Protecting Development Gains

Reducing Disaster Vulnerability and Building Resilience in Asia and the Pacific

The Asia Pacific Disaster Report, 2010

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

ISDR
United Nations
International Strategy for Disaster Reduction

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Economic and Social Commission for Asia and the Pacific

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.

ISDR
United Nations
International Strategy for Disaster Reduction

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 International Strategy for Disaster 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.

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Preface

The Asia-Pacific region has had to cope with an unprecedented number of disasters. In all cases, - from Cyclone Aila in Bangladesh, Bhutan and India, Typhoon Morakot in Taiwan Province of China, back-to-back Typhoons Ketsana and Parma in the Philippines, Viet Nam, Lao Peoples' Democratic Republic and Cambodia, the Padang earthquake in Indonesia, the Samoa earthquake and subsequent Pacific tsunami disaster, the heat waves and rampant wildfires in Australia and the Russian Federation, the "dzud" in Mongolia, the earthquake in Qinghai Province in China, to the massive floods and landslides in Pakistan, China, India and Bhutan, - it is the poor and vulnerable that bear the brunt and worst risks and impacts of these disasters.

People of the Asia-Pacific region are four times more likely to be affected by natural disasters than those living in Africa, and 25 times more likely than those living in Europe or North America – and while the region generated only one quarter of the world's GDP, it accounted for a staggering 85 per cent of deaths and 38 per cent of global economic losses during 1980-2009. It is clear that the Millennium Development Goals cannot be attained in the region if its hard fought development gains are not protected from the risks and impacts of disasters.

There has long been a gap in understanding of the scale of risks and losses in a disaster-prone region where disasters have such disproportionate impacts on human development. To address this glaring information and knowledge gap, ESCAP and UNISDR joined hands and produced for the first time, the Asia and Pacific Disaster Report 2010.

The report is centred on the thinking that good efforts made by Asia-Pacific countries in reducing vulnerability are not enough. Disaster risks are increasing exponentially, a result of the compounding effects of inequitable economic growth patterns, population pressures and extreme climatic events. Good efforts thus need to be matched by urgent scaling up of efforts in disaster risk reduction and new multidisciplinary policy approaches. First, we need to recognize that the risk of disasters is increasing globally and is highly concentrated in middle- and low-income countries. The main driver of this trend is rapidly increasing exposure to risk. It is in these situations that good urban governance and ecosystems protection become important and need attention.

In addition to the growing exposure to disasters, we should also recognize that the increasing socio-economic losses due to disasters are also linked with and exacerbated by poverty, and that the vulnerabilities of the poor stem from socio-economic and environmental imbalances. For example, most post-disaster efforts go into rebuilding the economy, even though the damage and loss can be even greater in the social sector – a divergence that risks widening levels of inequity. Unless these imbalances are addressed, people who are constantly exposed to disaster risk are more likely to remain poor and more vulnerable to disasters, perpetuating a vicious cycle from which it is extremely difficult to break free. Thus the question for us is not "how to?", but rather "how to do better?" – because people matter!

The report also identifies new opportunities for reducing risks. The first of these is making disaster recovery resilient - an opportunity that is often overlooked. The second is the improved use of emerging technologies to ensure that efforts before and after disasters are more effective and efficient. Last is the need to leverage on regional cooperation so that a commonly shared political will and action plans emerge that prioritize the work necessary to reduce risks. Finally, this report makes the first attempts at improving understanding of the disaster risks of the region, through an analysis of historical disaster damage and loss data. This initial attempt has produced an approach that can provide relevant historical information to decision makers and furthers our understanding of the quantitative risks and impacts of disasters.

We have the honour of presenting the Asia-Pacific Disaster Report to the distinguished Ministers and policy-makers participating in the Fourth Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR). This report also comes at a time when both the Global Assessment Report on Disaster Risk Reduction 2011 (GAR11) and the IPCC Special Report on Extreme Events (SREX) are underway. Aware of the focus of these global reports, it is our hope that the regional report will highlight the unique Asia- Pacific regional issues, and provide policy direction on what can be done better - in order to protect and secure inclusive and sustainable development in the region.

Dr. Noeleen Heyzer
Under-Secretary-General of the United Nations
and Executive Secretary of ESCAP

Ms. Margareta Wahlström
UN Special Representative
for Disaster Risk Reduction

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The 2010 Asia-Pacific Disaster Report (APDR) is the first biennial report of the Economic and Social Commission for Asia and the Pacific (ESCAP) and the United Nations International Strategy for Disaster Reduction for Asia and the Pacific (UNISDR AP) office. The report is produced in response to the recommendations of the first session of the ESCAP Committee on Disaster Risk Reduction held in Bangkok, 25-27 March 2009, following a proposal made by the Executive Secretary of ESCAP. Development of the report is attributed to a multi-stakeholder effort of disaster risk reduction organizations and experts from the region. The report provides a comprehensive outlook on the socio-economic aspects of disaster risks and risk analysis in the region.

Publication of this report was coordinated by the Information and Communications Technology and Disaster Risk Reduction Division (IDD) at ESCAP and the UNISDR AP office. The Statistics Division and the Macroeconomic Policy and Development Division of ESCAP also supported by providing valuable inputs to finalize the report.

The preparation of the report was the joint responsibility of the APDR team consisting of the ESCAP-UNISDR Editorial Committee, professional staff of the Disaster Risk Reduction Section, Information and Communications Technology and Development Section, Space Application Section at IDD/ESCAP, Asia-Pacific regional staff of UNISDR and many other professionals involved in disaster risk reduction in the region. The editorial process was led by Zengpei Xuan of IDD/ESCAP and Jerry Velasquez of UNISDR AP office.

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Abbreviations

AADMER	ASEAN Agreement on Disaster Management and Emergency Response
ACDM	ASEAN Committee on Disaster Management
ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Center
ADRC	Asian Disaster Reduction Center
ADRRN	Asian Disaster Reduction and Response Network
AMCDRR	Asian Ministerial Conference on Disaster Risk Reduction
AMeDAS	Automated Meteorological Data Acquisition System
APCICT	Asian and Pacific Training Centre for Information and Communication Technology for Development
APEC	Asia-Pacific Economic Cooperation
APSCO	Asia-Pacific Space Cooperation Organization
ARF	ASEAN Regional Forum
ARPDM	ASEAN Regional Programme on Disaster Management
ASEAN	Association of South-East Asian Nations
BRAC	Bangladesh Rural Advancement Committee
BRR	Agency for the Rehabilitation and Reconstruction of Aceh and Nias
CB	Citizens' band
CCA	Climate Change Adaptation
CIS	Commonwealth of Independent States
CO_2	Carbon dioxide
CRED	Centre for Research on the Epidemiology of Disasters
CSO	Civil Society Organization
DAC	Development Assistance Committee
DaLA	Disaster and Loss Assessment
DaNA	Damage and Needs Assessment

DEC	Disasters Emergency Committee
DLNA	Damage, Loss and Needs Assessment
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ECLAC	UN Economic Commission for Latin America and the Caribbean
ECO	Economic Cooperation Organization
EM-DAT	International Disasters Database
ENSO	El Niño-Southern Oscillation
EO	Earth Observation
ESA	European Space Agency
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization
GCC	Gulf Cooperation Council
GCC-DC	Gulf Cooperation Council - Disaster Centre
GDP	Gross Domestic Produce
GEO	Geostationary Earth Orbit
GEOSS	Global Earth Observation System of Systems
GFAS	Global Flood Alert System
GFDRR	Global Facility for Disaster Reduction and Recovery
GFMC	Global Fire Monitoring Center
GIS	Geographic Information System
GLOF	Glacial Lake Outburst Flood
GNDR	Global Network of Civil Society Organizations for Disaster Reduction
GNSS	Global Navigation Satellite System
GTZ	Gesellschaft für Technische Zusammenarbeit
HF	High Frequency
HFA	Hyogo Framework for Action
IAWE	International Associations for Wind Engineering
ICIMOD	International Centre for Integrated Mountain Development

ICT	Information and Communications Technology
IDB	Inter-American Development Bank
IFI	International Financial Institution
IFRC	International Federation of the Red Cross and Red Crescent Societies
IP	Internet Protocol
IPCC	Intergovernmental Panel on Climate Change
IRP	International Recovery Platform
IRRI	International Rice Research Institute
JAXA	Japan Aerospace Exploration Agency
KLAP	Kuala Lumpur Regional Action Plan
MDG	Millennium Development Goal
MODIS	Moderate Resolution Imaging Spectroradiometer
MTPDP	Medium-Term Philippine Development Plan
NAPA	National Adaptation Plan of Action
NGO	Non-Governmental Organization
NSET	National Society for earthquake Technology-Nepal
OAS	Organization of American States
OECD	Organization for Economic Cooperation and Development
OFDA	US Office of Foreign Disaster Assistance
PDNA	Post-Disaster Needs Assessment
PONJA	Post-Nargis Joint Assessment
PRSP	Poverty Reduction Strategy Paper
RSMC	Regional Specialized Meteorological Centre
SAARC	South Asian Association for Regional Cooperation
SAR	Synthetic Aperture Radar
SDMC	SAARC Disaster Management Centre
SOPAC	Pacific Islands Applied Geoscience Commission
TRIAMS	Tsunami Recovery Impact Assessment and Monitoring System
UN	United Nations

UNCCD	United Nations Convention to Combat Desertification
UNDG	United Nations Development Group
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Economic Social and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commissioner for Refugees
UNIFEM	United Nations Development Fund for Women
UNISDR	United Nations International Strategy for Disaster Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNU	United Nations University
VSAT	Very Small Aperture Terminal
WFP	World Food Programme
WMO	World Meteorological Organization

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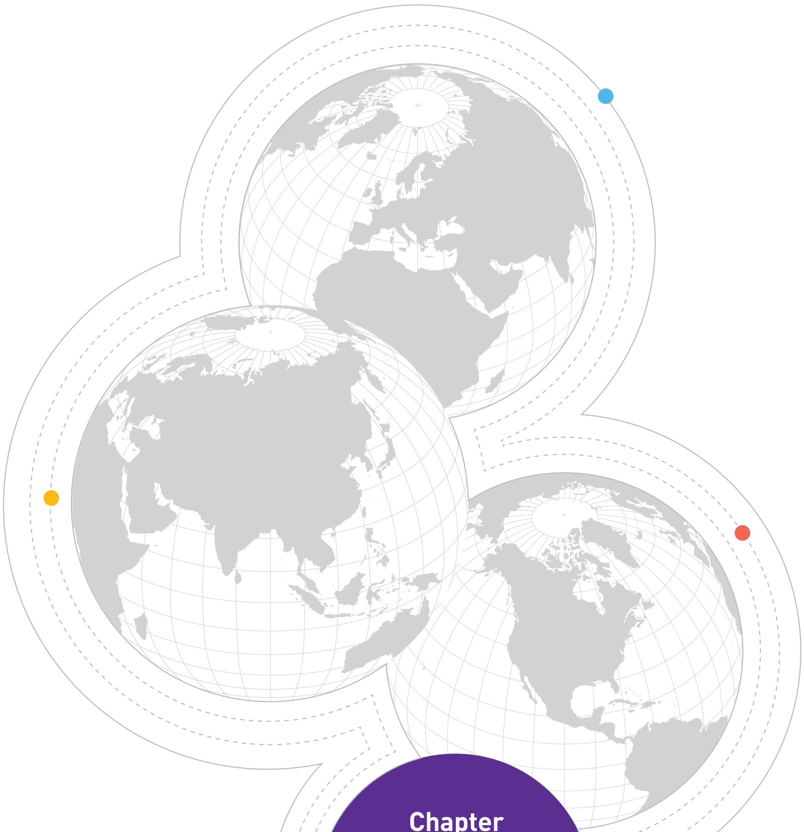


Chapter I

Disaster risk in Asia and the Pacific

Disaster risk in Asia and the Pacific

The Asia-Pacific region is very prone to disasters caused by natural hazards. These include droughts, floods, storms, extreme temperatures and wildfires, as well as mass movements such as landslides, volcanoes, earthquakes and tsunamis.

Disaster trends

According to the International Disaster Database (EM-DAT), between 1980-1989 and 1999-2009, the number of disaster events reported globally increased from 1,690 to 3,886. Over the whole period of 1980-2009, 45 per cent of these were in Asia and the Pacific. Figure I-1 shows such increase by regions. Asia-Pacific has been the region that suffered the largest number of disasters over these years. Both Asia-Pacific and Africa have experienced a sharp increase in the number of disasters in the last decade. Such increase could be related to many factors including increasing population exposed to hazards and improvements in reporting and collection of disaster data in EM-DAT.

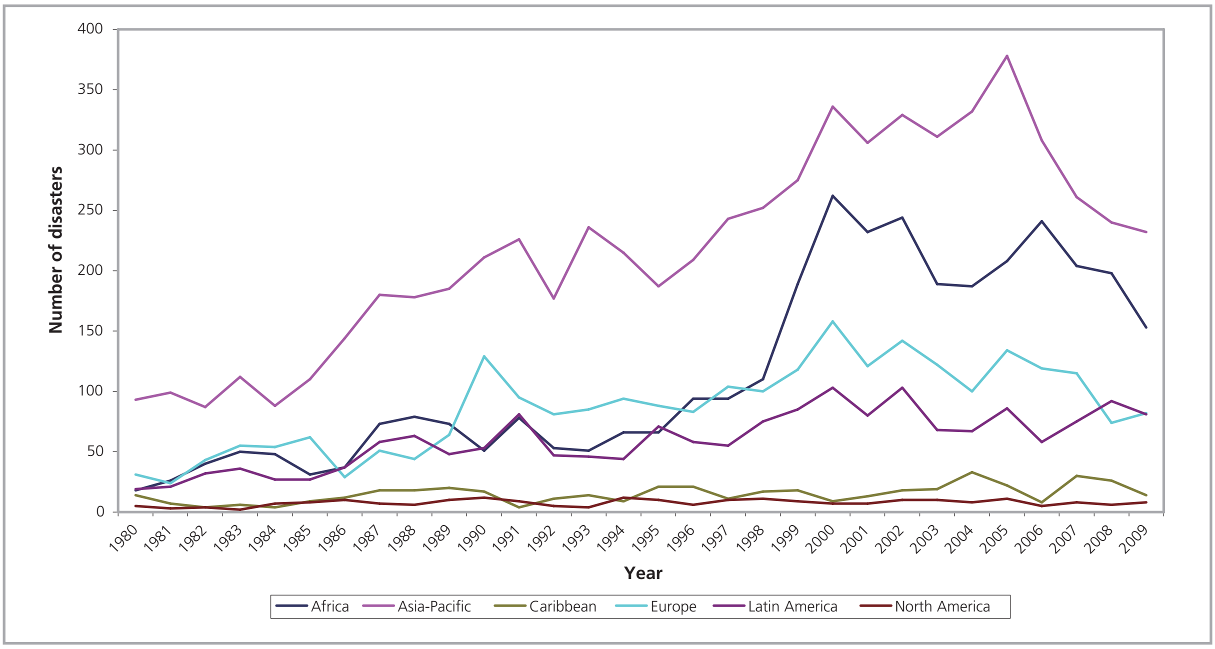
In terms of losses, however, this region is proportionally harder hit. While it generates 25 per cent of the world's GDP, it has suffered 42 per cent of the economic losses due to disasters. The region also has 61 per cent of the world's population, and has suffered a similar proportion of disaster-related deaths, but has 86 per cent of the total population affected by disaster. Between 2000 and 2008, the region's proportion of global deaths rose to 83 per cent – though this figure should be considerably lower for 2010 as a result of the January 2010 Haiti Earthquake. The most frequent hazard in the region is flooding, followed by storms, earthquakes and mass movements (Figure I-2).

