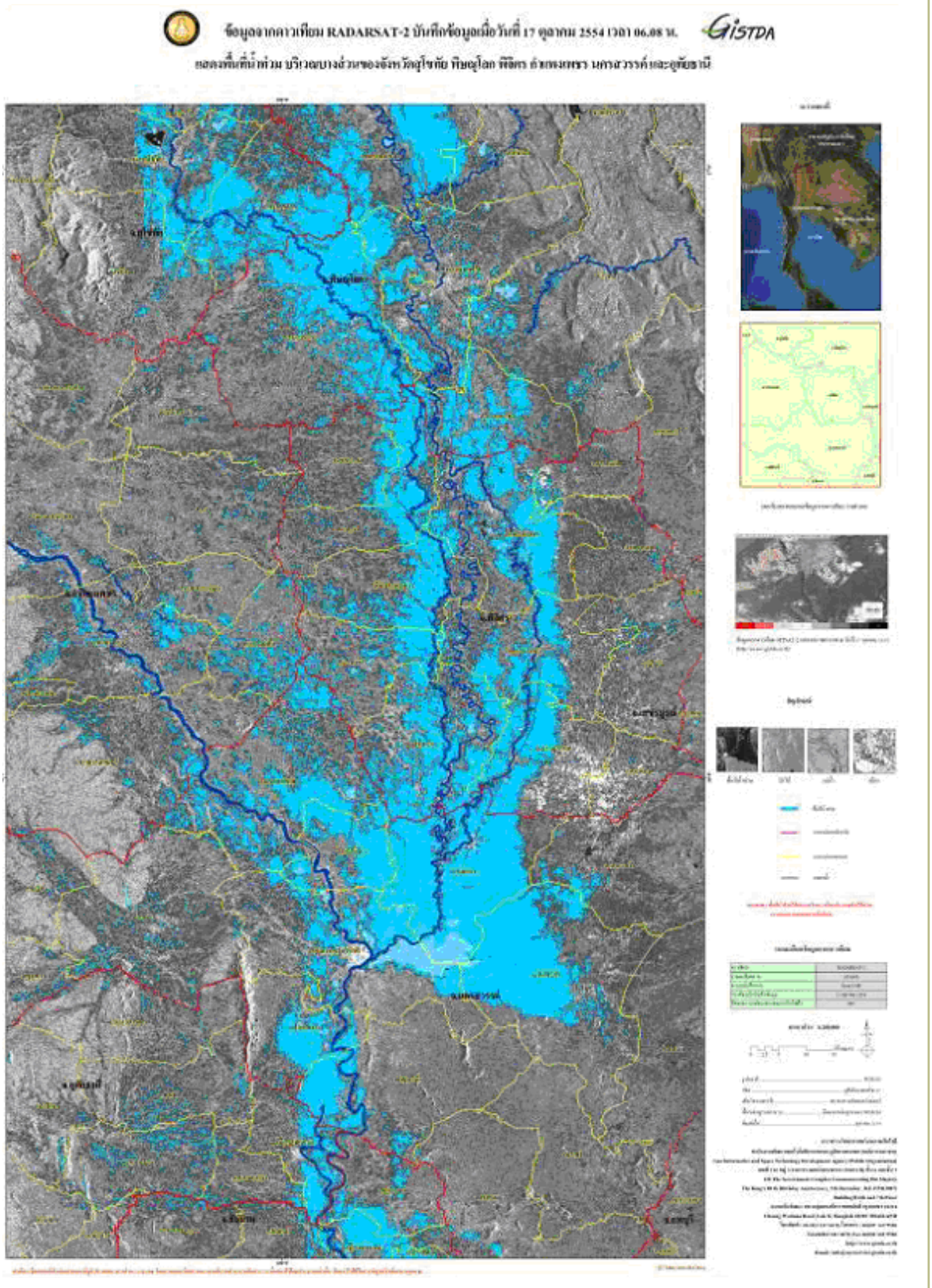
5.3.3 Social media for disaster risk reduction

Social media allow communities of users to exchange information about hazards or developing crises rapidly and to foster interaction with official authorities and relief agencies. It has proven to be most visible though in terms of expanding information flows in all directions among the public at large at the time of a disaster, although potential also remains for its wider use in terms of preparedness and later recovery activities. These uses of social media and crowdsourcing can result in significant impacts in saving lives and assets.

Although many official agencies are rushing to increase their capacities to harness the huge flow of data generated by social media for more timely and effective actions, the full potential use of social media for beneficial DRM remains in its early stages. These changes are transforming disaster risk management outlooks and planning assumptions both by raising new opportunities and creating new challenges for authorities in charge of organizing and implementing the entire range of DRM activities. The role of social media at the time of crisis can become even more beneficial to the extent that its use is anticipated by public authorities.

Social media played an unprecedented role in the 2011 Thailand flood events, with massive increases in the use of Facebook, Twitter, and YouTube, among

Figure V.VII **RadarSat-2 image for flood monitoring in Thailand**



Source: GISTDA, (2011). http://flood.gistda.or.th/flood/y2011/FL80_report/rd2_20111017_rad_55_0045_0046.pdf (accessed 4 September 2012).

other examples.[3] Many private initiatives also emerged spontaneously to provide updated flood, assistance and recovery information to the public. There were also several official initiatives using social media on behalf of Thai authorities including:

- the launch of the www.floodthailand.net website which included information and interactive tools,
- the creation of an official Twitter account @ FloodThailand by the Thai Ministry of ICT,
- use of social media (Twitter, Facebook and a website) by the Bangkok Metropolitan Administration to communicate with the public about the floods,
- communicating with the public through Twitter and Facebook, among other means by various other government entities such as the Provincial Electric Authority and the Royal Irrigation Department.

Earlier in 2011, social media also played a critical role during and after Japan's Great Earthquake and Tsunami. While all types of social media were employed to considerable effect, Twitter attracted particular attention. When power was lost in many places, Twitter often was used from smartphones. This proved to be vital in allowing users to exchange information, sometimes in very perilous circumstances. Twitter use peaked to unprecedented levels in the hours that followed the disaster (Kaigo, 2012). One of the advantages of large public communication platforms such as Twitter in crisis situations is that they can bear the load of heavy increases in traffic while more traditional telecommunications systems or websites collapse.

The analysis of Twitter use during and immediately after the disaster indicated that people in the disaster areas used it to call for assistance in life-threatening situations, to report the conditions of others and to obtain lifesaving assistance for them (Acar and Yuya, 2011). More generally, it was used to post information about evolving circumstances where people were threatened, including in potential life-threatening situations involving fires and explosions. For people in more secure locations, they tended to use Twitter to share information about changing conditions and to try to understand the situation better, including about the fate of friends and relatives.

In both the cases of Japan and Thailand, social media proved to be very useful in addressing the crisis situation. Common features emerged which are worth considering for the future. These included the occasional use of social media to transmit rumours and false information, and although this was infrequent its occurrence disclosed that there was little that could be done to stop this behaviour which caused additional unwanted stress. One example of the confusion which was caused occurred when people re-tweeted messages requesting rescue or assistance for people who had already been rescued, resulting in the loss of time and unnecessary exposure for the rescue services. Another observation from recent experience was that the proliferation of "hash tags"[4] related to the events in Twitter communications made it difficult for users to identify which channel to follow.

Recent use of social media in several disaster situations demonstrates the key importance of Government designating a central authority for official information and coordinating its communication through social media. Targeting and localizing information is also extremely important. While a social media presence by government agencies should target "myth busting" at the time of a crisis, it is even more important to anticipate and launch a social media service prior to the occurrence of a disaster event. By acting on such foresight, the communications team and procedures can already be in place and are practiced before critical needs arise.

Crowdsourcing offers considerable opportunities for both preparedness and emergency response activities. Crowdsourced mapping was used in Pakistan during the floods in 2010 (Chohan and Vaughn, 2011), relaying vital information from disaster-stricken areas. Among other lessons from that experience, early coordination and the definition of clear cooperation mechanisms between the various parties involved need to be accorded primary importance prior to the occurrence of a disaster. Forethought and anticipation can contribute to prior consideration of such untraditional but increasingly crucial actors as crowdsource mapping designers, information feedback curators, space technology specialists, telecommunications operators and their respective operational relationships with established disaster management authorities.