As the number of reported disasters has increased, so has the number of reported people affected. The scale of three of the regions most recent major disasters in indicated in Box I-2.

Across the subregions

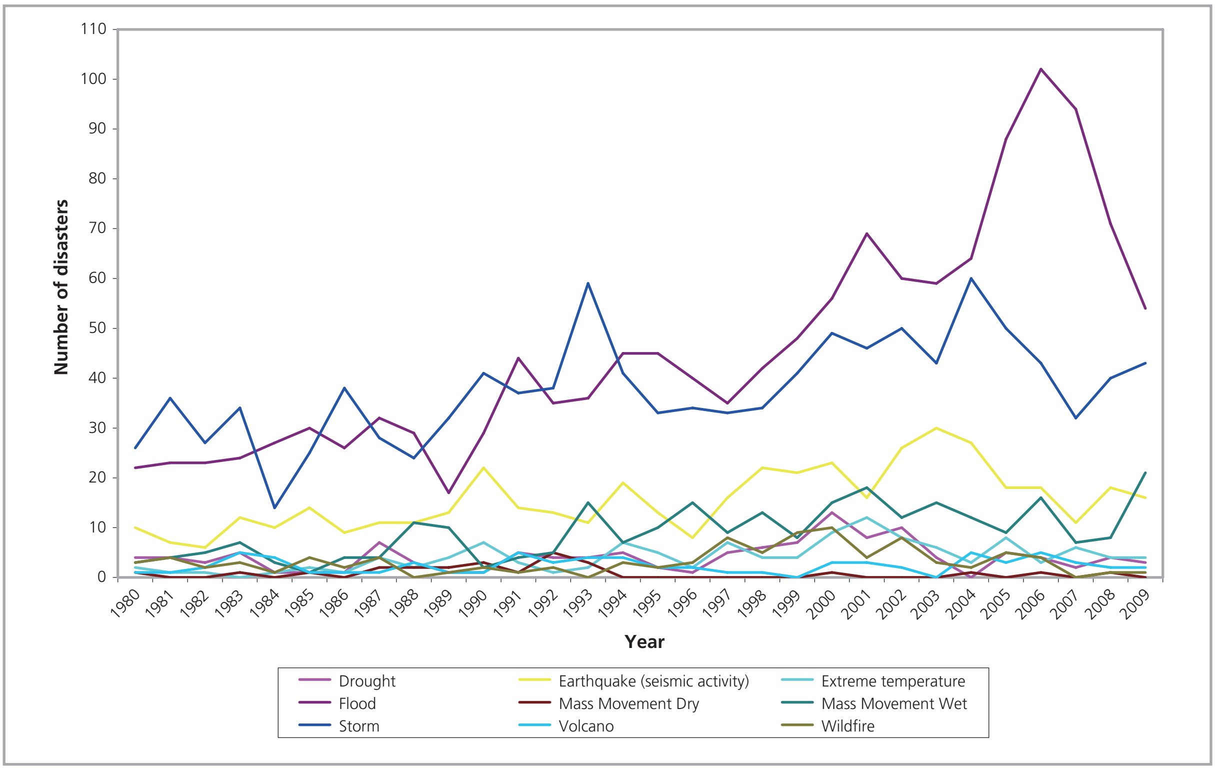
Disasters affect all subregions of Asia and the Pacific. Over the period of 1980-2009, South and South-West Asia had the greatest number at 1,283, followed by South-East Asia at 1,069. These regions also experienced the most fatalities, with the figure for South-East Asia spiking as a result of the 2004 Indian Ocean Tsunami. However, the East and North-East subregions suffered more both in terms of number of people affected and economic damage. Considering their smaller country and population sizes, both human and economic losses are also significant among the Pacific Island states. Statistics by country and sub-region are shown in Table I-1.

Figure I-1 Reported disasters, by global region, 1980-2009



Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

Figure I-2 Number of disasters by type of natural hazard in Asia-Pacific, 1980-2009



Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

Note: Wind storms are termed hurricanes in the North Atlantic and South Pacific, typhoons in the West Pacific and cyclones in the Indian Ocean.

Table I-1 Disaster events and impacts by subregion and country, 1980-2009

East & North East Asia	Events	Killed	Affected ('000s)	Damage ($, millions)
China	574	148,419	2,549,850	321,545
DPR Korea	24	1,879	10,736	46,331
Hong Kong, China	57	511	16	568
Japan	155	8,492	2,785	188,184
Macau, China	23	263	2,485	2,156
Mongolia	5	0	1	0
Republic of Korea	70	3,240	1,341	19,818
Sub-total	908	162,804	2,567,214	578,602
North & Central Asia				
Armenia	5	5	319	203
Azerbaijan	11	60	2,316	286
Georgia	14	24	726	847
Kazakhstan	14	184	719	142
Kyrgyzstan	20	422	177	227
Russian Federation	176	31,795	5,686	12,004
Tajikistan	49	2,069	6,636	1,709
Turkmenistan	2	11	0	180
Uzbekistan	6	74	652	38
Sub-total	297	34,644	17,231	15,636
Pacific (Oceania)				
American Samoa	6	40	23	0
Australia	154	955	15,798	34,690
Cook Islands	9	32	7	61
Fiji	35	219	1,092	593
French Polynesia	5	30	6	72
Guam	8	6	12	0
Kiribati	2	0	84	0
Marshall Islands	3	6	1	0
Micronesia (Federated States of)	8	72	40	10
Nauru		0	0	0
New Caledonia	7	8	2	51
New Zealand	43	23	35	1,562
Niue	3	2	1	0
Northern Mariana Islands	1	0	0	0
Palau		0	0	0
Papua New Guinea	55	3,456	1,156	169
Samoa	9	179	262	1,298
Solomon Islands	14	168	219	36
Tonga	9	17	123	125
Tuvalu	4	0	0	0
Vanuatu	31	212	268	411
Sub-total	406	5,425	19,126	39,078
South & South-West Asia				
Afghanistan	125	19,304	6,774	497
Bangladesh	229	191,650	316,348	16,273
Bhutan	9	303	66	5
India	416	141,888	1,501,211	51,645
Iran (Islamic Republic of)	140	77,987	42,050	24,978
Maldives	4	102	14	529
Nepal	74	10,881	4,507	1,621
Pakistan	131	84,841	29,966	8,871
Sri Lanka	60	36,871	13,963	1,942
Turkey	95	21,900	6,571	35,145
Sub-total	1,283	566,423	1,914,696	141,506
South-East Asia				
Brunei Darussalam	1	0	0	4
Cambodia	30	1,959	16,404	518
Indonesia	312	191,164	17,545	22,582
Lao PDR	30	945	3,998	337
Malaysia	58	1,239	579	1,723
Myanmar	25	139,095	3,315	2,726
Philippines	349	32,578	109,423	7,168
Singapore	3	36	2	0
Thailand	101	11,730	53,762	5,983
Timor-Leste	8	27	14	0
Viet Nam	152	15,914	67,735	7,180
Sub-total	1,069	394,687	272,777	48,220
GRAND TOTAL	**3,963**	**1,163,983**	**4,791,044**	**823,041**

Note: Damage data are at 2005 prices

Source: ESCAP based on data from EM-DAT: the OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

Table I-2 to Table I-5 show data of the countries most severely affected by disasters. As might be expected, in terms of absolute numbers these tend to be the largest and most populous countries. These countries are, for example, often exposed to flooding – as in Bangladesh, China, the Russian Federation and India. When considered in relative terms, however, the smaller countries may be even more exposed. The Pacific Island states such as Fiji and Vanuatu are regularly faced with storm surges while countries such as Kyrgyzstan, Bhutan and several Pacific Island states, including Solomon Islands, Tuvalu and Fiji, are in seismically active areas, therefore, are exposed to earthquakes. In 2008, Samoa, American Samoa and Tonga were among the world's top 10 countries and territories in terms of the number of deaths per 100,000 inhabitants. These high levels of exposure are reflected in the human and economic impact, as shown in Table I-2 to Table I-5.

Table I-2 Asia-Pacific countries ranked by number of disasters, 1980-2009

Rank	Country	Events
1	China	574
2	India	416
3	Philippines	349
4	Indonesia	312
5	Bangladesh	229
6	Russian Federation	176
7	Japan	155
8	Australia	154
9	Viet Nam	152
10	Iran (Islamic Rep. of)	140

Source: ESCAP based on data from EM-DAT: the OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

Table I-3 Asia-Pacific countries ranked by number of deaths from disasters, 1980-2009

Rank	Country	Deaths
1	Bangladesh	191,650
2	Indonesia	191,164
3	China	148,419
4	India	141,888
5	Myanmar	139,095
6	Pakistan	84,841
7	Iran (Islamic Rep. of)	77,987
8	Sri Lanka	36,871
9	Philippines	32,578
10	Russian Federation	31,795

Source: ESCAP based on data from EM-DAT: the OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

Table I-4 Asia-Pacific countries ranked by number of people affected by disasters, 1980-2009

Rank	Country	Affected (millions)
1	China	2,550
2	India	1,501
3	Bangladesh	316
4	Philippines	109
5	Viet Nam	68
6	Thailand	54
7	Iran (Islamic Rep. of)	42
8	Pakistan	30
9	Indonesia	18
10	Cambodia	16

Source: ESCAP based on data from EM-DAT: the OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

Table I-5 Asia-Pacific countries ranked by economic damage, 1980-2009

Rank	Country	Damage ($ billions)
1	China	322
2	Japan	188
3	India	52
4	DPR Korea	46
5	Turkey	35
6	Australia	34
7	Iran (Islamic Rep. of)	25
8	Indonesia	23
9	Republic of Korea	20
10	Bangladesh	16

Note: Damage data are at 2005 prices

Source: ESCAP based on data from EM-DAT: the OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium

Types of disaster and impact

The most common type of disaster in the region is flooding, followed by storm (Table I-6). The greatest loss of life, however, has been from earthquakes. The number of earthquakes recorded excludes many low-intensity events, which occur continually around the region and cause little damage. All these events may seem less dramatic than severe earthquakes, but since they happen much more frequently, they cause greater and longer-lasting damage to infrastructure and livelihoods in the region.

Droughts – Physical damage is typically limited largely to livestock and crops, rain-fed and irrigated. Droughts can also delay planting operations and result in outbreaks of pests. Drought can also affect hydropower generation, resulting in electricity shortages and in some cases, lower export earnings.

Earthquakes – Excluding localized losses, earthquakes generally have little impact on standing crops. However, they can cause widespread loss of life and destroy infrastructure and other productive capacity, including agricultural infrastructure and distribution, and marketing networks. For example, the May 2008 Wenchuan Earthquake in China resulted in 69,227 deaths, and destroyed or badly damaged transport infrastructure, water and sanitation facilities, communications and power supply networks, and industrial and agricultural infrastructure, as well as social infrastructure, including hospitals, clinics, schools and houses (ADB 2009).

Floods – Where warning systems are weak, floods can cause considerable loss of life. They can also wash away roads, bridges, irrigation infrastructure and even flood control structures, along with non-fixed assets and flimsier housing, whilst causing considerable damage to remaining buildings and other infrastructure. Intense flooding also destroys crops, disrupts agricultural operations, erodes river banks and even shifts the courses of rivers while leaving heavy deposits of sediment on fields and irrigation channels. Floods can also be associated with an increased incidence of pestilence and crop diseases, which further reduces crop yields. Nevertheless, the net agricultural impacts are sometimes beneficial, as moderate flooding in less severely affected areas can boost soil fertility and productivity by depositing micro-nutrients, fine silt and loam (Dixit and others, 2008). For instance, in Nepal crop land near rivers and in low-lying areas were heavily affected by the 2007 floods, resulting in high crop losses, but in other areas the standing paddy crop benefited from the temporary immersion, probably resulting in expected overall surplus production (WFP and others 2007).

Storms – The impacts of storms (e.g. tropical cyclones and typhoons) are similar to floods because they are associated with heavy rain and related flooding. Storms can also cause storm surges and related seawater intrusion, damaging crops and aquaculture. High winds can also damage physical structures and crops, take off roofs, destroy buildings, power lines, trees and crops. As with flooding, related levels of loss depend in part on the strength of a storm and its occurrence in the agricultural cycle.

Unreported and forgotten disasters

To calculate disaster risks, it is necessary to consider the historical damage and loss data. There are many such sources, but the most commonly used source is the EM-DAT or the US Office of Foreign Disaster Assistance (OFDA)/Centre for Research on the Epidemiology of Disasters (CRED) database, which is maintained by the Université Catholique de Louvain, Brussels, Belgium. Although the EM-DAT data provides a broad overview of the economic damage and human losses due to disasters, it does have its limitations. For example, for a disaster to be entered into the EM-DAT international database, it must fulfil one or more of the following criteria: 10 or more people reported killed; 100 or more people reported affected; a declaration of a state of emergency; or a call for international assistance. The Asia-Pacific region experiences many disasters that fall below these thresholds but nevertheless inflict serious damage for highly vulnerable populations. Indeed, so frequent are these events that many communities accept them as an integral part of their existence and, with varying degrees of success, learn to live with them.

Many of the disasters, particularly in rural areas, go unreported because local governments lack the technical and human resources for community-level disaster monitoring – unable to fully identify or map potential local hazards or develop the appropriate rescue, recovery or re-construction plans.

To highlight the issue of unreported and forgotten disasters, this report compares the records from two disaster databases, EM-DAT and DesInventar, for Indonesia and Sri Lanka. EM-DAT is the OFDA/CRED International Disaster Database, while the Network for Social Studies on Disaster Prevention in Latin America created DesInventar in 1992 to record the impacts of highly localized small-scale events and later was extended to a number of other countries.

It should be noted that the Indonesia and Sri Lanka national DesInventar databases use a more detailed classification of events, which has to be equated to EM-DAT if a comparison is to be made. This is done in tables I-7 and I-8 below. Floods in EM-DAT may be reported as Floods, Flash Floods, Surges, Urban Floods, etc., in the DesInventar national databases. It should also be noted that some events in EM-DAT are reported as different types of events in national databases (as per DesInventar methodology). For example, Floods of 1989 in Sri Lanka are reported (at least) as Floods, Landslides and Rains in DesInventar, depending on the specific manifestation on each division or district.

Compared with EM-DAT, DesInventar reports many more disaster events (Tables I-9a and I-9b). On the other hand, it reports fewer deaths for certain hazards like floods, suggesting that EM-DAT may be over-estimating deaths and may need to pay greater attention to data verification. One explanation is that "missing" is always aggregated together with "killed" in EM-DAT, whereas in DesInventar databases they are shown in separate entries in the database. The main difference between these databases is that DesInventar does not impose a threshold for disaster events to enter the database. For this reason, the total mortality for some disaster events may be higher in the Sri Lanka and Indonesian national DesInventar databases.

Table I-6 **Top 10 disaster types and their impact, Asia and the Pacific, 1980-2009**

Rank		Events	Deaths (thousands)	People affected (millions)	Damage ($ millions)
1	Floods	1,317	128.95	2,676.16	301,590
2	Storms	1,127	384.20	664.03	165,770
3	Earthquakes	444	570.80	109.71	264,530
4	Mass movements – wet	264	14.28	1.36	2,130
5	Extreme temperatures	119	17.51	85.90	18,080
6	Droughts	108	5.33	1,296.27	53,330
7	Wildfires	96	1.06	3.31	16,210
8	Volcanic eruptions	71	17.51	2.36	710
9	Mass movements – dry	20	1.53	0.02	10
10	Insect Infestations	8	0.0	0.00	190

Note: * Damage and loss reported in $millions at 2005 constant prices.

Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium, and data on implicit price deflators in $ from the United Nations Statistics Division National Accounts Main Aggregates Database.

Table I-7 Compilation of DesInventar data to EM-DAT type of events for Indonesia, 1998-2009 (12 years)

DesInventar Events	EM-DAT type	Reports	Killed	Deaths	Injured	Missing	Houses Destroyed	Houses Damaged	Affected
DROUGHT	Drought	1152	0	0	0	0	0	0	0
FLOODS	Floods	2463	1820	1275	187284	545	119729	177481	11917479
SURGE	Floods	161	17	15	201	2	3645	3781	25538
	Subtotal	**2624**	**1837**	**1290**	**187485**	**547**	**123374**	**181262**	**11943017**
FLOODS/LANDSLIDE	Landslide	245	1471	1194	39479	277	42607	57362	440661
LANDSLIDES	Landslide	900	1393	1286	1517	107	9585	7095	18099
	Subtotal	**1145**	**2864**	**2480**	**40996**	**384**	**52192**	**64457**	**458760**
CLIMATE CHANGE	Storm	1	95	95	0	0	0	0	0
STRONG WIND	Storm	925	140	136	1582	4	29250	34080	151214
	Subtotal	**926**	**235**	**231**	**1582**	**4**	**29250**	**34080**	**151214**
	TOTAL	**5847**	**4936**	**4001**	**230063**	**935**	**204816**	**279799**	**12552991**

Note: DesInventar data are available for Indonesia only from 1998 onwards.

Source: UNISDR and UNDP based from DesInventar database - www.desinventar.org

Table I-8 Compilation of DesInventar data to EM-DAT type of events for Sri Lanka, 1998-2009 (12 years)

Event	EM-DAT type	Reports	Killed	Deaths	Injured	Missing	Houses Destroyed	Houses damaged	Affected
DROUGHT	Drought	1,225	0	0	0	0	0	0	12,499,704
FLOOD	Flood	4,674	389	376	184	13	38,374	94,262	9,215,076
SURGE	Flood	26	3	3	0	0	2	39	3,394
TIDAL WAVE	Flood	5	2	2	0	0	0	0	150
URBAN FLOOD	Flood	72	3	3	0	0	7	67	23,876
	Subtotal	**4,777**	**397**	**384**	**184**	**13**	**38,383**	**94,368**	**9,242,496**
SUBSIDENCE	Landslide	115	14	14	4	0	62	387	3,161
LANDSLIDE	Landslide	1,753	799	760	239	39	2,039	7,884	101,511
	Subtotal	**1,868**	**813**	**774**	**243**	**39**	**2,101**	**8,271**	**104,672**
CYCLONE	Storm	94	26	21	127	5	24,598	124,684	1,260,456
GALE	Storm	993	21	21	103	0	771	10,102	103,411
RAINS	Storm	1,663	12	12	28	0	184	2,023	704,562
WINDSTORM	Storm	1,208	26	26	122	0	656	12,261	95,961
LIGHTNING	Storm	322	267	267	259	0	18	140	1,314
	Subtotal	**4,280**	**352**	**347**	**639**	**5**	**26,227**	**149,210**	**2,165,704**
TOTAL		12,150	1,562	1,505	1,066	57	66,711	251,849	24,012,576

Note: DesInventar data are available for Indonesia only from 1998 onwards.

Source: UNISDR and UNDP based from DesInventar database - www.desinventar.org

Table I-9a Comparison of EM-DAT and DesInventar data for Indonesia, 1998-2009 (12 years)

	Events		Deaths		People affected	
	EM-DAT	Desinventar	EM-DAT	Desinventar	EM-DAT	Desinventar
Floods	63	2,624	2,826	1,837	3,525,309	11,943,017
Landslides	29	1,145	1,115	2,864	332,330	458,760
Storms	2	925	4	235	3,715	151,214
Droughts	1	1,152	0	0	15,000	0
Total	95	5,847	3,945	4,936	3,876,354	12,552,991

Note: DesInventar data are available for Indonesia only from 1998 onwards.
Source: UNISDR and UNDP based from DesInventar database - www.desinventar.org

Table I-9b Comparison of DesInventar and EM-DAT data for Sri Lanka, 1998-2009 (12 Years)

	Events		Deaths		People affected	
	EM-DAT	Desinventar	EM-DAT	Desinventar	EM-DAT	Desinventar
Floods	20	4,777	357	397	4,536,690	9,242,496
Landslides	0	1,868	0	813	0	104,672
Storms	2	4,280	14	352	425,000	2,165,704
Droughts	1	1,225	0	0	1,000,000	12,499,704
Total	23	12,150	371	1,562	5,961,690	24,012,576

Source: UNISDR and UNDP based from DesInventar database - www.desinventar.org

The differences in reported losses in EM-DAT and DesInventar are also evident in other databases. For example, in Sri Lanka, 230 death have been reported from floods and landslides from 1989 onwards in the DesInventar national database, which is categorized by type of effect and by district. However, the same figure is reported as 325 in EM-DAT, 276 in ReliefWeb, less than 300 in ADRC, and 300 by Dartmouth Flood Observatory. Which one is the most accurate is difficult to say at this time.

This results in two large gaps in our understanding of disaster risks. First is that it is only EM-DAT where most countries have systematic disaster losses recorded and made available for analysis. In Asia and the Pacific region, only Nepal, Iran, and Sri Lanka have comprehensive national databases. In India, the province of Orissa has the database. Indonesia, Viet Nam, Maldives and Vanuatu just recently started to develop their own databases.

The second gap is that EM-DAT only provides information on larger disaster. Medium to small disaster are more frequent, causing accumulated impacts on society, but they are not captured in EM-DAT. Thus, extensive disaster risks are not measured.

These two limitations pose challenges in our attempt to understand disaster risks in Asia and the Pacific, and provide us with a clear picture of where the gap exists, and where concerted action would be needed by countries in the region.

The next section is an attempt by this report to interpret disaster risks most relevant to decision makers in Asia and the Pacific, despite the limitations posed by EM-DAT data.

Physical and economic exposure to disasters

Overall disaster risk depends on three factors:

- *Hazard* – The type and intensity of a hazard event
- *Exposure* – The number of people and the scale of assets exposed to the event
- *Vulnerability* – The capacity to cope with and recover from hazard events.

Over the past 20 years, the risks for most hazards have been increasing. This is mainly because of the increase in exposure, though this has partially been offset by reduced vulnerability resulting from better development conditions (GAR 2009). Factors that influence vulnerability are examined in greater detail in Chapter II.

For flooding, as indicated in Table I-10, the Asia-Pacific region has the world's top 10 most exposed countries. This is true both in absolute numbers, with Bangladesh at the top, and in terms of relative exposure with Cambodia at the top. For storms, the region has the top four most exposed countries in absolute terms, and in relative terms the second most exposed – the North Mariana Islands. For earthquakes, Asia and the Pacific has the top four most exposed countries in terms of absolute exposure, and the top two in terms of relative exposure – Vanuatu and Solomon Islands.

A corresponding analysis can be carried out for economic exposure. This is done by mapping physical exposure onto the distribution of economic output to estimate the GDP at risk. For flooding, seven countries from the Asia-Pacific region are in the world's top 10 most exposed countries – absolutely (lose) and relatively (loss related to GDP) (Table I-11). For cyclones, six Asia-Pacific countries are in the world's top 10 for absolute exposure. For earthquakes, for example, Japan is the most exposed followed by China and the Philippines. In terms of relative exposure to storms, the highest levels are among the small Pacific Island countries. For earthquakes, Vanuatu has the world's highest relative GDP exposure. Several other countries from the Pacific, South Asia and North and Central Asia also have high relative exposures to earthquakes.

Table I-10 Top 10 countries in the Asia-Pacific region based on absolute and relative physical exposure

Rank	Floods		Storms		Earthquakes	
	Absolute (millions)	Relative (%)	Absolute (millions)	Relative (%)	Absolute (millions)	Relative (%)
1	Bangladesh[1] (19.2)	Cambodia[1] (12.2)	Japan[1] (30.9)	North Marina Isl.[2] (58.2)	Japan[1] (13.4)	Vanuatu[1] (60.4)
2	India[2] (15.8)	Bangladesh[2] (12.1)	Philippines[2] (20.7)	Niue[9] (25.4)	Philippines[2] (12.1)	Solomon Isl.[2] (36.3)
3	China[3] (3.9)	Viet Nam[3] (3.9)	China[3] (11.1)	Japan[10] (24.2)	Indonesia[3] (11.0)	Tonga[6] (21.1)
4	Viet Nam[4] (3.4)	Bhutan[4] (1.7)	India[4] (10.7)	Philippines[11] (23.6)	China[4] (8.1)	Papua New G..[9] (17.5)
5	Cambodia[5] (1.7)	India[5] (1.4)	Bangladesh[6] (7.5)	Fiji[12] (23.1)	India[8] (3.3)	Philippines[12] (13.8)
6	Indonesia[6] (1.1)	Thailand[6] (1.3)	Rep. of Korea[9] (2.4)	Samoa[15] (21.4)	Pakistan[9] (2.8)	Timor Leste[14] (11.3)
7	Thailand[7] (0.8)	Nepal[7] (1.2)	Myanmar[11] (1.2)	New Caledonia[18] (20.7)	Iran[15] (1.7)	Japan[15] (10.5)
8	Philippines[8] (0.7)	Lao PDR[8] (1.1)	Viet Nam[13] (0.8)	Vanuatu[20] (18.3)	Bangladesh[17] (1.3)	Bhutan[17] (0.8)
9	Pakistan[9] (0.5)	Myanmar[9] (0.9)	Hong Kong[17] (0.4)	Tonga[21] (18.1)	Papua N. G..[9] (1.1)	Indonesia[31] (0.4)
10	Myanmar[10] (0.4)	Philippines[10] (0.9)	Pakistan[19] (0.3)	Cook Islands[32] (10.5)	Afghanistan (1.0)	Kyrgystan[35] (0.4)

Source: P. Peduzzi, UNEP/GRID-Europe

Note: Number in parenthesis is the value. Number in superscript against each country shows its global rank.