Although they are not the same as social media, publicly accessible "open" geospatial technology and integrated GIS share some of the attributes of wide application and transparency of publicly sourced information. They are therefore increasingly useful tools to be employed in preventing and responding

[3] Twitter use spiked by 20 per cent during the floods, while in 2011 Facebook membership in Thailand rose from 7 to 12 million people according to Socialbakers, See Agence France-Presse (AFP), "Social media use soars in flood hit Thailand", 5 November 2011.

[4] The # symbol, called a hashtag, is used to mark keywords or topics in a message sent through Twitter, commonly known by users as a "tweet".

to both extensive and intensive disasters. Open forms of geospatial technology includes open data, open source software and open geospatial standards which all possess the advantage that they can be quickly and widely used. For example, crisis mapping systems based on Social Networking Service and open geospatial technology were launched immediately after earthquakes occurred in Haiti, New Zealand, and Japan since 2010.

Governments need to anticipate and to adopt social media strategies in order to ensure social media's benefits are maximised in terms of disaster preparedness and response. Since social media use in DRM is still in its infancy, more research and analysis is required to identify best practices. In the meantime, governments and the international DRM community need to remain open and engaged with monitoring and exploiting this new area of applied social media, and more generally, other "Web 2.0" advanced communications technologies.

5.3.4 The roles of innovative technologies in disaster supply chain management

As discussed at some length in chapter 4 of this report, global supply chains typically are composed of firms, suppliers, transportation and distribution links and labour that link production networks, cross-border businesses, and eventual customers, clients or consumers. In addition to their commercial roles, supply chains are essential elements in the activities necessary for responding to crisis situations and disasters. They are most evident in their logistical functions of obtaining, delivering and distributing emergency relief assistance or later recovery materials to the people or areas affected by a disaster. Supply chains are critical components of all DRM activities, but they also can be vulnerable to the increased urgency and disrupted operational conditions imposed by crises.

At the time of a disaster, the availability and access to large quantities of food, water, medical, shelter and other basic human and material needs literally becomes a matter of life and death. Even following a disaster it is critical to maintain the most effective supply and logistical chains possible so as to avoid compounded crises of food insecurity, extraordinary price inflation, reduced trade and export opportunities with potential long-term consequences for the society and the State. In order to work, supply chains and their various integral functions all depend on abundant information which can be quickly and accurately provided. In this respect, ICT and the use of space technology can become essential components of effective disaster management.

ICT and space technology can assist and help improve the general supply chain methods followed in situations of disasters. Satellite imagery, wireless communication systems and satellite-based positioning and navigation systems can help change the outlook of the approach followed by supply chain management in disaster-related circumstances. Satellite images can provide the key locations of the supply chain affected by the disaster, the amount and kinds of impacts on the abilities to access or supply essential commodities and material. Wireless communication systems are easily transportable, battery-powered, rugged and operate without technical support. All types of transport vehicles can be installed with satellite tracking systems in an effort to maintain continuous contact with vehicles in-transit and to monitor them globally. The delivery of shipments must be dependable and reliable particularly at the time and under the conditions of a disaster, so satellite navigation can become indispensable when other forms of guidance are likely to be inoperable.

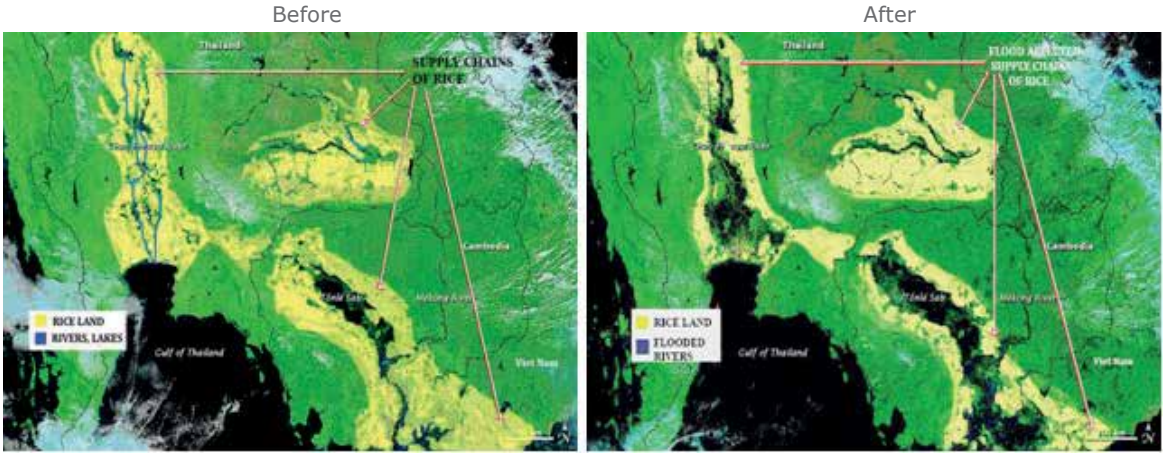
The following case studies analyse another dimension of how space technologies specifically can provide additional benefits in managing crucial food supplies and related economic considerations during a disaster.

South-East Asia floods in Cambodia, Thailand and Viet Nam, 2011

Around 70 per cent of the total global rice export trade involves rice produced in South-East Asia. Therefore a disaster in this area can seriously disrupt the supply of rice to other parts of the world, as was seen after the 2011 floods in South-East Asia. The flooded areas of Thailand covered 12.5 per cent (Chachavalpongpun, 2011) of total cultivated land with the result that its rice production was reduced by 1 million tons (USDA, 2011) for the year. In Cambodia, 10.7 per cent (WFP, 2011) of all crops were destroyed. Also the thousands of hectares of rice which were destroyed in southern Viet Nam had a significant impact on local food supplies as well as globally. Overall, South-East Asian rice exports decreased by 3 million tons (FAO, 2012) resulting in shortages of rice and increased prices internationally.

In such adverse situations of limited supply, the first step for emergency supply chain management is to identify the affected locations and to try to assess the impacts and resulting needs of the affected population.

Figure V.VIII **Satellite images of rice production areas in South-East Asia, before and after flooding**



Source: MODIS NASA Terra satellite, Nov 2008 and 2011 (Scale 1 unit = 100 km). http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=76291 (accessed 4 July 2012).

This can be a difficult task, especially when a large area like most of South-East Asia is affected. Many types of critical information are required immediately. Satellite imagery provides decision makers with descriptive information and accurate positional data about resources that are spread across many kilometres of terrain. The satellite images in figure V.VIII illustrate conditions before and after flooding in South-East Asia, providing essential information about conditions of supply. The earlier image displays the major rice producing areas of South-East Asia and the later one clearly shows how those areas are seriously affected by the floods.

This type of information can be refined to observe a specific location like the Chao Phraya River (figure V.IX) by using satellite-based positioning and navigation systems. The technology can obtain and provide further relevant information like the identification of inaccessible warehouses, the amount of crop losses, or the condition and potential use of transportation routes like roads, highways or railways which may be impassable. High resolution satellite imagery can help to determine evacuation routes, evaluate alternate transport routes and locate sites suitable for temporary dwellings or sources of water. All of these functions, and many more, are critically important for enabling emergency logistics specialists to make more timely and better informed decisions, quicker.

In the case of such major floods, when communication becomes even more vital for coordination throughout the entire supply chain, the general means of communication and infrastructure is easily hampered. In such situations, satellite communication becomes very useful. Managers can use the information derived from these techniques to communicate with and coordinate other elements of the supply chain to maintain sufficient inventories, meet demand at various or shifting destinations, schedule labor requirements, or to reroute shipments under changing circumstances or crucial needs (Rishel, Scott and Alan, 2003). A practical, but absolutely crucial advantage of these systems is that they easily can allow for revised delivery instructions or to communicate urgently required actions for goods in transit. With space technology, vehicles can be tracked continuously by satellite systems enabling greater efficiencies, improved security and better accountability through constant monitoring from distribution offices or logistics headquarters.