Table I-11 Top 10 countries in the Asia-Pacific region based on absolute and relative GDP exposure

Rank	Floods		Cyclones		Earthquakes	
	Absolute ($billions)	Relative (%)	Absolute ($billions)	Relative (%)	Absolute ($billions)	Relative (%)
1	China[1] (12.5)	Bangladesh[1] (14.5)	Japan[1] (1,226.7)	North Marina Isl.[2] (59.4)	Japan[1] (340.7)	Vanuatu[1] (96.5)
2	Bangladesh[3] (9.7)	Cambodia[2] (14.0)	Rep. of Korea[4] (35.6)	Vanuatu[9] (27.1)	China[7] (16.0)	Solomon Isl.[2] (46.3)
3	India[4] (9.3)	Viet Nam[3] (4.4)	China[5] (28.5)	Niue[11] (24.9)	Philippines[9] (11.4)	Tonga[6] (22.7)
4	Japan[6] (4.5)	Philippines[5] (2.5)	Philippines[6] (24.3)	Fiji[13] (24.1)	Indonesia[11] (7.9)	Papua New G.[8] (22.1)
5	Thailand[8] (3.0)	Thailand[6] (1.8)	Hong Kong[7] (13.3)	Fiji[8] (16.0)	Turkey[14] (5.7)	Timor Leste[13] (14.9)
6	Philippines[9] (2.5)	India[8] (1.3)	India[9] (8.0)	Japan[14] (23.9)	Iran[17] (3.8)	Philippines[14] (11.2)
7	Viet Nam[10] (2.2)	Myanmar[9] (1.1)	Bangladesh[13] (3.9)	Philippines[5] (23.9)	Australia[25] (2.7)	Japan[23] (6.6)
8	Rep. of Korea[18] (1.2)	Lao PDR[11] (1.1)	North Marina Isl.[19] (1.5)	New Caledonia[16] (22.4)	India[25] (2.1)	Kyrgystan[35] (4.0)
9	Indonesia[19] (1.0)	Nepal[13] (0.9)	Australia[23] (0.8)	Samoa[21] (19.2)	Pakistan[31] (1.4)	Azerbaijan[36] (4.0)
10	Cambodia[21] (0.9)	Sri Lanka[18] (0.6)	New Caledonia[25] (0.7)	Tonga[24] (17.4)	New Zealand[34] (1.0)	Indonesia[41] (3.5)

Note: Number in parenthesis is the value. Number in superscript against each country shows its global rank.
Source: P. Peduzzi, UNEP/GRID-Europe

Impact of climate change on disaster risk

Future development policy, including that on creating mega-infrastructure, will need to take due consideration of future disaster risks, and in particular the impact of climate change. There has been many efforts to link the rise in the reported number of disasters with emerging evidence on global climate change but it is not possible to establish this link conclusively. Because of the degree of randomness in both global climate systems and the occurrence of disasters, and the limited data available covering the past three decades, it is statistically difficult to quantify and isolate the exact impact of climate change.

However, there is some evidence of linkages between physical changes, atmospheric, terrestrial and oceanic, and the weather processes that lead to disaster caused by natural hazards. So it is difficult to set aside the potential impact of climate change. This section therefore analyzes the climate change findings of various international, regional and national agencies for the Asia-Pacific region and considers the implications for disaster risk reduction, particularly for hydro-meteorological disasters such as floods, droughts, extreme temperatures, typhoons, hurricanes, and wildfires.

IPCC has examined the published results from many different models to indicate the potential global changes by 2100. In summary, it has concluded:

- *Surface warming* – Global average surface air temperature will increase by between 1.1°C and 6.4 °C.
- *Sea level* – The sea level will rise by between 18 and 59 centimetres, and oceans will become more acidic.
- *Extreme events* – It is very likely that there will be more frequent hot extremes, heat waves and heavy precipitation events.
- *Precipitation* – It is very likely that there will be more precipitation at higher latitudes and likely that there will be less precipitation in most subtropical land areas.
- *Cyclones* – It is likely that tropical cyclones typhoons and hurricanes – will become more intense, with larger peak wind speeds and more frequent heavy precipitation associated with ongoing increases in tropical sea surface temperatures.

Nevertheless, there will be differences within Asia-Pacific subregions:

Extreme temperatures – In Central Asia, the Tibetan Plateau and North Asia, the warming is likely to be well above the global mean. In East and South Asia, it will be above the global mean, and in South-East Asia, it will be similar to the global mean. In East Asia, summer heat waves or hot spells will be of longer duration, more intense and more frequent. East Asia and South Asia are also very likely to have fewer very cold days.

Precipitation – Boreal winter precipitation is very likely to increase in North Asia and the Tibetan Plateau, and it is likely to increase in Eastern Asia and the southern parts of South-East Asia. Summer precipitation is likely to increase in North Asia, East and South Asia and most of South-East Asia, but it is expected to decrease in Central Asia. An increase in the frequency of intense precipitation events is very likely in parts of South Asia and East Asia.

Storms – Since 1970s, there is good evidence for an increase in the more damaging and intense tropical cyclone activity in the North Atlantic. This is correlated with increases in tropical sea surface temperatures. However, there is no clear trend in the global annual number of tropical cyclones. Extreme rainfall and winds associated with tropical cyclones are likely to increase in East, South-East and South Asia. Monsoonal flows and the tropical large-scale circulation are likely to be weakened. However, there has been little assessment of the projected changes in regional climatic means and extremes. Also, there are substantial variances in models representing monsoon processes. A lack of clarity over likely future changes in the El Niño-Southern Oscillation (ENSO) further contributes to uncertainty about future regional monsoon and tropical cyclone behaviour. Consequently, it is difficult to obtain quantitative estimates of projected precipitation changes. Nevertheless, it is clear that the region's very complex topography and marine influences will result in local climate changes that can vary significantly from regional trends.

Droughts – Many long-term trends over the period 1900-2005 indicate significant increases in precipitation in Northern and Central Asia, and more dry conditions in parts of Southern Asia. More intense and longer droughts have been found over wider areas since the 1970s, particularly in the tropics and subtropics. Higher temperatures and decreased precipitation have increased the prevalence of drier conditions and contributed to changes in the distribution of droughts. Changes in sea surface temperatures, wind patterns, and decreased snow pack and snow cover have also been linked to droughts.

Sea level – Global average sea level is rising as a consequence of three factors: thermal expansion of warming ocean water; the addition of melted water from the ice sheets of Greenland and Antarctica, and from glaciers and ice caps; and an increased surface runoff. Over the 20th Century, the average rate of global mean sea level rise was about 1.7 millimetres per year. During 1993-2003, it was 3.1 millimetres per year, and since 2003, it has been about 2.5 millimetres per year. Prior to 1990, more than 50 per cent of the sea level rise came from thermal expansion, but this proportion has now dropped to 15 per cent, with a much greater contribution from the melting of glaciers, ice caps and ice sheets. If current trends continue, the glacier and ice cap reservoir will be exhausted by 2200 (UNEP, 2007).

In addition to the scenarios presented by IPCC and the United Nations Environment Programme (UNEP), there is an emerging body of evidence from other studies in Asia and the Pacific. The rest of this chapter presents a collection of case studies from the region on possible climate change impacts on Glacial Lake Outburst Floods (GLOFs) droughts, sea level rise, extreme precipitation events, and forest fires.

Glacial lake outburst floods

In the Indian sub-continent over the last 100 years, the air temperature has increased by an estimated 0.3ºC to 0.6ºC – and by 2100 the temperature may increase further by 3.5 ºC to 5.5ºC (IPCC, 2007). This will affect high-altitude glacial environments, which are very sensitive to temperature changes. Studies by ICIMOD (2007), SAARC (2008) and others have shown that in recent decades the Himalayan glaciers have been melting at unprecedented rates. This results in the formation of ever-larger glacial lakes, with the risk of sudden breaches and "GLOFs". Most of the Himalayan glacial lakes have appeared within the last five decades, often with devastating consequences. Two known hotspots of glacial activity are the Dudh Koshi sub-basin of Nepal and the Pho Chu sub-basin of Bhutan (ICIMOD, 2007).

Nepal – The Imja glacier has been retreating ever faster: from 1962 to 2000 it retreated by 42 metres per year but between 2001 and 2006 the rate increased to 74 metres per year. In Bhutan between 1963 and 1993, glaciers were retreating by 30 metres per year. In the Lunana region of the Pho Chu sub-basin in 2001, some of the glaciers were retreating as fast as 57 metres per year with rate increases since 1970 of up to 800 per cent. Some of the smaller glaciers have now disappeared. As the glaciers melt, they can form new lakes, expand or merge existing ones. In the Dudh Koshi sub-basin, the total number of lakes has decreased by 37 per cent, but their total area has increased by 21 per cent. The Thorthormi glacier had no supra-glacial ponds during the 1950s, but now has a new cluster of supra-glacial lakes. If this trend continues, it will merge to form a large lake posing a serious GLOF threat.

Bhutan – In the Pho Chu sub-basin, the total number of lakes has decreased by 19 per cent but the total area has increased by eight per cent. The Luggye Tso Lake, for example, is expanding once again. Monitoring of Lake Imja Tsho using the European Space Agency (ESA) radar satellite imagery has provided a useful means for detecting growth of the lake, even monthly – and it now seems that the lower terraces at several villages could be over topped by a GLOF.

These local changes in the Himalayas underline the importance of investigating the impact of global warming on glaciers over much larger areas. ICIMOD and SAARC among others say that given the complexity and expense of monitoring, safeguarding, these precious regional resources will need greater action from the international community. GLOF mitigation measures and early warning systems are expensive particularly for smaller countries, therefore, a regional approach may prove more useful.

Droughts

According to United Nations estimates, one third of the world's population lives in areas with water shortages, and 1.1 billion people lack access to safe drinking water. After floods, droughts are the world's second most geographically extensive hazard (Liu, 2007). In Asia, drought is the second most significant disaster after flooding in terms of affected population and it occupies fourth position in terms of damage. Droughts may cause less immediate physical damage than earthquakes, floods, or storms, and as a result often receive lower priority in disaster risk reduction. But they often have a longer-lasting impact, undermining food and water security. As they become more frequent and widespread, they will need much greater attention. They can also exacerbate environmental degradation and desertification.

Drought is a particularly severe problem in China. In 2006, for example, a severe drought in Southern China left 520,000 people short of drinking water, damaged 102,000 hectares of crops, and caused economic losses of over $50 million. In that year, the city of Chongqing suffered its worst drought in half a century, causing financial losses of around $1 billion. Across China that summer, 18 million people went short of drinking water.

Australia has also been severely affected. Some areas of Australia may have annual rainfall of over 1,200 millimetres, but overall this is the world's driest inhabited continent. Severe droughts affect some parts of Australia about once every 18 years – though the intervals between these events have varied from 4 to 38 years. Severe droughts occurred in 1982 and 1994, and starting in 2002, three years of rainfall deficits led to continuing drought in 2005. But the most severe drought was in 2006. Since 1999, severe drought has also hit much of Central and South-West Asia – affecting close to 60 million people and putting stress on agriculture, animal husbandry, water resources, and public health. Preliminary analysis suggests that these droughts are related to large-scale variations in the climate across the Indian and Pacific Oceans due to global warming and related weather disturbances such as ENSO (Liu, 2007).

Drought planning and mitigation can now make more use of satellite remote-sensing techniques. China, for example, has made substantial progress in using these techniques to monitor soil moisture and droughts. To further address this, the National Climate Program has developed the Drought-Flood Monitoring System and Operational System for Climate Impact Assessment and for Short-term Climate Prediction.

Sea level rise

In the Asia-Pacific region, the countries among the most fragile and exposed are the Maldives and the Pacific Island developing countries. Many Pacific Island countries are low-lying atolls, but even in the larger countries many people live by the sea. In Fiji, for example, half the population live within 60 kilometres of the shore and 90 per cent of villages are on the coast. Sea level rise may force people to move away from their customary land on coastal lowlands.

With limited land space and human and financial resources, these economies are already facing disasters caused by natural hazards, particularly storms, droughts and floods. Now, warming ocean temperatures and sea level rise are threatening fisheries as well as coral reef and mangrove habitats.

- *Loss of land* – due to flooding coastal plains, with low-lying atolls especially at risk.
- *Less fresh water* – as a result of floods, droughts and cyclones which threaten freshwater supplies.
- *Lower agricultural productivity* – as a result of extreme weather events, such as warmer, wetter climates that favour the breeding of pests.
- *Degraded coral reefs* – coral reefs are bleached by higher ocean temperatures, causing some species, such as tuna to move to other areas.
- *More disease* – a result of warmer, wetter conditions that favour insects such as mosquitoes as well as aquatic pathogens.
- *Reduced tourist income* – due to visitors discouraged by disasters and the prevalence of disease as well as by shrinking biodiversity.
- *Lower productivity* – More severe disasters and lower health standards will undermine natural and human resources and inhibit economic development.

However, the impact is also likely to be severe in larger low-lying nations such as Bangladesh, and along deltas and river systems such as the Mekong (Box I-4). UNU and the United Nations High Commissioner for Refugees (UNHCR) (2009) mapped the effects and concluded that in the densely populated Ganges and Mekong systems a sea level rise of 1 metre could affect 24 million people and reduce the land currently under intensive agriculture by at least 1.5 million hectares. A sea level rise of 2 metres would affect an additional 11 million people and render at least 969,000 more hectares of agricultural land unproductive. This would force millions of people to migrate, though many of these "environmental migrants" who lack the necessary financial, social, and political resources would be unable to move far enough to fully mitigate the impact and would find themselves in equally precarious destinations.

Tropical cyclones

In the last 50 years, there have been significant inter-decadal and inter-annual fluctuations in the frequency of tropical cyclones in the Western North Pacific. But there is no clear long-term trend (ESCAP/WMO Typhoon Committee, 2009). The situation differs from one part of the region to another. Japan and the Philippines, for example, show no significant trend in the frequency of land-falling cyclones. And in the case of China and Thailand, the number seems to be decreasing, while for the Republic of Korea, it could be increasing. In China, the maximum intensity of land-falling tropical cyclones seems to be declining but there is no trend in mean intensity. And while the extreme winds induced by tropical cyclones appear to be decreasing, there is no trend for the associated precipitation.

Most climate models project a reduction in the number of tropical cyclones in the Western North Pacific, but there are fewer studies on cyclone intensity. In a warmer climate, some models project an increase in the number of intense cyclones. However, such projections have considerable uncertainties and limitations.

Heavy precipitation

Based on existing methods of rainfall monitoring, IPCC has concluded that most land areas have seen more frequent events of heavy precipitation, which are consistent with global warming and the observed increases of atmospheric water vapour.

The Japan Meteorological Agency, however, has undertaken a new study that shows a gradual increase in hourly rainfall and frequency of heavy daily rainfall. The Automated Meteorological Data Acquisition System (AMeDAS) has made observations at one-hour intervals at about 1,300 regional observing stations since late 1970s. AMeDAS covers a shorter historical record than local weather stations which have records going back about 100 years but it has around nine times as many stations, making it easier to capture localized heavy precipitation. AMeDAS tallies up the frequency of days with over 200 millimetres or over 400 millimetres of rain, and the frequency of hours with over 50 millimetres and over 80 millimetres of rain. Using 11-year average values, this shows gradual increases in hourly rain and in the frequency of heavy daily rain. However, since the observation period of AMeDAS is short and the frequencies of heavy and strong rain change considerably every year, further data will be needed to capture the long-term trend (Ebihara, S, 2003).