Pakistan floods 2010

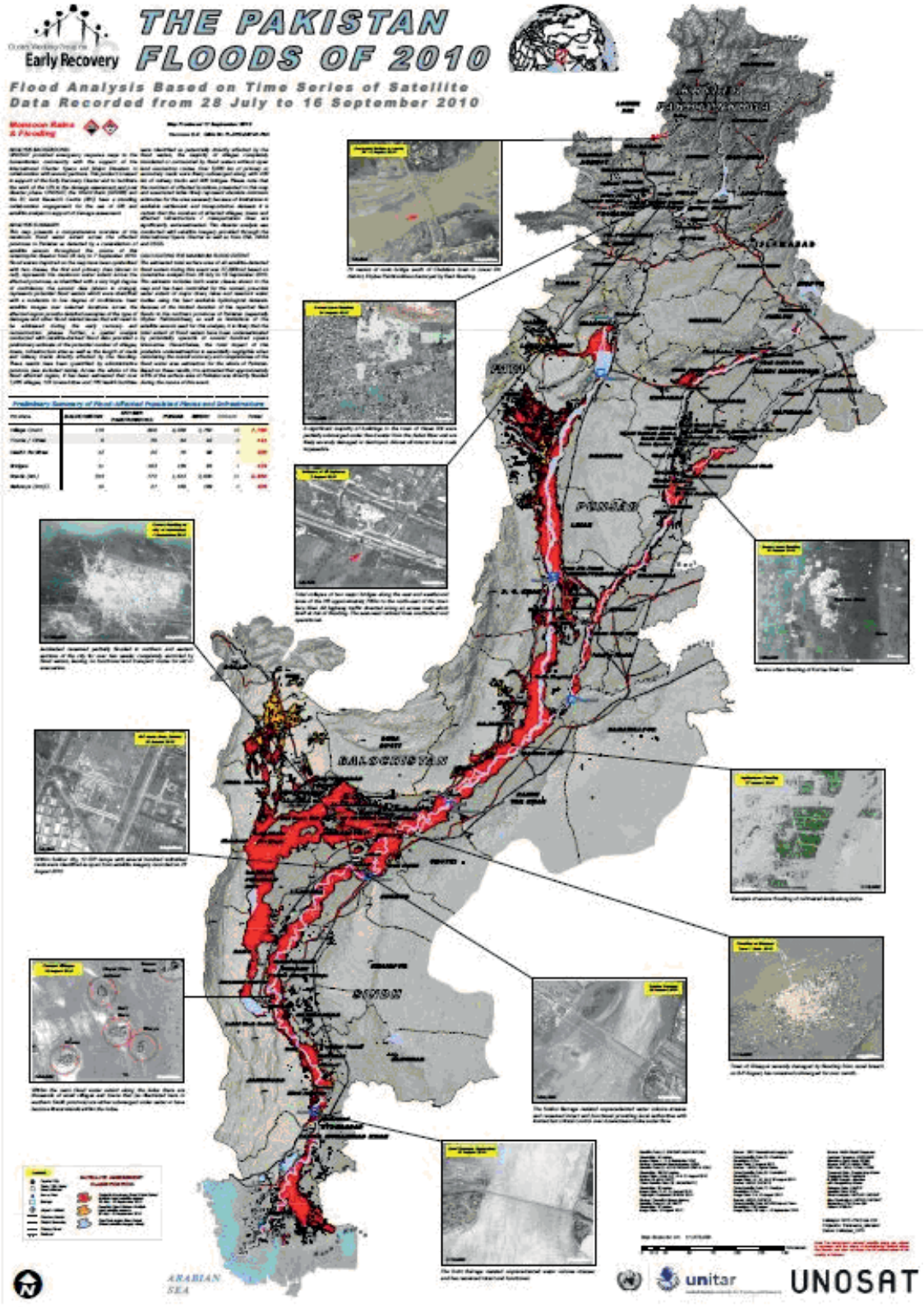
Pakistan is among the top five rice exporting countries in the world, but in 2010 its rice exports were reduced by 30 per cent (USDA, 2011) because of the extensive floods that swept through much of the country. This resulted in FAO's mean price index for Pakistan increasing by 13.7 per cent. Effective supply chain management becomes crucial in such situations and satellite images like figure V.X can provide the necessary information for these disrupted circumstances. It illustrates real-time information about the impacts on each aspect of the entire food supply chain of Pakistan at the time.

Recent studies of some of the world's most isolated wilderness areas were conducted with the aid of satellite-based positioning and navigation technology to gather valuable contingency information for later

Figure V.IX **Satellite image of flooding along the Chao Phraya River, October 2011**

Source: UNITAR/UNOSAT image. http://www.unitar.org/unosat/node/44/1608 (accessed on 30 August 2012).

Figure V.X **Pakistan floods, remotely sensed time series analysis, 2010**



Source: UNITAR/UNOSAT image. http://unosat-maps.web.cern.ch/unosat-maps/PK/FL20100802PAK/UNOSAT_PAK_FL2010_EarlyRecoveryOverview_v2_LR.pdf (accessed on 29 August 2012).

assessment of damaged areas and to evaluate techniques to meet urgent requirements, often under arduous conditions (Walter, 1990). Gathering accurate, more current and timely information for better decision-making has been a frequent challenge for both Governments and private organizations, but it can now be greatly facilitated by the use of space technologies. The information provided by the images in figure V.X contributed to identifying regions in need of assistance, the quantity of resources required, limitations to transportation access, and related damage to routes and facilities. All of this information aided emergency logistical operational planning.

To illustrate this point, Jacobabad is an important location for rice cultivation and milling and can be seen completely encircled by floodwaters, without any access for land transportation (http://www.jacobabad.gos.pk/index.php?option=com_content&view=article&id=55&Itemid=63, accessed on 20 July 2012). Another location for rice cultivation, Dir, was affected by flash floods, collapsing two major bridges on Pakistan's longest highway, running from the port city of Karachi (UNDP, 2010). This created a serious difficulty in transporting food supplies. Pakistan's liner shipping connectivity index which indicates how well the region is connected globally (UNCTAD, 2011), further stressed the impacts that the floods in Pakistan were having on the global supply chain. The severity of the extended consequences from the flood disaster can be seen by the additional impacts which it exerted on the production and transportation of the country's food supply.

As elaborated in chapter 4, supply chain management can experience several critical limitations when faced with a disaster, even if it occurs far away. These can rapidly become extremely costly interruptions for essential services and supplies, but advanced communications and space technologies can address some of these problems with increased levels of safety and efficiency, worldwide. Space technologies are unaffected by extreme environmental conditions and can be well-suited to the delivery of emergency relief assistance, container tracking, asset visibility and remote monitoring throughout extended supply chains in the following ways:

- In logistics, global real-time visibility contributes to ensuring products and services can reach their destinations in the safest, most economical and timely fashion that conditions will permit.
- In navigation and tracking, monitoring the progress of shipments and transport conditions around the globe on a real-time basis reduces the occasions of lost or misdirected products, and lowers related operation costs.
- In emergency response, aiding search and rescue efforts, speeding the delivery of emergency services and disaster relief and minimizing security incidents or transportation accidents through advance information of threatening conditions can save lives.
- In system management, connecting field users with senior managers provides more comprehensive and timely coordination of thousands of assets worldwide.
- In asset visibility, managing and updating multiple transactions improves operational status through a global network of partners and customers.

5.4 Addressing the critical aspects of effective disaster risk reduction

Some of the most impactful applications of innovative technologies in supporting HFA implementation for DRR have been in data acquisition, mapping and monitoring of extensive and intensive risks. These abilities have proven to be key technical inputs especially for HFA priority actions 1 (policy and institutional commitment), 2 (risk assessment and early warning) and 3 (information, knowledge and education). Some other related functional applications are outlined below.

5.4.1 Empowering vulnerable populations

With the advance of these technologies, many activities that enhance the safety of vulnerable populations, especially for children and the ageing community, are developed and demonstrated in the society. For example, an innovative GPS watch and tracking device, combining positioning services and mobile communications, has been developed for older people in China. The user is able to make a previously designated emergency call allowing family members to monitor older people through a web-based position query. Besides the senior members of a community, this device could easily be adapted to monitor the location of children especially in crisis situations. Further, by using ICT applications to assist in broadening the awareness and enhancing the capacity of the public, and particularly members of vulnerable populations, they can become more involved in wider public efforts to create safer and more resilient societies.

5.4.2 Resilient land-use planning through climate change adaptation and disaster risk reduction applications

Many disaster risk reduction measures have similarities with climate change adaptation (CCA) programmes. Synergies between DRR and CCA add

compound values to projects through lessons learned from the various perspectives of different disciplines; they also obtain optimal benefits from scarce resources by avoiding the duplication of efforts. This convergence between DRR and CCA approaches has become evident in certain types of projects. As they are identified and their success factors distilled, they need to be promoted more widely, scaled-up when practicable and replicated in locally relevant applications elsewhere.

Regional cooperation has a particular role to play in advancing integrated or comprehensive programmes such as integrated coastal zone management, river-basin floodplain management, watershed development, integrated drought mitigation and land-use planning in areas sensitive to climate and disaster risks. It is important to highlight that EO information products inform and can shape the essential components necessary to realize these projects.

There are enabling mechanisms for integrating DRR and CCA through increasing the opportunities to share and expand the use of appropriate technologies. Tools and techniques used for DRR can be integrated into CCA strategies in early warning systems, hazard, risk and vulnerability analysis, risk assessment and monitoring, and risk mitigation, and contribute to the preparation of response strategies. They can also be applied in additional critical sectors like public health, food, water and environmental security, agriculture, forestry and infrastructure, among others. There are success stories and good practices demonstrating integration which should be replicated more widely, even as there are other applications like GIS techniques and integrated assessment programmes which can be scaled for more localized benefits.

In the specific context of SIDS' vulnerability, there is the important "Low Emission Climate Resilient Development" (LECReD) initiative being pursued as a "One UN" programme. It is being pursued by the Government of Maldives, jointly with the United Nations Country Team and the Regional Integrated Multi-hazard Early Warning System (RIMES) to reduce the scale of otherwise applicable global climate change models (GCMs). This joint effort incorporates historical data, including EO products and reports addressing climate change in the Maldives in order to analyse significant climate change risks for the country (figure V.XI).

Figure V.XI **Maldives Low-Emission Climate Resilient Development project, by Earth observation**

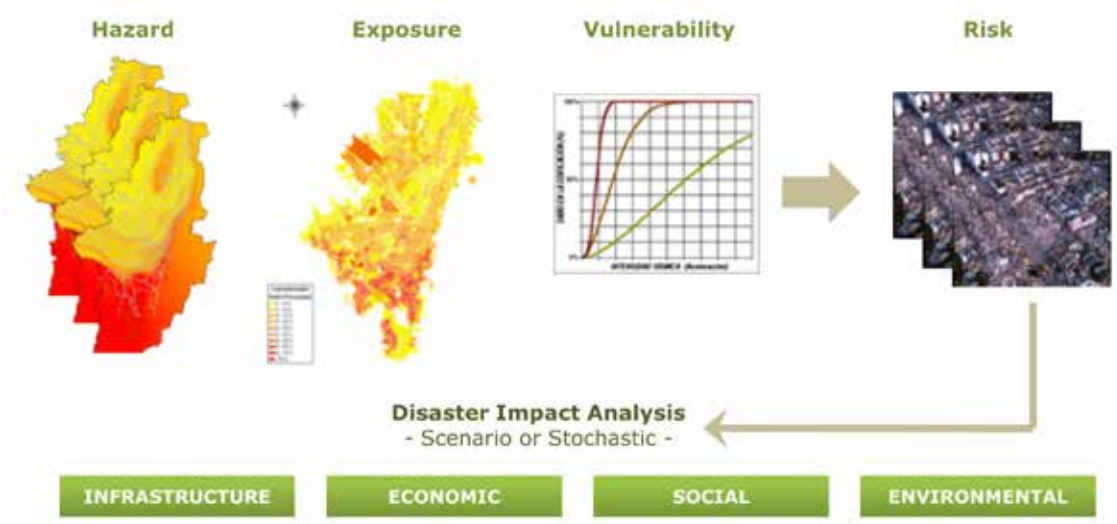
Source: UNITAR/UNOSAT image. http://unosat-maps.web.cern.ch/unosat-maps/PK/FL20100802PAK/UNOSAT_PAK_FL2010_EarlyRecoveryOverview_v2_LR.pdf (accessed on 29 August 2012).

5.4.3 Geospatial modeling for risk-sensitive land-use planning

Risk-sensitive development planning is central to advancing national DRR strategies. In this regard, the Central American Probabilistic Risk Assessment (CAPRA) has been effective in facilitating well-informed risk-sensitive decision-making process across the major development sectors such as territorial planning, public investment and the financial sectors. In the context of Central America and Caribbean, CAPRA has demonstrated sector-specific applications for risk reduction (figure V.XII). Based on remote sensing and GIS applications, CAPRA makes use of geospatial data and probabilistic models for risk evaluation (World Bank, 2012).

In the Asia-Pacific region, catastrophic risk modelling is an emerging area with several operationally demonstrated applications in the high seismological risk areas of Japan and Turkey. In the multi-hazard contexts of Bangladesh, India and Maldives, geospatial catastrophe risk modelling has provided a basis to assess the nature of hazards and the exposure and vulnerability to catastrophic shocks. It equally can

Figure V.XII **Geospatial risk assessment framework for resilient sectoral development planning**



Source: Ghesquiere, F. The Use of Probabilistic Risk Modelling to Guide Vulnerability Reduction: The Case of Bogota, Presented at the Asian Conference on Disaster Reduction. (Colombo, 13 June 2011).

assess the effects of natural hazard consequences on housing and public infrastructure (World Bank and UNISDR, 2010). Consisting of stochastic, hazard, vulnerability and financial modules, the model addresses wide-ranging issues of risk management and offers geospatial solutions to facilitate resilient sectoral development planning.

5.4.4 Resilient recovery

Satellite data have become an essential information source for damage and loss assessments generally and for post-disaster needs assessments (PDNA) specifically. In this regard, a case example from the Pakistan floods in 2010 is highlighted below.

Pakistan made extensive use of EO products during the 2010 floods to support humanitarian assistance, as well as to conduct a preliminary damage and needs assessment. The progressive flooding which started in July and continued through various parts of the country until November 2010 was captured by a constellation of satellites. All of the images and additional value added products were placed in the public domain and were widely available. This action assisted decision-making at different levels of government as it also provided a wide variety of images that were relevant to various government departments. At the national level, Pakistan's Space and Upper Atmosphere Research Commission (SUPARCO) worked closely with the National Disaster Management Authority and provincial governments to provide EO information products which served as the only reliable means of information about the national extent of the flood and the resulting damage to infrastructure and agriculture (Iqbal, 2012).

A joint team comprising experts from the Government of Pakistan, the Asian Development Bank, and the World Bank used EO information products for damage assessment, as a part of the preliminary damage and needs assessment. The team commissioned SUPARCO to produce independent validation data on the damage caused by the flooding. GIS and satellite imagery was used to map the extent of inundation and to estimate the detailed damage to housing, agriculture and transportation facilities in the affected areas (ADB and World Bank, 2010). With its experience of using EO products extensively during these floods, the Government of Pakistan has since established a task force prior to each annual monsoon season to plan for contingent disaster management support using satellite-derived data in case of flooding in any part of the country.

5.4.5 Enabling risk governance frameworks

Relying on an e-government[5] network in addition to basic demographic information and extensive GIS data, countries in the Asia-Pacific region are establishing comprehensive national disaster database

[5] E-government refers to the process of restructuring internal government processes and improving information exchange systems in government institutions with the use of ICT, for the purpose of improving public service delivery.

Box V.4 **The Asia-Pacific Gateway for Disaster Risk Reduction and Development**

The Asia-Pacific Gateway for Disaster Risk Reduction and Development is a platform created and managed by ESCAP for integrating DRR experience and information into development planning. The gateway enhances regional access to information on good practices, policy options, methods, tools and programmes on disaster and risk management related to key development sectors. It serves as a regional portal that provides quick and easy access to networks and organizations across the region and facilitates value-added regional analysis.

This regional information gateway will serve policymakers and decision makers in the region focusing on the information and networking needs of national DRM authorities and line ministries involved in national development frameworks. The regionally aggregated data and information can also address the interests of academic and research institutions, NGOs, international organizations and donor agencies.

Specific objectives of the gateway include:

- improving access to DRR information and related policies,
- collecting and analysing regional DRR information and data,
- creating a regional online network of DRR practitioners,
- enabling users to participate in online discussions,
- collating and reviewing existing national development plans for all Member and Associate Members States of ESCAP,
- establishing partnerships to share knowledge,
- profiling regional cooperation mechanisms, and
- maintaining a database of national disaster management agencies or organizations, national planning authorities, development networks and organizations working with DRR in the region.