India gathers daily rainfall data from 1,803 weather stations. For Central India during the monsoons between 1951 and 2000, there were fewer moderate rain events and more extreme ones. However, since one trend has offset the other, there has been no significant trend for seasonal mean rainfall. Central India is expected to have a substantial increase in hazards related to heavy rain in the future (Goswami and others, 2006).

Forest fires

Forest fires are primarily induced by humans although they are also aggravated by climatic extremes. Many communities have traditionally used fires to clear agricultural land but nowadays fires are regularly used to convert peat lands to commercial plantations, often to produce biofuels. These land-use fires can spread as wildfires during dry spells or during the extended droughts that are likely to occur during ENSO events. These appear to be increasing in severity and frequency as a result of climate change (GFMC, 2009). Fires are also becoming more likely as a result of greater regional vegetation dryness following the melting glaciers in the Himalayas. In mainland South and South-East Asia, forest fires cause seasonal smoke pollution, which is aggravated by industrial pollution and trash burning – leading to the "Asian brown cloud" or the seasonal smoke pollution in Northern Thailand.

In Central Asia, unsustainable forestry practices, often illegal, are increasing the risk and severity of wildfires and contributing to steppization. In North Asia, warming will affect forest cover and fire regimes and reduce the extent of permafrost. In North-East Asia, notably in the far east of the Russian Federation, mixed forest ecosystems are becoming increasingly vulnerable to fire – as a consequence of careless fire use and reduced institutional capacities to manage fires (GFMC, 2009).

Climate change and disaster risk

Although it is extremely difficult to quantify the physical impact of any particular climate change process, there have been some qualitative estimates of future disaster risks and the threats to development in Asia and the Pacific (IPCC, 2007). In the absence of any countermeasures, climate change is expected to influence future disaster risks in three ways: first, through the likely increase in weather and climatic hazards such as global warming, sea-level rise, and erratic precipitation patterns; second, through increases in the vulnerability of communities to natural hazards due to ecosystem degradation, reductions in water resources and food availability, and changes in livelihoods; and third, by pushing more people to higher levels of hazard exposure. Many communities will also be less able to cope with even existing levels of disastrous natural hazards, as a result of environmental degradation and rapid unplanned urban growth coupled with climate change.

An index of disaster risk

In the past five years, a number of international agencies have developed indexes for disaster risk and management. United Nations Development Programme (UNDP), in partnership with UNEP-GRID, for example, has produced a Disaster Risk Index (DRI), which ranks the countries according to the level of risk (Peduzzi et al, 2009). Similarly, Columbia University and the World Bank under the ProVention Consortium have implemented a Hotspot project, which aims to identify at greatest risk (Dilley, 2006). The Americas Indexing Programme of the Instituto de Estudios Ambientales of the Universidad Nacional de Colombia in partnership with the InterAmerican Development Bank has produced a set of composite indexes that represent different aspects of disaster risk or disaster risk management (Cardona, 2006).

The current chapter provides risk indices by assessing risk patterns of non-major disaster events caused by hydrometeorological whose recurrence period is within 20 months. Extremely large disasters caused by earthquakes, tsunamis, and tropical cyclones are not a primary target.

Using data from EM-DAT (for the period of 2000-2004 to 2005-2009), trends have been estimated for the risks of deaths and the number of people affected per month per million population, as well as the economic damage and loss per month expressed as a percentage of GDP.

The use of a return period of once in 20 months provides us with an opportunity to make the results more meaningful to decision makers in the region, since 20 months is well within the terms of elected officials in the region. It also circumvents the inherent limitations of the EM-DAT database, which is its incomplete coverage of more frequent disaster events in countries.

The overall results are presented in Figure I-3. This uses the following symbols to express changes between the periods 2000-2004 and 2005-2009:

▼ – Risk has reduced
▲ – Risk has increased
■ – Risk has stayed the same

The results are in one sense reassuring. Apart from the risk of deaths caused by meteorological hazards, generally, risks have not increased. However, this may also seem surprising given the enormous efforts in recent years to improve multi-hazard early warning systems.

This figure also shows the changes in risk by various country groups.

East and North-East Asia – Risks have decreased or kept constant for almost all types of disasters and types of impact, the exception being the risk of deaths by climatological disasters.

North and Central Asia – Risks decreased for multi-hazard and climatological disasters but increased for people affected by hydrological and meteorological disasters.

Pacific region – Risks increased for deaths by geophysical, hydrological and climatological disasters. The risk of people affected per month per million has also increased for multi-hazard and hydrological disasters.

South-East Asia – The risk of deaths and numbers of people affected by meteorological disasters has increased as well as the risk of deaths by climatological disasters.

South and South-West Asia – Risk of loss by climatological disasters has reduced while the risk of deaths by meteorological disasters has increased.

Figure I-3 **Trend in disaster risk, Asia-Pacific country groupings – 2000-2004 to 2005-2009**

Country grouping	Multi-hazard			Geophysical			Meteorological			Hydrological			Climatological		
	Casualties	Total People Affected	Econ. Damage and Loss	Casualties	Total People Affected	Econ. Damage and Loss	Casualties	Total People Affected	Econ. Damage and Loss	Casualties	Total People Affected	Econ. Damage and Loss	Casualties	Total People Affected	Econ. Damage and Loss
Asia and the Pacific	■	▼	■	■	■	■	▲	■	■	■	■	■	▼	■	▼
East and North-East Asia	■	■	■	■	▼	■	■	■	■	■	■	▼	▲	■	■
North and Central Asia	▼	▼	▼	■	■	■	▼	▲	▼	▼	▲	▼	▼	■	▼
Pacific	■	▲	■	▲	▼	■	▼	■	▼	▲	▲	■	▲	■	▼
South-East Asia	■	▲	■	■	■	■	▲	▲	■	■	■	■	■	▲	▼
South and South-West Asia	■	■	■	■	▼	■	▲	■	■	■	■	■	▼	▼	▼
LDC	▲	■	▲	■	▲	■	■	▲	▲	■	▼	▼	▼	■	▼
LLDC	■	▼	■	▼	■	■	▲	▼	▼	▲	▲	■	▼	▼	▼
Low income	▲	▼	■	■	■	▼	▲	■	▲	■	■	▼	■	■	▼
Lower middle income	▼	■	■	■	▼	▼	■	■	■	■	▲	■	■	▼	■
Upper middle income	■	■	▼	▲	▲	▼	▲	■	▼	■	■	▼	▲	▲	▼
High income	■	■	■	■	▲	▼	■	▼	■	■	■	■	▲	▼	■

Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium. The estimates were calculated by comparing the Value at Risk of impact of disasters between 2 periods of 5 years.

Notes: Multi-hazard comprises Geophysical, Meteorological, Hydrological and Climatological

Geophysical = Earthquake, Volcano, Mass Movement (dry), Meteorological = Tropical Storm, Extra-Tropical cyclone - winter storm, Local / Convective Storm, Hydrological = Flood and Mass Movement (wet) Climatological = Extreme Temperature, Drought, Wildfires

Analysis of countries with special needs suggests that risk of hydrological disasters has increased in the Landlocked Developing Countries (LLDCs), while the Least Developed Countries (LDCs) have experienced an increase in risk of loss caused by multi-hazard, geophysical and meteorological events. Overall the risks appear to be increasing in the poorer countries.

Figure I-4 presents the result of similar analysis of trends of risk for individual countries. The blank cells in the table indicate the countries, period and type of loss for which no conclusive assessment could be made.

Figure I-4 Trend in disaster risk, Asia-Pacific economies – 2000-2004 to 2005-2009

	Multi-hazard			Geophysical			Meteorological			Hydrological			Climatological		
Country	Causalities	Total People Affected	Econ. Damage and Loss	Causalities	Total People Affected	Econ. Damage and Loss	Causalities	Total People Affected	Econ. Damage and Loss	Causalities	Total People Affected	Econ. Damage and Loss	Causalities	Total People Affected	Econ. Damage and Loss
East and North-East Asia	■	■	■	■	▼	■	■	■	■	■	■	▼	▲	■	■
China	■	■	■		■		▲	■	▲	■	▲	▼	▲	▲	
Democratic People's Republic of Korea															
Hong Kong, China	■						■			■	■	■	■	■	■
Japan	■	▼	▼	▲	▼	■	▼	▲	▼	▲	▲	▼	■		■
Macao, China	■	■	■				■	■	■						
Mongolia	▼						▼			■			■	▼	■
Republic of Korea	▼	▲					▼			▼	▲	▼	■		■
North and Central Asia	▼	▼	▼	■	■	■	▼	▲	▼	▼	▲	▼	▼	■	▼
Armenia	■			■	■	■				■	■	■	■		
Azerbaijan	■		▼	■						■			■	■	
Georgia	▼	▼	▼	■			■		■	■			■		▼
Kazakhstan	▼			■		■	■	■	■	■			■		■
Kyrgyzstan	▲	■		■	▲	■	■		■	▼	▼		■	■	■
Russian Federation	▼	▼	▼	■			▼		▼	▼	▲	▼	▼		
Tajikistan	▲	■	▼	■	■		■			▼			■	▲	
Turkmenistan	■	■	■	■	■	■				■	■	■			
Uzbekistan	■		▼	■	■	■				■		■	■	▼	▼
Pacific	■	▲	■	▲	▼	■	▼	■	▼	▲	▲	■	▲	■	▼
Australia	▲	■	■	■	■	■	■		■	▲	▲	■	▲		▼
Cook Island															
Fiji	▲			■	■	■	▼			▲		▲	■	■	■
French Polynesia															
Guam															
Kiribati	■		■							■		■	■	■	■
Marshall Islands	■		■				■	■	■	■		■			
Micronesia (Federated States of)	■	▼					■	▼		■	■	■	■	■	■
Nauru															
New Caledonia															
New Zealand	■	▲	▼	■	■	■	■			■			■	■	
Niueu															
Northern Mariana Islands															
Palau															
Papua New Guinea	▲		■	▼	▼	■	■		■	▲	■	■	■	■	■
Samoa	▲			■			■	■	■	■	■		■	■	■
Solomon Islands	■		■	■		■	■	▼	■	■		■	■	■	■
Tonga	■			■			■								
Tuvalu															
Vanuatu	■	▲	■	■		■	■		■	■		■			
South-East Asia	■	▲	■	■	■	■	▲	▲	■	■	■	■	■	▲	▼
Brunei Darussalam	■	■	■										■	■	■
Cambodia	▼	▼					■		■	▼	▼		■		
Indonesia	■	■	▲		▲	▲	■		■	■	■	▼	■		
Lao People's Democratic Republic	▲						■			■			■	■	■
Malaysia	▼	■		■			■	▼	■	▼	■		■	■	■
Myanmar															
Philippines	■	■	■	▼			■	■	▲	▼	▲	▲	■	■	
Singapore															
Thailand	▼	▲	■	■			▼	▼		■	▲	■	■		
Timor-Leste	■	■	■				■		■	■		■	■	■	■
Viet Nam	■	■	▲				▲	▲	▲	▼	▼	▼	■		
South and South-West-Asia	■	■	■	■	▼	■	▲	■	■	■	■	■	▼	▼	▼
Afghanistan															
Bangladesh	■	■	▼	■			▼	▼		▼	▼	▼	▼		■
Bhutan	■		■	■		■	■	■	■	■		■	■	■	■
India	■	■	▼	▼			■	▼		■	■	■	▼		▼
Iran (Islamic Republic of)	▼	▼	▼	▼	▼	■	■			▼	▲		■	▼	▼
Maldives	■			■			■	■	■	■		■			
Nepal	▼	■		■	■	■	■	■	■		▲		▼		■
Pakistan	▼	■	▲	▼			▲			▲	▲		▼		▼
Sri Lanka	▲	■		■			■		■	▲	■		■	▼	■
Turkey	▼	▼		▼	▼		▼	▼	■	■	▼		▼		

Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium. The estimates were calculated by comparing the Value at Risk of impact of disasters between 2 periods of 5 years.

Box I-1 – Regional cooperative mechanism on disaster monitoring and early warning, particularly drought

ESCAP launched this Mechanism in September 2010, with technical support of China, India, Thailand, WMO, Asia-Pacific Space Cooperation Organization (APSCO), ESCAP/WMO Typhoon Committee and other stakeholders. Its major functions include: a) provision of satellite information products and services for monitoring drought and identifying high risk areas for early warning possible drought; b) an information portal for accessing technical services of the mechanism, national drought profiles, technical references and other drought risk management related information; and c) capacity building to assist ESCAP members in developing localized products and services and national service networks, and to provide opportunities for training, technology transfer, technical cooperation and pilot projects. At the initial stage, it will cover only drought, but gradually flood and other types of disasters at a later stage. In this connection, the Mechanism is expected to eventually also activate provision of space-based products to the affected government immediately after a major disaster strikes.

Box I-2 – Recent mega-disasters in Asia and the Pacific

Cyclone Nargis (Myanmar) – 2-3 May 2008

- Category: 4 (Saffir-Simpson scale)
- People killed: 84,530 deaths and 53,836 missing
- People affected: 2.4 million
- Economic damage: $4 billion

Wenchuan Earthquake (China) - 12 May 2008

- Magnitude: 8.0 (Richter scale)
- People killed: 69,227 deaths and 17,923 missing (by 25 September 2008)
- People affected: 45.6 million
- Economic damage: $85 billion

Indian Ocean Tsunami - 26 December 2004

- Magnitude: 9.3 (Richter scale)
- People killed: 184,167 and 45,752 missing
- People affected: 5.0 million
- Economic damage: $10 billion

Box I-3 – Estimating tsunami risks with sedimentation surveys

Gigantic earthquakes repeat at several hundred year intervals and the history of past events can be used to calculate the probability of future ones. For earthquakes with long recurrence intervals, these can be based on geological data. Indeed sediments left in the wake of tsunamis are often the only discernable record that a coastline has been struck.

In Indonesia, in Meulaboh and in Aceh, sand sheets represent earlier tsunamis soon after AD 1290-1400 and after AD 780-990. An additional limited sand sheet might correlate with a documented smaller tsunami in AD 1907. In Simeulue Island, a fresh, uneroded coral boulder from a paleo-tsunami layer yields an age consistent with a historically recorded earthquake in 1861. Another paleo-tsunami layer may have been deposited by a tsunami associated with an earlier event around 1799. In Pangandaran, West Java, the deposit is correlated to the tsunami in 1921.