The gateway is available at http://www.drrgateway.net.

and information platforms for sharing disaster-related information among States and government departments for intersectoral collaboration (box V.4). These efforts encourage more effective use of combined information resources at all levels and contribute to improving the identification, assessment and monitoring of disaster risks, as well as enhancing early warning and preparedness practices. As an example, Thailand has begun to develop a national disaster data warehouse that will collect standardized data from the provinces and aggregate the data on a national basis.

Similarly, a disaster early warning and inter-agency consultation and information sharing mechanism has been established in China to provide more effective identification, assessment and monitoring of disaster risks and support for decision makers. As a result, a three-dimensional monitoring network of satellite remote sensing and data transmission, ground monitoring stations and air-borne monitoring segments are linked to the system. Resulting satellite-based information is being used to prepare a series of scaled natural hazard-based risk maps at national (1:100,000) and provincial (1:250,000) scales, and for use by city and counties in disaster-prone areas (1:50,000).[6]

An integrated GIS system that allows information to be shared among government departments has proven to be extremely useful following the Great East Japan Earthquake. Urayasu City, a densely populated residential city of 163,000 people near Tokyo had been using integrated GIS since 2000 when the city experienced serious ground liquefaction. With the system already in place, after the 2011 earthquake, the municipal government was easily able to identify the location of damaged buildings, infrastructure and lifeline facilities and could map the citywide distribution of elderly and disabled people quickly (Japan, JCA, 2011).

[6] Refer to http://www.china.com.cn/policy/txt/ 2007_08/14/ content_8682007.html

5.5 Strengthening disaster risk reduction through innovative technologies

It is universally recognized that capacity development is an indispensable factor for accomplishing successful management and a reduction of disaster risks. The introduction and wider use of innovative technologies in capacity development for DRR can catalyze systems, encourage contemporary reform and streamline the processes involved. It opens new channels of information acquisition and exchange, facilitates multi-stakeholder participation and cooperation, and provides new ways of learning.

Technologies are enablers and facilitators in capacity development processes. To successfully leverage these tools and techniques in capacity development for DRR initiatives, it is important to understand their benefits as well as constraints. It is crucial to assess the development context of the country and the existing ICT or other capabilities involved, and follow good project management practices. Programmes that put technology before users' needs and process requirements often fail (Macapagal and John, 2011).

In managing databases and information systems, challenges often arise that are more political and social than technical. They may include issues concerning ownership of databases or systems and their sustainability; standards for data collection, validation and analysis; training in the use of the software applications; and people's overall understanding and acceptance of newer technologies as part of their everyday work. The pursuit and adoption of strategies which can allay these concerns, or better overcome them through the development of increased capacities are critical for success. The following discussion elaborates on some of the existing programmes and mechanisms which are being used to advance the use of innovative technologies in DRR practice.

5.5.1 Using innovative technologies in capacity development for disaster risk reduction

Capacity development for DRR is complex as it is required at three tiers of engagement: with individuals, within and among organizations, and within the wider enabling environments of societies. It is multidisciplinary, requires the involvement of many stakeholders and depends on a series of relationships spread across various communities of practice.

Fortunately, the growing demand for information and communication services is matched by the rapid advances in technological innovation, growing infrastructure and falling prices so that more people can participate in the modern "information society" regardless of their physical location. Almost 90 per cent of the world's seven billion people are now connected in some way to ICTs (UN-APCICT, 2010). There are many success stories in Asia and the Pacific where ICTs and other innovative technologies are being used to reduce disaster risks, including through their contributions to capacity development for DRR (ITU, 2011).

The United Nations Capacity for Disaster Reduction Initiative (CADRI) encompasses several of the motivating elements involved. This joint UN programme, which has emerged from the rise in international DRR policy interests since the adoption of the HFA in 2005, has identified four key capacity development actions (UNDP, OCHA and UNISDR, 2012); ICTs have important roles in all of them. The first is institutional strengthening, or the development of policies, practices and systems that allow for effective functioning of society, an organization or group. In this context, e-government has become "a means of enhancing the capacity of the public sector, together with citizens, to address particular development issues" (UNDESA, 2010). Many countries, regardless of their economic standings and national wealth, have embraced e-government. Where it is practiced, e-government has generally improved public sector efficiency and effectiveness, including in DRR operations and service delivery.

Many international organizations have information management systems and networks in place to organize and disseminate information, share knowledge and coordinate activities. Moreover, numerous institutions in the public and private sectors, and civil society have use a variety of ICT applications such as remote sensing, GIS, databases and information management systems. These applications can improve institutional capacities in collecting and analysing large amounts of data on hazards, vulnerabilities, risks, impacts and losses of disasters, and converting these into information useful for decision-making.

The second domain of capacity development actions for DRR identified by CADRI is leadership, which is essential for effective communication. ICTs provide new and additional ways to connect with people and institutions to communicate a shared vision, advocate for change and build support and to sustain networks.

With newer forms of communication, in particular the Internet and mobile phones, previous constraints on the place, time and opportunities for interaction have eased considerably. ICTs provide alternative channels to maintain a continuous dialogue with different groups of people, and allow leaders to monitor DRR interests and initiatives more closely. A variety of technologies ranging from radio broadcasting to Internet-based mapping applications can support the creation and dissemination of relevant DRR-related content by leaders. Web 2.0 and other new media applications such as blogs, video-sharing and social media networks (e.g. Facebook) all provide useful means for leaders to share their knowledge and experiences, and also to engage in wider networks to learn of people's immediate concerns for a safer society.

Knowledge is the third domain of capacity development noted by CADRI, as it encompasses the creation, collection and diffusion of information and expertise leading towards more widespread or effective DRR solutions. Many online portals with disaster risk-related resources are accessible through the Internet.[7] They present a dynamic collection of news about disaster risk and provide access to many training materials, maps, videos, research studies as well as many links to other resources useful in capacity development for DRR.

The Web 2.0 phenomenon has added a collaborative dimension, providing online opportunities for innovative peer learning at different levels of sophistication and covering a wide range of personal and professional experience. The number of online communities of practice and discussion groups sharing their DRR knowledge and experience has grown exponentially in recent years. PreventionWeb (www.preventionweb.net) enables individuals to contribute resources, announce events and follow experiences elsewhere through many related professional disciplines, technical institutions and academic programmes, as they also seek or post new organizational contacts. This "portal of DRR portals" also provides free tools and advice for anyone interested in online communities related to DRR issues. As of March 2012, 23 private communities and 193 public networks dedicated to DRR activities were registered and accessible on PreventionWeb.[8] Within the region itself, the Asia Disaster Risk Reduction and Response Network (http://www.adrrn.net), Duryog Nivaran (http://www.duryognivaran.org) and UNISDR's Asia Partnership for DRR (http://www.unisdr.org) are some examples of networks that facilitate the sharing of Asian and Pacific DRR knowledge.

These communications technologies and their related nodes can facilitate information between national and local interests in both directions. Existing information can be integrated into local practices to increase communities' DRR capacities. In Afghanistan, radio broadcasts are used successfully to raise awareness about disaster-related issues through a radio drama, "New Home New Life".[9] An evaluation of the popular programme based on daily life has clearly indicated that listeners recall the disaster-related messages from the story episodes and some listeners have taken specific actions to prepare for disasters (Bhanot, 2009).

Online courses are also becoming more popular as they allow "anytime-anywhere" training for professionals to acquire new knowledge and, in some cases, customized learning. Online educational tools, such as several hundred documents related to making schools safer from natural hazards, can complement physical individual and group training approaches, particularly in remote areas. The World Bank Institute offers a series of online training courses on DRR at http://einstitute.worldbank.org/ei/content/urban-development. Another example is provided by the Intergovernmental Oceanographic Commission of UNESCO's "Tsunami Teacher",[10] a Web-based learning package. Training and resource centres such as the Asian Disaster Preparedness Center (ADPC) at http://www.adpc.net and the Earthquakes and Megacities Initiative at http://www.emi-megacities.org also develop and conduct a variety of training programmes, support capacity development and share knowledge through both online and face-to-face events.[11]

To fully leverage the potential of ICTs in capacity development for DRR, it is important for government leaders and policymakers to be equipped with the knowledge to frame related policies and strategies. UN-APCICT/ESCAP in collaboration with ADPC has developed a training module about "ICT for disaster

[7] For other useful portals, see AlertNet (http://www.trust.org), IRIN (http://www.irinnews.org/), PreventionWeb (http://www.preventionweb.net), ReliefWeb (http://reliefweb.int/) and the UN-SPIDER Knowledge Platform (http://www.un-spider.org/).