In Sri Lanka, at Karagan lagoon, Hambantota, a sand layer might correlate with an historical tsunami, which occurred during 2100-2300 BP. In the same lagoon, the possible tsunami sand layers, which might suggests the past tsunami recurrence, were formed at about 600 to 1,000 years intervals. In Thailand, at Phra Thong Island, the ages of four paleotsunami sand layers, which are likely to have been deposited by the predecessors of the 2004 tsunamis, are estimated range from 300 to 2,300 years ago. In Banda Aceh in Indonesia, the 2004 Earthquake that caused the 2004 Indian Ocean Tsunami has a predicted 520 years return period earthquake though lesser events are more frequent, as indicated in the table below.

Magnitude (Mw)	Return period years	Tsunami height (m) at Banda Aceh
9.2	520	9.5
8.5	250	5.2
8.0	120	2.7
7.5	55	1.11
7.0	25	0.48

Source: Latief, H et-al 2009

Box I-4 – Climate change in the Mekong Delta, Viet Nam

The Mekong Delta would be seriously impacted by climate change due to sea level rise, warmer, longer and more arid dry seasons, increased flooding during the rainy season and elevated Carbon dioxide (CO_2) concentrations. This will directly affect the presence of pesticides in the environment, referred to as "pesticide fate". But there will also be indirect effects as a result of altered development, reproduction and dispersal of invertebrate pests; changes in resistance and cultivation conditions of common crop varieties; and changing land use patterns.

Since the mid-1980s, pesticide use in the Mekong Delta has increased substantially. This has been reduced somewhat through integrated pest management and 3R3G (3 reductions, 3 gains). But climate change is likely to influence land use and the outbreaks of insect pests and diseases and undermine these positive developments.

Source: Sebesvari and others, 2010

Box I-5 – Tornadoes in Bangladesh

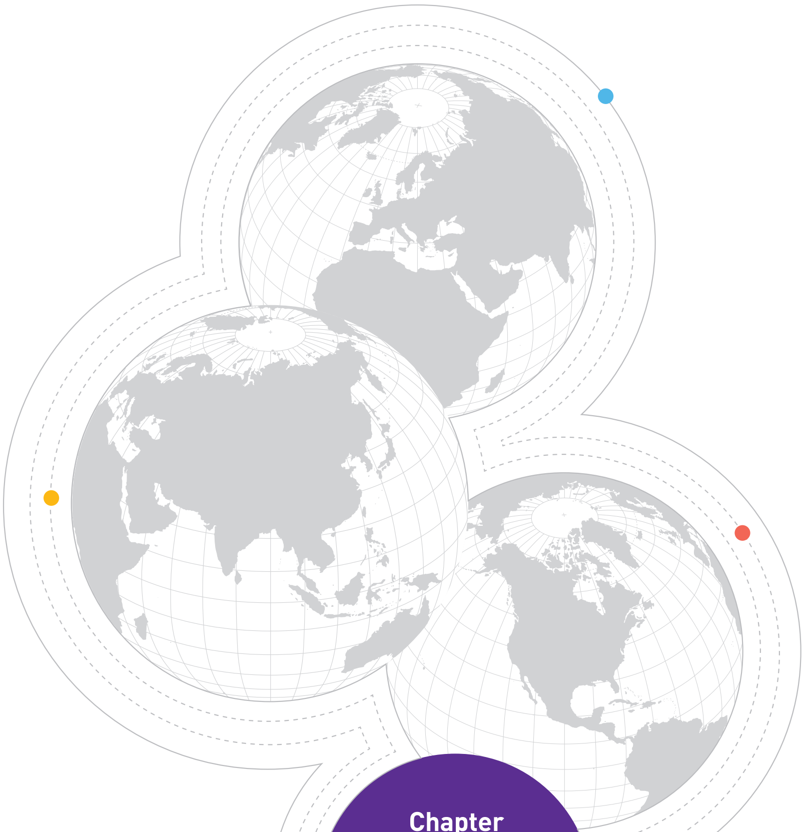
Bangladesh lies between the Himalayas to the north and Bay of Bengal to the south, and has an intricate river system and complex and shallow coastal configuration. Cold heavy air from the north and warm moist air from the south create the conditions for severe thunderstorms, which spawn frequent tornadoes or other strong winds. During the period 1961 to 1996, these caused more than 10,000 deaths. The frequency is likely to increase as a result of climate change (IAWE, 2009).

Source: Kayahara, 2009

Box I-6 – Building a disaster risk index

For building the index in this report, the definition of risk adopted in this report is the following one proposed by Cardona (2003):

"Risk: the expected number of lives lost, persons injured, damage to property and disruption of economic activity due to a particular natural phenomenon, and consequently the product of specific risk and elements at risk." "Thus, risk is the potential loss to the exposed subject or system, resulting from the convolution of hazard and vulnerability. In this sense, risk may be expressed in mathematical form as the probability of surpassing a determined level of economic, social or environmental consequences at a certain place and during a certain period of time".



Chapter

II

Socio-economic impacts of disasters

Socio-economic impacts of disasters

Disasters, whether single dramatic large-scale events or smaller-scale ongoing crises, not only cause immediate economic damage and loss of life, they also have a deep and lasting impact on human development. Disaster losses are often linked with, or exacerbated by poverty and vulnerabilities of the poor that stem from socio-economic and environmental imbalances. In turn, disasters may push people into poverty and affect the ability of the poor to rise out of poverty – since people who are constantly exposed to such threats and income shocks are more likely to stay poor and vulnerable, setting in motion a vicious cycle that can be extremely difficult to break.

Impacts of disasters

Disasters used to be considered as singular events primarily demanding emergency humanitarian responses focused on meeting basic physical needs of survivors. But for many people, smaller-scale disasters are an ongoing part of daily life. And on a larger scale these events have a legacy that is deep with potential lasting impact on the quality of economic growth and development. The loss of human capital and social consequences are particularly far reaching in developing countries, where they are often linked with or exacerbated by poverty, reflecting wider socio-economic inequalities. In turn, disasters can prevent people from rising out of poverty.

Disaster damages and losses can be considered in three categories: direct losses, indirect losses and secondary effects:

Direct damage and losses – These relate to loss of human life and injury together with physical damage to assets, including homes, schools, hospitals, transport and telecommunications infrastructure, crop and livestock losses, etc.

Indirect losses – These arise out of direct losses and relate to disruptions in the flow of goods and services that cause additional losses in income earnings and jobs.

Macroeconomic effects – These refer to the impacts on economic factors such as GDP growth rates, indebtedness levels, fiscal deficits, and balance of payment performance. These effects also arise when disasters increase the scale and incidence of poverty, affect human capital, heighten gender inequalities and even change the structure and composition of individual communities.

The scale and nature of disaster damages and losses depends on the type and intensity of a hazard event, the geographical area of impact, its population, the scale and nature of assets exposed to the event, the hazard's timing relative to the agricultural cycle, the extent and nature of vulnerability of people and assets to the hazard event and the scope for, quality and effectiveness of any warning systems. For example, physical damage in the event of a drought is typically limited largely to crops and livestock. Both rain-fed and irrigated crops may be adversely affected. Droughts can also delay planting operations and result in outbreaks of pests. Hydropower generation can be additionally affected, resulting in electricity shortages and, where relevant, reduced export earnings.

In contrast, earthquakes have little impact on standing crops, excluding localized losses. However, they can potentially cause widespread loss of life, destruction of infrastructure and other productive capacity, potentially including agricultural infrastructure and input distribution and marketing networks. For example, the May 2008 Wenchuan Earthquake in China resulted in 87,476 deaths, destroyed or badly damaged transport infrastructure, water and sanitation facilities, communications and power supply networks and industrial and agricultural infrastructure as well as social infrastructure, including hospitals, clinics, schools and homes (ADB 2009b).

Floods, too, with weak warning systems, can cause considerable loss of life and extensive physical damage to infrastructure. Roads, bridges, irrigation infrastructure and even flood control structures can be washed away together with non-fixed assets and flimsier housing and other building structures, whilst remaining buildings and other infrastructure can suffer considerable damage. Intense flooding also damages and destroys crops and can disrupt agricultural operations due to prolonged inundation of flood waters, flood-related river bank erosion and cutting, shifts in the course of rivers and heavy deposits of sediment on fields and in irrigation channels. In common with droughts, floods can also be associated with an increased incidence of pestilence and crop disease, further reducing crop yields. However, the net direct impacts of flooding on the agricultural sector are sometimes beneficial, rather than detrimental, as moderate flooding in less severely affected areas can improve soil fertility and productivity by depositing micro-nutrients, fine silt and loam on fields (Dixit and others 2008). For instance, crop land near rivers and in low-lying areas were heavily affected by the 2007 floods in Nepal, resulting in high percentage or even total crop losses, but the standing paddy crop in other areas benefited from the temporary immersion, with an overall surplus production expected from the latter areas (WFP and others 2007).

The impacts of typhoons[1] are similar, to the extent that they are associated with heavy rain and related flooding. Typhoons can also cause storm surges and related seawater intrusion, damaging crops and aquaculture activities; and considerable wind damage both to physical structures and crops, taking off roofs, bringing down whole buildings, power lines and trees, and flattening crops. As with flooding, related levels of loss depend in part on the strength and timing of a typhoon relative to the agricultural cycle.

These various direct losses can lead to a wide array of indirect and secondary effects. The 2005 India/Pakistan Kashmir Earthquake, for instance, was estimated to have resulted in the loss of almost a third of local jobs in the Pakistani Azad Jammu and Kashmir (AJK) region, one of the poorest regions in the country (Shortall, 2009). Direct losses in one sector can also lead through to indirect impacts in others, most obviously where widespread crop losses result in reduced inputs to the agro-processing industry and associated job losses. Crop losses can necessitate greater food imports as well, with potential implications for the balance of payments and levels of foreign reserves, and force up prices, affecting poor households disproportionately and fuelling inflation. There may be further consequences for agricultural production in subsequent cropping seasons as well, in part depending on access to inputs and the extent of damage to agricultural land and infrastructure. For instance, 20,000 hectares of seed-growing areas in Sichuan, which produces up to 20 per cent of China's rice seeds, were badly hit by the 2008

1 Wind storms are termed hurricanes in the North Atlantic and South Pacific, typhoons in the West Pacific and cyclones in the Indian Ocean. The terms are used interchangeably in this chapter.

Earthquake, raising concerns about subsequent rice crops.[2]

Disasters can even have consequences for world markets. For instance, a rapid increase in world rice prices in early 2008, in turn feeding into a wider food price crisis with particularly severe impacts on the world's poor, was in part linked to a series of pest outbreaks and natural hazard events in a number of major producing countries (IRRI 2008). The price of Thai rice increased almost three-fold between December 2007 and April 2008, to a high of around $1,000 per tonne. The price subsequently fell but has remained around double the pre-crisis level, reflecting longer-term fundamentals behind the crisis (most notably rising global demand in excess of growth in output and higher production costs).

Disasters can also have potential budgetary consequences, relating both to possible disaster-related reductions in government revenue and additional, unplanned expenditure in support of the relief and recovery effort.

A government may be obliged to address these budgetary pressures via a partial reallocation of resources, with implications for planned investments and potential distributional consequences, or a widening of the fiscal deficit. The latter will imply increased domestic and/or external borrowing or an expansion of the money supply, each, in turn, with potentially significant knock-on effects (Benson and Clay 2004).

The legacy of a disaster may be particularly far reaching via its impact on human capital, with long-term implications for socio-economic growth and development. This impact reflects both tragic loss of life and disruptions to education, in turn due to damage to school buildings and reduced attendance. In Nepal, for instance, disasters have been found to have a significant impact on children's school attendance by physically preventing children from reaching schools; by reducing household capacity to meet the cost of school fees and stationary; by resulting in the transfer of children into income-generating activities to supplement household earnings; and by resulting in increased (adult) male migration, requiring children to stay at home to help with domestic and agricultural work (Gautam and Oswald, 2008). The 2008 Koshi Flood alone disrupted the education of some 23,000 Nepali school students, including both displaced students and students of the host schools where the displaced were sheltered (Archarya, and Aryal, 2008). In Viet Nam, disaster-related damage to school buildings has also disrupted the quality of schooling, resulting in the temporary relocation of students to schools in neighbouring localities, thereby increasing class sizes, and resulting in shifts from full to half-day or even a third-day schooling, within remaining usable classrooms, sometimes for periods of a year or more.

Economic and social damage assessments

Studies of recent disasters in the region's LDC – the 2007 Cyclone Sidr in Bangladesh, the 2008 Cyclone Nargis in Myanmar, the 2009 Bhutan Earthquake, the 2009 Tsunami in Samoa, and the 2009 Typhoon Ketsana in Lao Peoples' Democratic Republic and Cambodia, were carried out to determine the value of damaged assets and the magnitude of losses on economic flows as well as reconstruction requirements for various sectors. Table II-1 shows that at the macroeconomic level, the impacts of disasters varied from extremely severe in the case of Cyclone Nargis to marginal in the case of Typhoon Ketsana.

As indicated in Table II-2, disasters also have a significant impact on social sectors. However, the needs assessments conducted, suggested that during reconstruction, a lower priority was given to the social sectors. In Bangladesh, for example,

2 www.javno.com/en-world/sichuan-earthquake-agriculture-damage-usd6-bln---fao_160203, quoting FAO. Accessed 6 December 2009.

while the social sectors suffered 55 per cent of the damage and losses from Cyclone Sidr, it was only accorded 22.6 per cent of the funds in the needs assessments. This divergence between economic and social recovery will widen levels of inequity – and underlines the importance of dedicating more resources to the social sectors not only in the post-disaster recovery process but more importantly as an essential component of a country's long term development strategy.

Table II-1 Major disasters in Asia and the Pacific – the social and economic impact

Disasters	Deaths	Affected population	Effects on GDP (%)
Cyclone Sidr	3,406	1,000,000	2.8
Cyclone Nargis	84,537*	2,400,000	21
Samoa Tsunami	154	5,274	20
Typhoon Ketsana, Lao PDR	28	180,000	0.4
Typhoon Ketsana, Cambodia	43	180,000	0.2
Bhutan Earthquake	12	7,240	--

Note: * Including people missing, the total is around 140,000.