[8] As of 28 March 2012.

[9] New Home New Life has been broadcast in Dari and Pashto on the BBC World Service since 1994, communicating educational messages about key developmental themes such as health, gender equity, good governance, and sustainable rural livelihoods. This is complemented by weekly educational programmes to provide additional information on the issues raised in the radio drama.

[10] Tsunami Teacher. http://itic.ioc.unesco.org/index.php?option=com_content&view=article&id=1441&Itemid=1075&lang=en

[11] See PreventionWeb, "Events Calendar" http://www.preventionweb.net/english/professional/trainings-events/events.

risk management" as part of its Academy of ICT Essentials for Government Leaders Programme, available from http://www.unapcict.org/academy/. The module has been repackaged into a self-paced online course and is provided through a learning management system, the APCICT Virtual Academy.[12]

Accountability is the fourth domain of the core capacity development actions highlighted by CADRI. Accountability involves installing systems and mechanisms so that providers, beneficiaries and stakeholders can interact with each other, monitoring the progress or needs of DRR activities in a participatory manner. As governments are providing more information online, it becomes easier for citizens to contribute and become involved. These mechanisms also enable media, researchers and civil society organizations to become more engaged as commentators or for holding responsible parties accountable for increasing public exposure to risk. Governments can create citizen engagement platforms that are accessible from the Internet or by means of mobile phones. Each of these possibilities only hints at the greatly expanded opportunities for the innovative uses of technology to incorporate the perspectives of citizens in advancing DRR. These capacities can serve as effective public feedback mechanisms which will contribute to more informed decision-making.

There are other innovations for improved institutional communications about DRR. Aid information management systems (AIMS) are software applications that record and process information about development activities and related aid flows in a country. While they were created to assist countries in managing external assistance, AIMS strengthen a government's capacity to plan, implement, monitor and evaluate the use of public resources. Their design simultaneously allows for improved aid coordination, information sharing, and mutual accountability at the same time which could have beneficial applications for the planning and implementation of DRR strategies. In this context, UNDP has assisted in implementing the web-based Development Assistance Database (DAD), an AIMS that tracks the use of aid received for disaster response and recovery after the 2004 Indian Ocean Tsunami. The Governments of Indonesia, Maldives, Sri Lanka and Thailand have established national DAD systems.

[12] The APCICT Virtual Academy learning management system offers video lectures synchronized with presentations; self-assessment and review quizzes; downloadable learning resources; and learner's tracking and progress monitoring. For users without sufficient Internet connection, a DVD version of the APCICT Virtual Academy provides a nearly identical learning platform and a comparable experience.

5.6 International and regional cooperation for harnessing the potential of innovative technologies

The repercussions of disasters are often beyond the capacity of any single country in the Asia and Pacific region, especially for developing countries. There are numerous international cooperation mechanisms and action plans for disaster risk reduction to assist countries by increasing their access and use of new and innovative technologies. Some of the key ones include the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), ESCAP's Regional Space Applications Programme for Sustainable Development (RESAP), the International Charter Space and Major Disaster (the Charter), Sentinel Asia, RIMES, among others. Whether individual countries possess their own space assets and maintain the supporting institutional capacities or not, they can still benefit from well-established regional and international cooperation in the field.

These international and regional cooperation mechanisms can be approached to obtain satellite data and provide essential information products to anticipate, respond to or recover from disasters. The International Space Charter has been operational since 2000 to provide a unified system of space products to countries affected by natural hazards or human-induced crises. Currently a dozen of the world's space agencies are members, offering access to more than 20 EO satellites.

Within the region, Sentinel Asia supported by JAXA provides satellite data and products. The Asia-Pacific members are the China National Space Administration, the Indian Space Research Organization, the Japanese Aerospace Exploration Agency and the Korea Aerospace Research Institute. Authorized users of the Charter are the space agencies and civil protection, search and rescue, defence or security authorities from the countries of charter members, as well as some authorized United Nations entities and international organizations. These latter organizations include the United Nations Office for Outer Space Affairs, the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) and UNITAR's Operational Satellite Applications Programme.

Any member or these United Nations agencies can activate the Charter on behalf of disaster-affected countries to obtain access to satellite data or products

free of cost in the event of major disasters. Similarly, ESCAP, OCHA and UN-SPIDER also may extend their support to disaster-affected countries, and especially to address the particular needs of LDCs, LLDCs, and SIDS for comprehensive access to satellite products.

The United State Geological Survey also provides historical satellite data from American satellites such as Landsat, as well as selected views from high resolution satellites, to all countries free of cost. Beyond meeting the immediate needs for disaster response, these resource materials can be used for further analysis associated with hazard zonation, vulnerability and risk assessment or for spatial planning and strategic developmental considerations.

5.6.1 Regional cooperation for capacity development

ESCAP aims to facilitate data access through RESAP, especially through its Regional Cooperation Mechanisms for Disaster Monitoring and Early Warning and for drought monitoring. These efforts promote closer regional cooperation, capacity-building and training, enhancing community resilience and resource mobilization for space applications to enhance the wider awareness and capacities to use space applications for DRR in the region. Under this framework, a training network has been established with partner institutions in the Coordination Agency for Surveys and Mapping in Indonesia, the Centre for Space Science and Technology Education in Asia and the Pacific in India and various universities in China. ESCAP also intends to use its existing collaboration with JAXA and Sentinel Asia as well as its association with UNITAR's UNOSAT (UNITR, 2012) to encourage wider access to satellite data for disaster-affected countries.

5.6.2 Regional data-sharing and monitoring network for technical data

RIMES, an intergovernmental institution established with support from ESCAP, has initiated a regional data-sharing arrangement to enable more local meteorological and hydrological data to become available for improved forecasting. Effective management of impacts from climate variability and change requires high-quality, high-resolution, and long-term observational data for characterizing present climate variability, extremes, and observable trends. It is also required to calibration the increasingly sophisticated models being used to understand the complexities of hazard behaviour and risk exposure. In addition to data transmitted by the World Meteorological Organization's Global Telecommunication System (GTS) more use of local meteorological and hydrological data can improve the resolution of future forecasting for hydro-meteorological hazards. RIMES has facilitated a data-sharing arrangement with the Indian National Center for Medium Range Weather Forecasting (NCMRWF) to disseminate more local data for improved forecasting.

At present, nine countries participate in this data sharing arrangement: Bangladesh, Bhutan, India, Lao People's Democratic Republic, Maldives, Mongolia, Myanmar, Nepal, and Sri Lanka. In addition to national meteorological and hydrological services (NMHSs) which receive cascading benefits from NCMRWF's improved forecast products, national departments of irrigation, agriculture, and other primary users of weather information also have become additional beneficiaries.

5.6.3 Building regional capacities for using geospatial information

As discussed previously, current and accurate geospatial information is particularly crucial in a disaster situation, so that national authorities can make urgent and well-informed decisions about necessary actions. Limited or poorly functioning information exchanges between key players continue to be a constraining factor to more effective disaster risk management in Asia and the Pacific. A survey conducted in 2011 by the Permanent Committee on GIS for Asia and the Pacific (PCGIAP, 2011) disclosed that many developing countries in the region have not established international standards and sufficient interoperability specifications at national level. The High-Level Forum on United Nations Global Geospatial Information Management[13] further elaborated on the need for full interoperability of multi-dimensional geospatial information and integration with other data sources at national, regional, and global levels in order to provide an effective information base for DRM and development applications. More recently, Rio+20 highlighted the importance of comprehensive hazard and risk assessments, and the more effective sharing of information and knowledge, including reliable geospatial information.

In order to address these issues and to strengthen the capacity of disaster management authorities in the region, ESCAP has embarked on a project for improving disaster risk preparedness in the ESCAP

[13] See: http://ggim.un.org/forum1.html

Box V.5 **Building capacities for geo-referenced information**

ESCAP has made efforts to create a regional platform for countries with special needs to enhance their capacities for integration of geo-referenced information in the policies and programmes related to DRR. This has been pursued by developing synergy through regional cooperation of sharing geo-referenced information and related capacity-building efforts to expand its adaptation and effective utilization. These initiatives include developing geo-referenced disaster risk management portals, establishing a network of communities of practice concerned, and improving operational linkages to regional networks for transboundary disaster events. The overall objective is to facilitate data sharing among and within participating countries. A programme of capacity development conducted through ESCAP's RESAP Education and Training Networks in China, India and Indonesia has been at the core of these activities.

region. The project focuses especially on the needs of LDCs, LLDCs and SIDS to strengthen government capacities in the implementation of the HFA. It seeks to expand the use of standardized geospatial information tools for the implementation of disaster risk preparedness and timely early recovery activities (box V.5).

5.7 Conclusions and recommendations

Innovative technologies are critical and essential tools for disaster risk reduction and management which are more widely available and professionally accessible than they were even a few years ago. By virtue of their combined attributes of satellite broadband communications, navigation, positioning and timing, and earth observations coupled with geo-referenced information systems, these applications enable the identification and detailed characterization of known and previously unconsidered intensive and extensive disaster risks. They have become powerful and accessible tools that can lead to the protection of lives, assets and development accomplishments.

The use of innovative technologies, and especially ICT, space applications and related technologies throughout Asia and the Pacific can contribute to more effective and efficient DRM and DRR practices. The main obstacles to their wider acceptance are a lack of resources and limited technical expertise.

The continuous strengthening of international and available regional cooperation mechanisms will assist countries to access and apply the use of innovative technologies' products and services better, and more widely throughout the region. The same technologies can enable more affordable access to existing capacity-building opportunities for building in-country expertise. They can establish new channels for acquiring information and fostering its wider exchange. A sustained commitment to embrace innovative technologies can facilitate multi-stakeholder participation and will stimulate new forms of professional cooperation. To the extent possible, by pooling or sharing already existing advanced technology resources in the region and by making them integral to cooperation arrangements which cut across development sectors, disaster risk reduction can become a more realized regional value.

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6 The way forward to reducing vulnerability and exposure to disaster risks in Asia and the Pacific

Eight-year-old Amreen washes dishes in rainwater, in Khwas Koorona Village in the northwestern Khyber-Pakhtunkhwa province of Pakistan. An estimated 2.5 million of the province's 3.5 million residents have been affected by severe floods.
Credits: UN Photo/UNICEF/ZAK

6.1 The needs and the challenge

The preceding chapters of the present report have explored the status of disaster risks in the region, highlighting the elements most responsible for driving the growing numbers of hazards, undiminished vulnerabilities and growing exposure associated with them. In addition, key strategies have been presented that are currently being employed by various States and local communities to reduce disaster risks by addressing the underlying vulnerability and exposure of people and economies in the region.

The primary conviction of this report is driven by a concern that people's vulnerability and exposure, experienced individually and collectively, continue to be twin challenges for the region. Faced with growing economic losses and increasingly vulnerable populations, this report has analyzed the drivers of risks and the strategies that are in place to deal with the growing risks. It has been inspired by some, but not enough, examples of good practice motivated by the intentions of reducing social vulnerability.

The report has pursued three primary questions that all dedicated collaborators in the region need to join: "How do they and the people with whom they work understand the disaster risks in the region better?" "How can all concerned stakeholders intensify their own work on vulnerability reduction in a truly concerted, consistent and sustained way?" and "What strategies are needed and can be applied to reduce socioeconomic exposure to hazards?" One primary conclusion which addresses each of these concerns is that commitment at the highest levels of Government and actions at all levels of the society are required to reduce the rising exposure and increasing vulnerability of disaster risks throughout the region.

6.2 There is a primary need to re-evaluate the basic understanding of disaster risks

Disasters are dynamic and need to be re-evaluated constantly. As economic losses increase, the reality of unexpected sequential events like the Japan earthquake, tsunami and nuclear disaster, and a wider consideration of exposure as a dominant driver of future risks highlight the need to constantly revisit the understanding of risks, and how they affect the region. It is absolutely crucial to appreciate that the future will not consist simply of "more of the past", as even fundamental assumptions of what constitutes public exposure to disaster risks in contemporary societies will most certainly continue to evolve. There are growing indications that development only stimulates some of these adverse conditions. Primary conclusions for advancing this wider perspective of contemporary disaster risks follow as States and individual communities look towards the future.

Strengthen the socio-economic evidence base

Socio-economic evidence needs to become a firm foundation from which to proceed in the continuing re-evaluation of risks in the region. Other comprehensive socio-economic data and analyses are needed to understand the prevailing vulnerabilities to disasters better. It is also needed to establish the true costs and actual benefits of investment in reducing risk. Efforts to build the socio-economic evidence base either will disclose inadequacies or preferably stimulate additional commitments to improve risk communications. This is essential for engaging all stakeholders, and particularly those responsible for decision-making, planning and investment. Progress can only be possible when the subject of risk becomes a matter of concern in additional sectors of society and in the priority areas involved with sustainable development, disaster risk reduction and climate change.

The first step in building this socio-economic foundation of evidence is the systematic recording of disaster impacts and losses through the institutionalization of national disaster inventory systems. There are pressing needs to set international, regional and national standards for data collection, the analysis and interpretation of resulting information and its dissemination to enable targeted and better-informed strategies for creating safer societies.

The recording of comprehensive disaster losses and consequential impacts will enable governments to measure and quantify the socio-economic costs of recurrent disasters. Only then can a strong case be made to justify significant and sustained investments in DRR from fiscal budgets and long-term public investment plans.

6.3 Intensify and broaden vulnerability reduction

The beneficial lessons, actually generous instructions, from countries and communities which have successfully reduced human vulnerability to disasters and therefore potentially mortality, need to be learned and exchanged, while stimulating learning on both

sides of the dialogue. One approach to ensure that efforts to intensify activities are effective is to promote "no regrets" activities that yield both developmental and risk reduction benefits. Several chapters of this report cite opportunities to do this in such areas as expanding social safety nets, setting targets to encourage investments in DRR, developing a common framework for the Millennium Development Goals (MDGs) and DRR, and by improving risk governance in the region.

Set targets and expand social safety nets to reduce people's vulnerability

Surprisingly, commitments to reduce disaster risks are still not perceived as a priority in policymaking circles despite the potential costs and the magnitude of avoidable losses and the solid evidence which exists. However, experience in some high-risk developing countries demonstrates that setting definitive targets to reduce disaster losses stimulates Government decisions to make investments in DRR. Targets with specifically identified economic and social measures to reduce vulnerabilities ensure that investment attains visible and measurable results. Expanding social protection initiatives and creating social "safety nets" for times of crisis provide particular value with added political dividends. Policy initiatives pursued by several countries such as Bangladesh, India, Indonesia, the Philippines and Thailand provide examples and practical experience for lessons that can be shared. These strategies should be embraced as catalysts to motivate specific development objectives, and for creating further investment opportunities.

By expanding social protection programmes, the vulnerability of disadvantaged groups in some hazard-prone areas has been reduced. The integration of social protection into broader economic and social strategies for the purpose of guaranteeing a reliable foundation for social and economic security is based on the principle that society as a whole accepts the responsibility to provide basic opportunities for the well-being and essential services for people with the greatest needs. A minimum level of protection can be affordable and is fully capable of serving as a base to provide minimum needs, which also reduce vulnerability and consequent risks. Specific measures include supplementary incomes or in-kind transfer programmes, food-for-work programmes, rural employment guarantee schemes and labour-intensive public works programmes.

Build a common framework on DRR and the MDGs

Disaster risk reduction and development can, and actually should, support common objectives. Most activities that deliver the MDGs produce "no regrets" benefits to reduce disaster risks. For example, if a country can deliver clean water and sanitation, it can increase the likelihood of providing key features related to the HFA priority areas of disaster preparedness and MDG 7 related to water and sanitation. Progress made on providing universal primary education has been the largest single contribution to DRR efforts. Improvements in school enrolment increase the likelihood of progress, in particular with regard to three HFA priorities: DRR planning and budget allocation, risk assessment and early warning, and knowledge, education and innovation.

Common frameworks for MDG and DRR can assist countries in prioritizing capacity strengthening and development. The years of implementation of MDGs and HFA have resulted in considerable progress towards reducing global disparities and the risk of disasters. There is now a need to understand these approaches in terms of development consequences and disaster vulnerability.

Strengthen risk governance

The improvement of risk governance in the context of sustainable development and the need to promote more integrated approaches to environmental, economic and social aspects of development are needed to reduce disaster risks. Rio+20 calls for stronger political commitment to ensure that disaster risk reduction and building resilience of communities and nations are addressed with a "renewed sense of urgency in the context of sustainable development and poverty eradication." Stronger linkages were encouraged among disaster risk reduction, recovery and long-term development planning during this Conference.