Source of data: (i) Cyclone Sidr in Bangladesh – Damage, Loss and Needs Assessment for Disaster Recovery and Reconstruction, Report by Govt of Bangladesh, April 2008; (ii) Post Nargis Joint Assessment (PONJA) – Report by Tripartite Core Group comprising Govt of Myanmar, Association of South-East Asian Nations (ASEAN), UN, July 2008; (iii) Samoa - ESCAP - the Early Recovery Team consisted of the United Nations (UNDP, UNEP, UNESCO, FAO, OHCHR, ESCAP, UNISDR), the World Bank, Asian Development Bank, IPA, Conservation International and SPREP; (iv) Ketsana Typhoon in the Lao PDR (September 29, 2009): Damage, Loss and Needs Assessment for Disaster Recovery and Livelihood Restoration, A Report prepared by the Government of the Lao PDR, November 2009; (v) Comprehensive Post Disaster Needs Assessment – Ketsana Recovery and Reconstruction in Cambodia, Royal Govt of Cambodia Report, March 2010, (vi) Bhutan Earthquake September 21, 2009 - Joint Rapid Assessment for Recovery, Reconstruction and Risk Reduction, The Royal Government of Bhutan, the World Bank and the United Nations, 20 October 2009.

Table II-2 Damage, loss and needs assessments, selected disasters in LDCs

		Damage and loss assessments				Needs assessment	
	Sectors	Damage $ millions	Losses $ millions	Total $ millions	% by sector	Total $ millions	% by sector
Bangladesh Cyclone Sidr 2007	Social	904.20	21.00	925.20	55.3	215.30	22.6
	Productive	25.10	464.00	489.10	29.2	325.00	34.1
	Infrastructure	222.50	30.90	253.40	15.1	397.00	41.7
	Cross-sectoral	6.10	-	6.10	0.4	15.40	1.6
	Total	1,157.90	515.90	1,673.80		952.70	
Myanmar Cyclone Nargis 2008	Social	937.54	30.00	967.70	24.1	859.00	85.7
	Productive	669.00	2138.00	2,806.80	69.8	51.00	5.1
	Infrastructure	132.26	58.00	189.90	4.7	88.00	8.8
	Cross-sectoral	15.20	42.00	57.20	1.4	4.00	0.4
	Total	1,754.00	2,268.00	4,021.60		1,002.00	
Samoa Tsunami 2009	Social	15.78	10.51	26.29	11.2	70.16	19.3
	Productive	39.45	76.33	115.78	49.5	192.11	52.8
	Infrastructure	81.68	9.78	91.46	39.1	101.24	27.8
	Cross-sectoral	-	0.32	0.32	0.1	0.64	0.2
	Total	136.91	96.94	233.85		364.15	
Lao PDR Typhoon Ketsana 2009	Social	10.13	0.74	10.87	18.9	13.64	20.6
	Productive	19.71	2.36	22.07	38.3	24.39	36.9
	Infrastructure	21.16	3.47	24.36	42.8	28.10	42.5
	Cross-sectoral				0.0	-	0.0
	Total	51.00	6.57	57.3		66.13	
Cambodia Typhoon Ketsana 2009	Social Sectors	39.54	3.35	42.89	33.2	42.91	20.1
	Productive Sectors	1.05	59.00	60.05	46.5	119.05	55.8
	Infrastructure	14.47	11.47	25.94	20.1	37.40	17.5
	Cross-sectoral	0.20	0.10	0.31	0.2	14.16	6.6
	Total	55.26	73.91	129.18		213.52	
Bhutan Earthquake 2009	Social	13.50	52.00	65.50	100.0	41.70	95.3
	Productive	-	-	-		-	
	Infrastructure	-	-	-		-	
	Cross-sectoral	-	-	-		2.04	4.7
	Total	13.50	52.00	65.50		43.74	

Sources: (i) Cyclone Sidr in Bangladesh – Damage, Loss and Needs Assessment for Disaster Recovery and Reconstruction, Report by Govt of Bangladesh, April 2008; (ii) Post Nargis Joint Assessment (PONJA) – Report by Tripartite Core Group comprising Govt of Myanmar, ASEAN, UN, July 2008; (iii) Samoa - ESCAP - the Early Recovery Team consisted of the United Nations (UNDP, UNEP, UNESCO, FAO, OHCHR, ESCAP, UNISDR), the World Bank, ADB, IPA, Conservation International and SPREP; (iv) Ketsana Typhoon in the Lao PDR (September 29, 2009): Damage, Loss and Needs Assessment for Disaster Recovery and Livelihood Restoration, A Report prepared by the Government of the Lao PDR, November 2009; (v) Comprehensive Post Disaster Needs Assessment – Ketsana Recovery and Reconstruction in Cambodia, Royal Govt of Cambodia Report, March 2010, (vi) Bhutan Earthquake September 21, 2009 - Joint Rapid Assessment for Recovery, Reconstruction and Risk Reduction, The Royal Government of Bhutan, the World Bank and the United Nations, 20 October 2009.

Impact on livelihoods and poverty

In many economies the largest share of economic output and employment is for agriculture – as many people work in subsistence agriculture, relying primarily on meagre assets, agricultural land, small-scale livestock raising and cash crops, and common natural resources such as fish and non-timber forest products. For this reason, the greatest impact of disasters on livelihoods is often felt through damages and losses in the agriculture sector – to houses and shelters and productive assets including agricultural land, livestock, rural and small-scale enterprises as well as loss of employment. For example:

- ***Pakistan*** – The 2005 Kashmir Earthquake was estimated to have resulted in the loss of almost a third of jobs in the Azad Jammu and Kashmir region, one of the country's poorest regions (Shortall, 2009).

- ***Bangladesh*** – Cyclone Sidr affected densely populated areas with poverty levels ranging between 35-50 per cent of the population – reducing the incomes and employment for two million people.

- ***Myanmar*** – Cyclone Nargis caused extensive damage and loss of livelihoods, employment and income for poor communities dependent on small-scale agriculture and fishing and resource-based small-scale enterprises.

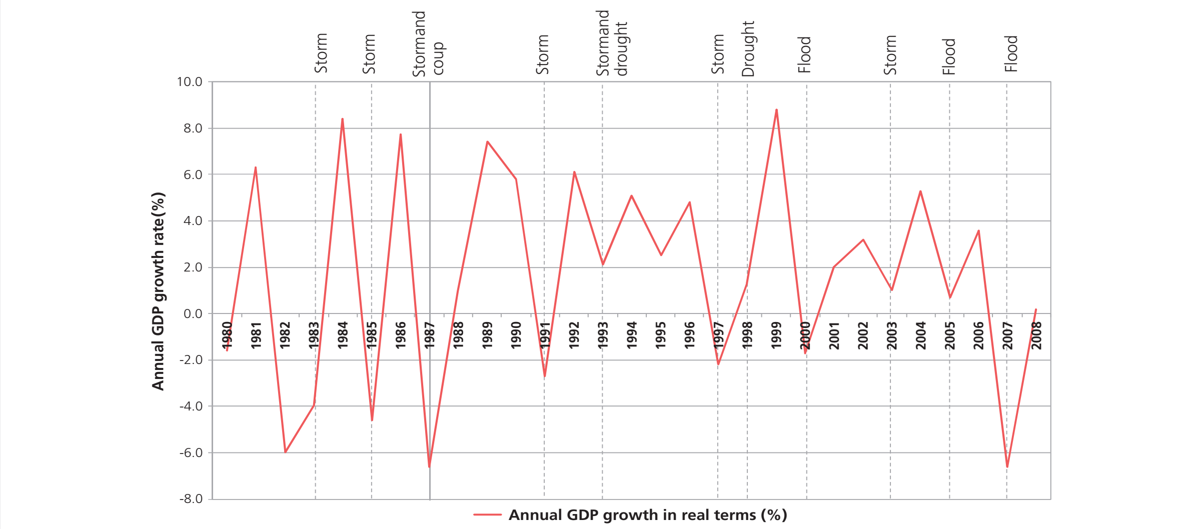
- ***Samoa*** – The tsunami hit one of the country's poorest regions, where a higher than average proportion rely on home produced food. As a result, while Samoa as a whole subsequently experienced a significant increase in household income many of those in the tsunami-affected areas were left behind and poverty increased.

- ***Cambodia*** – Typhoon Ketsana hit 14 of the country's poorest provinces where families, which were already suffering from food shortages, are further impoverished as most of the rice crop was damaged or destroyed.

- ***Lao PDR*** – Typhoon Ketsana hit districts in five southern provinces that were among the country's poorest and most food insecure – and just when household food stocks were at their lowest and farmers were preparing for the harvest.

In small economies, inter-annual movements in GDP can even closely track patterns of hazard occurrence. As indicated for Fiji in Figure II-1, Fiji experiences a wide range of natural hazards, including cyclones, droughts, floods, earthquakes and tsunamis. In such economies, even events such as cyclones or volcanic eruptions whose impact would be relatively localized in a larger country can have significant macroeconomic ramifications. They can destroy a significant segment of the transport, power, and communications networks, as well as productive and social infrastructure, and even precipitate an exodus of human capital (Benson and Clay, 2004). A loss that would be merely a local transfer in a larger country can represent a devastating setback in such economies (Handmer and Thompson, 1997).

Figure II-1 **Fiji, annual fluctuations in GDP relative to the incidence of disaster, 1980-2008**



Source: Based on Benson (1997a) with additional data from www.databank.worldbank.org and www.sopac.org/fiji

Countries with small and vulnerable economies have the highest ratio of economic loss to capital stock and also tend to have very low national savings, and thus have less capacity to absorb impacts and recover. These include the Least Developed Countries, Small Island Developing States (SIDS) and Landlocked Developing Countries (LLDCs) – which together comprise about two thirds of the countries with very high economic vulnerability to disasters (UNISDR, 2009).

However, the medium to longer-term macroeconomic ramifications of major disaster events are less clear-cut, particularly in larger economies. Even short-term impacts can be difficult to gauge in larger economies from a visual examination of broad indicators of economic performance alone, because of difficulties in disentangling their effects from other influences on economic performance. For instance, returning to the example of the 2004 Indian Ocean Tsunami, Indonesia achieved an actual annual GDP growth rate of 5.7 per cent (in constant price terms), compared to a post-disaster forecast of 5.2 per cent, whilst GDP grew by 6.2 per cent year-on-year (in constant price terms) in Sri Lanka, 0.8 percentage points higher that the revised post-disaster forecast. In contrast, the Thai economy's growth shrank to only 4.5 per cent, compared to post-tsunami forecast of 5.7 per cent due to various, unrelated factors, including rising oil prices and domestic interest rates, inflation, drought and unrest in the countries three southern most provinces (NESDB, 2006). The Maldives economy, too, performed much more weakly than forecast, with a negative growth rate of 4.6 per cent compared to a post-tsunami forecast of -1.7 per cent, followed by 19.1 per cent growth the following year, bringing GDP up to a level of 13.6 per cent higher (in real terms) than in 2004.

Over the past 10 years, there has been a surge of academic interest, in part stimulated by rising disaster losses, to establish whether disasters are good or bad, on balance, for an economy. Much of this research has focused on cross-country empirical analysis, in particular on the impact of disasters on GDP growth, taking a lead from existing theories of development which place considerable emphasis on the roles of capital and labour growth and productivity (e.g. Solow, 1956; Denison, 1967). As already discussed, disasters reduce the pace of capital accumulation by destroying existing productive and social capital (including standing crops) and diverting scarce resources away from new investment. They can also result in deaths, long-term health problems and withdrawal of children from education, reducing existing human capital stock. At the same time, disasters can generate construction-led booms and offer an opportunity to upgrade capital and so achieve a leap in technological progress, potentially stimulating an economy via Aghion and Howitt's (1998) endogenous Schumpterian model of growth through a process of creative destruction.

Somewhat confusingly, some of the empirical analysis has concluded that disasters either boost economic growth or have little detrimental impact (e.g. Albala-Betrand, 1993; Caselli and Malhotra, 2004) but others say that they reduce growth and may even force countries onto lower long-term growth projections (e.g. Hochrainer 2009; Noy 2009; Skidmore and Toya 2007). However, questions have been raised about the findings of both Albala-Betrand and Caselli and Malhotra, the former relating to bias regarding the predominance of geophysical hazards in his dataset (see below) (Benson and Clay, 2004) and the latter relating to the proxies used to measure capital and labour destructions and the timing of the growth response (Fomby and others, 2009).

Some researchers have gone a step further and disaggregated by type of hazard, in recognition of their varying direct and indirect impacts. This has yielded some extremely illuminating and relatively consistent findings (Table II-3).

These findings on differences in the economic impact of various types of natural hazard are explained to some extent by the fact that climatological, hydrological and meteorological hazards destroy intermediate inputs to production, particularly agricultural crops with direct adverse impacts on economic output. In contrast, earthquakes (geophysical hazard) leave crops largely standing but damage infrastructure, reducing the capital-labour ratio. As such, so it is held, they redress imbalances between the two relating to relative over-investment in productive capital and under-investment in human capital, particularly in middle-income countries, resulting in higher growth via both increasing returns and high reconstruction investments (Lopez, 2009; Loayza and others, 2009). Adverse impacts of climatological hazards are most extreme in the case of droughts, where there is little to no damage to infrastructure and thus no possibility of increasing returns to production or reconstruction-led booms. Lower-income countries often have larger agricultural and agro-processing sectors, explaining why climatological, hydrological and meteorological disasters also have relatively larger economic impacts in these economies.