Rio+20 reinforced the importance of the environment in supporting economic growth and social development, and recognized that consideration of a "green economy" in the context of sustainable development and poverty eradication, is an important approach available for achieving sustainable development. The Conference called for more integrated and better coordinated approaches to

institutional and programme mechanisms. This was expressed with particular demand in the context of a green economy, including the consideration of ensuring various aspects that could enable disaster risk reduction and climate change adaptation at national levels. This includes the integration of DRR and climate change adaptation into national development strategies and investment, strengthening local governance, and creating stronger partnerships with civil society. The opportunity rests in being able to capitalize on green economy principles that can provide political support as well as in seeking additional resources to strengthen risk governance capacities. The necessarily includes those measures accounting for disaster loss and assessing risk.

6.4 Reduce exposure to disasters

Many of the approaches, which proceed to reduce vulnerability, are derived from development experience. Nonetheless, much more also needs to be done to arrest the growing exposure of people and assets to hazards throughout the region.

Strategies such as land-use planning, ecosystems management, post-disaster recovery and supply chain management have the potential to reduce exposure to future disasters. Most of these strategies are already risk-sensitive, but barriers continue to exist in translating these strategies into actual investments that reduce risks. Research has disclosed that although existing strategies are clear about their intentions for reducing disaster risks, many of them would benefit from being more explicit about their means of accomplishing disaster risk reduction. There are also additional associated needs to develop requisite social demand and more government ownership for realizing DRR. Efforts to improve accountability in all aspects of disaster risk management and to arrest increasing exposure are strategic ones, which can earn considerable political capital.

Remove barriers and engage new stakeholders to reduce exposure to disasters

There is experience, which demonstrates that even when land-use planning, ecosystem management and disaster recovery have been deployed with the intention of reducing risks, barriers still remain to further investment. It would be highly beneficial to seek additional means and other collaborative interests to broaden commitments to a safer public environment. For example, both the World Trade Organization and the Clean Development Mechanism of the Kyoto Protocol focuses on removing barriers as a cost-effective approach in achieving their common goals. Removing barriers in financial incentives can provide other means to influence risk sensitive private sector investments, such as by insurance pricing and coverage, the use of credit ratings, and market and stock prices.

There is also an important need to engage new stakeholders, particularly ones involved in decision-making, planning and investment. This requires the engagement of other professional and commercial interests and primary Government departments engaged with sustainable development, disaster risk reduction and climate change consequences. These expanded relationships should strive to address the combined impacts and to pursue the common goals of sustainable development, DRR and CCA.

Be explicit on "how to do disaster risk reduction"

Improved governance strategies and specific measures for implementation are vital elements to address rising vulnerabilities and exposure. Given the particular needs of a country or a community, these may include legislation, policies, frameworks, decentralized capabilities, increased accountability and more inclusive participation in governance. Both legislation and management practices need to address underlying risk factors in order to be effective, while development plans equally should be grounded in efforts, which identify and mitigate disaster risks.

Discrepancies remain between policy intentions and actual achievements. In this respect, the well-informed implementation of practical and local actions may yield more appropriate solutions rather than relying on existing bureaucratic procedures. An increased involvement of communities through more inviting and engaging overtures to address common or community concerns, and democratic processes generally, can become influential strategies for more dynamic risk reduction. However, in any case, adequate capacities, resources and funding are vital to ensure proper implementation. Responsibility, incentives and accountability at all levels of government need to be clearly defined and institutionalized if any semblance of direction is to be sustained.

Build social demand for disaster risk reduction

There is equally a need to build wider social demand for addressing vulnerability and for reducing exposure to hazards. In Asia and the Pacific, there has so far been considerably more attention directed towards holding officials accountable for reducing vulnerability rather than reducing exposure. While it is notable that more people and communities voice their expectations for government officials to provide timely warning and enable evacuation when hazards threaten local communities, it is now timely for a similar commitment to mobilize efforts that can reduce people's exposure to hazards and future disasters.

A greater challenge is in building social demand for significantly reduced vulnerability, but lasting benefits ultimately exist in reducing people's exposure to hazards. Some strategies for the future may include promoting participation from communities and local governments to encourage multi-stakeholder participation in decision-making related to local disaster risks. The meteoric rise of social media across the region offers tremendous opportunities for future accountability in DRR. The availability of the latest "Web 2.0" technologies and the nearly universal access for some variety of modern communications throughout societies will enable citizens to become more involved and conversant with developing circumstances. More importantly, easy access to this technology allows people to express collective views and to introduce changed possibilities.

Take responsibility and ownership for reducing risks

It is essential that Governments assume full ownership and guiding responsibility for disaster risk reduction as part of an inclusive and sustainable development strategy. This is exemplified by one of the champions of building disaster resilience at the local level in the Philippines, Governor Joey Sarte Salceda of Albay Province, who has adopted a pragmatic approach to reducing risks of disasters for his community. The governor notes that "people have the basic right to the capacity to adapt; relief, recovery and rehabilitation are essentially compensation [penalty] of the State for failing to reduce exposure and to increase capacity. No [need for] evacuation if [the] vulnerable is relocated. No rescue, if evacuated. No rehabilitation, if homes are built safely. The more disasters, the higher the rights of the vulnerable, [and] the higher the duties of the State."

This is only one of the many different approaches that can be pursued in the rich cultural contexts of the region. However, there is a visible trend indicating that the responsibilities for DRR are becoming more decentralized as provinces and municipalities become key stakeholders engaging in risk governance. While accountability for reducing vulnerabilities is improving, a need still remains to improve the breadth of ownership required for reducing exposure of people and assets to hazards.

6.5 A direct approach to disaster risk reduction

In acknowledging the increasing risks in the region, it is necessary to promote a more direct approach to disaster risk reduction if the promise of development is not to be lost. Shortcuts do not reduce risks, but informed approaches, innovative technologies and wider popular engagement can ensure that their joint activities can be both effective and affordable.

Capitalize on innovative technologies

Innovative technologies have significant impact because they surmount previous limitations and offer many new directions and opportunities to communicate, to plan, to analyse, and to learn. They accordingly are filling critical information gaps in disaster risk management. They also address basic needs of observation and synthesis essential for effective spatial multi-sectoral information products. A variety of geospatial information products enable fast tracked multi-sectoral integration of disaster risk reduction and climate change adaptation in development planning, monitoring and evaluation process. When the historical spatial information on hazard, vulnerably and exposure is put to use to evaluate disaster risk, it aids in understanding the complexity of risk and when applied, it can facilitate the implementation of risk-sensitive land management planning. The use and application of innovative technologies can provide benefits in many dimensions of urban risk assessment, land use or spatial planning, early warning and preparedness, education and learning among others yet to be imagined.

Regional cooperation has contributed to wider access for critical geospatial information products. This specific combined technical and administrative collaboration across the region provides a powerful example that can be replicated. There is a similar opportunity for decision makers, ministers of finance

and planning, and other technical specialists to combine their talents and abilities to invest in DRR.

Promote peer learning through regional institutions

Experience tells us that peer learning works. When it crosses either geographical or subject boundaries, it can become even more stimulating and engaging. Therefore, for national stakeholders, the best venues for inspirational and impactful learning are regional. To accomplish this wider value, regional organization and international development agencies should facilitate and provide multidimensional capacity development and promote an enabling policy environment for building disaster resilience grounded within both DRR and development practice. The Rio+20 outcome specifically emphasizes the important role of regional organizations in promoting a balanced integration of economic, social and environmental dimensions of sustainable development and requests that these organizations support efforts for capacity-building, development and implementation of regional agreements and arrangements as appropriate, and exchange of information, best practices and lessons learned, particularly for integrating disaster risk reduction and resilience into development plans.

These would include strengthening MDG and HFA implementation by developing the inter-operable frameworks for identifying the common interventions that could bring in synergy and convergence between MDG and HFA as well as institutional structures and capacities. Work towards combining these goals could also support the development of Sustainable Development Goals. Bodies and mechanisms such as the ASEAN, APEC, SAARC and the United Nations Regional Coordination Mechanism could be further utilized in this regard.

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About the cover photo: Tsunami-devastated town, Ishinomaki-Shi, Miyagi Prefecture, Japan
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