Table II-3 **Literature review on the long-term impact of disasters by disaster type**

Reference	Disaster type	Impact on long term growth	Other key findings
Raddatz (2009)	Geophysical	0/+	
	Climatological	--	Reduce GDP per capital by 1 per cent point for low-income countries but statistically insignificant impact on high income countries
Fomby et al (2009)	Climatological (Drought)	--	
	Hydological (Moderate floods)	++ (with lag)	
	Hydrological (Severe floods)	0	
	Geophysical (Earthquake)	0	In developing countries, impact on agricultural GDP is negative but positive on non-agricultural growth
Loayza et al (2009)	Hydrological (Floods)	--- (for developing country industrial growth) +++ (for services output in all countries)	Any positive impact of floods, earthquakes or storms are reversed in the event of severe events
	Meteorological (Storms)	-- (agriculture), ++ (industrial growth)	
Okuyama and Sahin (2009)	Meteorological (Storms)	---	Highest impact multiplier of 2.02 (damage and losses spread to the widest extent), also found negative relationship between disaster impact and income level

Note: scale is as follows – +++ ,--- significantly positive or negative; ++, -- positive or negative; +, - marginally positive or negative; 0 neutral

Consequences of major earthquakes may also be particularly extreme in lower income countries because of greater delays in the reconstruction process (see below), higher associated opportunity costs of reconstruction spending, greater loss of life (reducing changes in the capital-labour ratio) and potentially widespread damage to basic infrastructure, such as road networks and ports, on which the economy relies. Noy (2009) and Skidmore and Toya (2007) similarly find that the adverse economic impacts of disasters decline with development, although they do not distinguish between different types of hazard. They also find, variously, that countries with higher foreign exchange reserves, greater degrees of openness to trade more developed financial sectors, including higher levels of domestic credit experience, and higher rates of literacy or educational attainment, experience relatively lower losses.

Hallegatte and others (2007) explored a different angle, developing a theoretical econometric model to explore how economic outcomes are affected by the degree of availability and timeliness of reconstruction funding. Using probability density functions for future losses based on historical data for Europe, their model shows that GDP losses remain moderate if a country has the capacity to fund the reconstruction effort but that when funding available for reconstruction is limited, resulting in reconstruction activities over a number of years, disaster-related GDP losses increase sharply. The authors tentatively suggest that this may partly explain why some poorer countries that experience repeated disasters cannot develop, instead remaining in a perpetual state of reconstruction, making it difficult to accumulate productive capital. In such situations, it is particularly important that reconstructed infrastructure is built to higher standards.

Results of analysis on the role of technological transfer further support the finding that economic impacts of disasters are more severe in lower-income countries. In line with the Schumpterian theory of creative destruction, Hallegatte and Dumas (2009) developed a theoretical Solow-like growth model which revealed that slower, better quality reconstruction, allowing embodiment of new technologies, amplifies the short run adverse consequences of a disaster but that these impacts are partly cancelled out in the long-term assuming the level of reconstruction resources lies above a threshold value (see below). Meanwhile, Cuaresma and others (2008) explored the extent of post-disaster foreign knowledge spill-overs empirically, finding that countries with higher levels of development are better able to take advantage of capital upgrading opportunities post disaster, in effect confirming Hallegatte and Dumas' theoretical predictions to the extent that lower income countries are less likely to be able to access sufficient reconstruction resources even to replace like with like.

Some of the variations in detailed nuances of the above findings are almost certainly attributable to differences in the disaster data on which the analyses are based. In interpreting the findings, it is particularly important to bear in mind that none of the indicators of disaster impact are necessarily particularly accurate. Thus, as Hochrainer (2009), for instance, notes, there are enormous data challenges in measuring impacts. Further variations in findings reflect the fact that, inevitably, the various models involve different elaborations, varying simplifying assumptions and control for a range of different factors such as per capita income, levels of literacy or educational attainment, external debt stocks, aid flows and the degree of trade openness.

Nevertheless, some relatively consistent, key messages emerge, including that:

- ***Disasters have larger relative impacts on developing, than developed, countries.***
- ***The nature and overall magnitude of impact varies between types of hazard.***
- ***Severe disaster events do not have positive impacts under any circumstances.***

The majority finding that climatological, hydrological and meteorological hazards have particularly severe economic impacts on developing countries is especially important in the light of climate change, emphasizing the particular need to enhance resilience to these types of hazard.

Impact on health and education

Some of the most immediate concerns are for health. Contamination of water supplies, for example, leads to an increase in water-borne diseases such as cholera and diarrhoea. At the same time the destruction of crops and agricultural land lead to increases in food insecurity.

There can also be disruption to education due to physical damage to schools and the surrounding infrastructure. The Indian Ocean Tsunami in 2004, for example, resulted in losses to the education sector estimated at $ 230 million. This type of economic impact to the sector is more apparent in some countries in the region. In the Philippines, the Department of Education showed an annual expenditure of U$ 8.6 million in 2006 for repair and reconstruction of schools damaged by typhoons. Additionally, disasters negatively impact education by making it more difficult for families to afford sending their children to school. Households may be less able to meet the cost of school fees, or have to keep children at home to do domestic and agricultural work to supplement household earnings, or to take the place of adults who have had to migrate to urban areas (Gautam and Oswald, 2008). The 2008 Koshi Flood alone disrupted the education of some 23,000 children. Also, during the 1998 floods in Bangladesh, 25-30 per cent of students dropped out in the eastern part of Dhaka when schools were closed for more than 3 months due to the floods. Disruption of classes occur after disasters even if there is no damage to school facilities, as schools are often used as emergency shelters for periods of several months. There are additional effects of disasters to learning by children. In the Philippines, for example, it was found that after disasters, children had lower attention span and interest in their studies (see below).

Psychosocial impacts

Disasters also have profound psychosocial impacts. In a matter of a few minutes or seconds, people go through violent and degrading experiences that separate them from a familiar world that gave them safety and meaning. They can lose their independence and self-worth that is essential for peaceful human interaction and socially cohesive communities. These psychosocial impacts are less obvious than physical impacts. Their negative effects are more gradual in onset and thus go un- or underreported. However, their effects can be more insidious and destructive on the long run to the well-being of societies.

To date, in Asia-Pacific, the availability of data is scarce and scattered across international organizations. Though, WHO and other organizations have some information on the psychosocial impact of the Indian Ocean Tsunami and more recent disasters, long term empirical research that substantiates the interlinkages between disasters and psychosocial disorders are not available.

Anecdotal evidence suggests that the extent of psychosocial impact will depend to some extent on the severity of the disaster and its cause. Natural phenomena such as typhoons or floods, for example, may be less traumatic than man-made events such as insurgencies or acts of terrorism. People may also be in a stronger position if they can return home quickly rather than living in "tent cities" that may be sources of disease epidemics, physical abuse, rape, and other human rights violations.

People are more likely to recover if they can rely on social support networks, such as the extended family, friends, or religious communities. In this regard, there are reports of some elderly showing greater mental resilience in confronting their ordeal than the young. Having experienced many challenging events in their long lives, typically, many build up a disaster "immunity", which plays a stabilizing role in the affected communities. However, this important potential role could be neutralized if the elderly succumb to diseases, dehydration and malnutrition deficiencies that are common in post-disaster situations. The elderly are especially vulnerable when social protection is non-existent, or when income support previously provided by children is no longer available in the aftermath of the disaster. One report on the Wenchuan Earthquake found that 70 per cent of elderly lost their stable income source, primarily due to the loss of their children. Not surprisingly, there was an increase in depression with women worse affected: 24 per cent of male and 37 per cent of females showed severe depression and another 30 per cent of males and 38 per cent of females showed moderate depression. It is incumbent upon state organs to anticipate these impacts by setting up social provisions of cash and in kind support prior to disaster striking. Furthermore, social protection systems for the elderly should be seen in terms of their role in societies and the social obligation to compensate them for the contributions that a long life brings to society – providing for the elderly is therefore an issue of social justice (Community Alliance November 2008).

Children also need special attention because their responses to trauma are different from adults and may not be immediately obvious, often masked by behavioural disorders such as increased hostility, hyperactivity, or apathy. Furthermore, they are the most vulnerable to malnutrition, dehydration and vector-borne diseases that can impact on their long term development.

Disasters also alter family dynamics in unhealthy ways. Men who have lost their traditional role as breadwinners may become particularly sensitive to - real or perceived - attempts at undercutting their authority. Other family roles may also change. Women who lose their spouses may be driven to take on activities culturally attributed to men, while harbouring deep misgivings about their capabilities to assume these duties. At the same time children may have to take on functions in the family that are inappropriate for their age and consequently increase their vulnerabilities further.

To date, for the most part, psychosocial trauma in the Asia-Pacific region is not recognized for what it is. In some cases, the efforts to contain the spread of disease and restore essential services is so overwhelming that psychosocial support seems a luxury. In other cases, psychological and psychiatric services that are provided in the immediate aftermath of disasters are the first ones to be phased out when circumstances start to normalize. Both survivors and relief organizations may unwittingly camouflage psychological trauma by focusing on the physical resilience of survivors. Furthermore, some countries in the region, notably Indonesia and the Philippines, have a longer tradition in providing psychosocial support than others. For other countries this concern is more recent. In 2005, the Maldives, for example, in cooperation with WHO, organized what appears to have been the first ever workshop on the current status and future preparedness in mental health and psychosocial aspects in disasters. In January 2010, the Asian Disaster Preparedness Centre organized an event on psychosocial responses to disasters with a special focus on children. The infrequent nature of these activities further underlines the urgent need for a more systematic, coordinated and long-term approach to address the issue.

Gender impacts

Gender relations in disasters deserve special attention because they are a reflection on gender relations in society which in Asia and the Pacific are often very imbalanced, preventing women from gaining the benefits of development and making their full contribution. Women have been stereotyped as housewives, secondary earners or mothers. Although gender issues are fairly well researched and debated, women are still largely marginalized in issues, such as, literacy, land ownership and access to credit (UNISDR 2009). Accordingly, in dealing with disasters and the risks arising from climate change, the women have different capacities to reduce risk and adapt and come up in political decision-making and legal rights (UNDP 2010).

Unsurprisingly, therefore, during and after the disasters, women and children suffer most. For example, women accounted for 61 per cent of deaths in Cyclone Nargis in Myanmar (Joint Assessment Report), and 70 to 80 per cent of those who died during the Indian Ocean Tsunami. In the 1991 Bangladesh cyclone, death rates among women were almost four times higher than those among men.

Women are also affected differently during the recovery. As caretakers they have to take most of the responsibility for sick and injured family members while having less access to formal recovery assistance when they are not the head of the household. They may also be offered fewer opportunities for employment and education. In families under stress women also faced increased violence. A post-tsunami assessment in Thailand, for example, reported that young women who lost their jobs were in danger of being forced into commercial sex work. At the same time there were fears of increases in HIV infections and other diseases (UN Country Team Thailand, 2006).

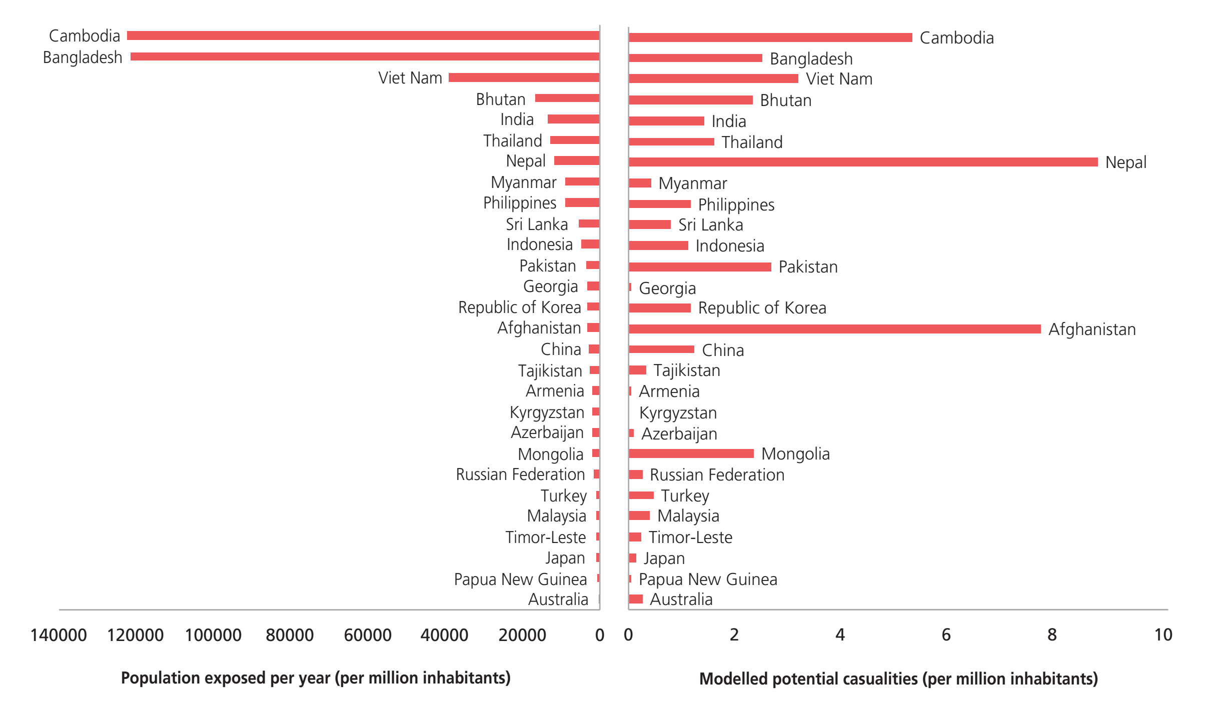
Smaller-scale, local, slow-intensity disasters such as monsoon floods and prolonged droughts also have distinct implications for women. In parts of India and Pakistan, for example, during the periods of seasonal drought men migrate to cities or move out with animals in search for water and pasture, leaving women, children and elderly to produce food, get water and look after the household. In Nepal as more and more males migrate to find work elsewhere, more women become heads of households, remaining in areas prone to flooding or other disasters. The effects can also be different for disasters associated with climate change – and require gender-sensitive policies that take into account the particular needs and capacities of both women and men.

Socio-economic vulnerability to disasters

In the context of disaster risk reduction, disaster vulnerability can be defined as “the lack of capacity to anticipate, cope with, resist and recover from the impact of a natural disaster” (Blakie and others, 1994). Vulnerability, therefore, can be determined by factors such as access to information, assets, social protection and insurance. Two cities may, for example, have the same exposure to flooding but if one has better flood defences its people and its economy will be at lower risk. This is illustrated in Figure II-2 for higher-frequency, lower-impact floods – those that occur on average every five years. Using data from 1990 to 2009, the right hand graph shows the potential number of deaths, while the left hand graph presents the population exposed per year. This indicates, for example, that Nepal has about the same level of exposure as Thailand, but has a higher risk of deaths. On the other hand, Bangladesh while highly exposed to these types of floods is less vulnerable. A similar analysis can be carried out for storms, indicating that for lower-impact storms, the countries most vulnerable are the Philippines and Samoa (Figure II-3).

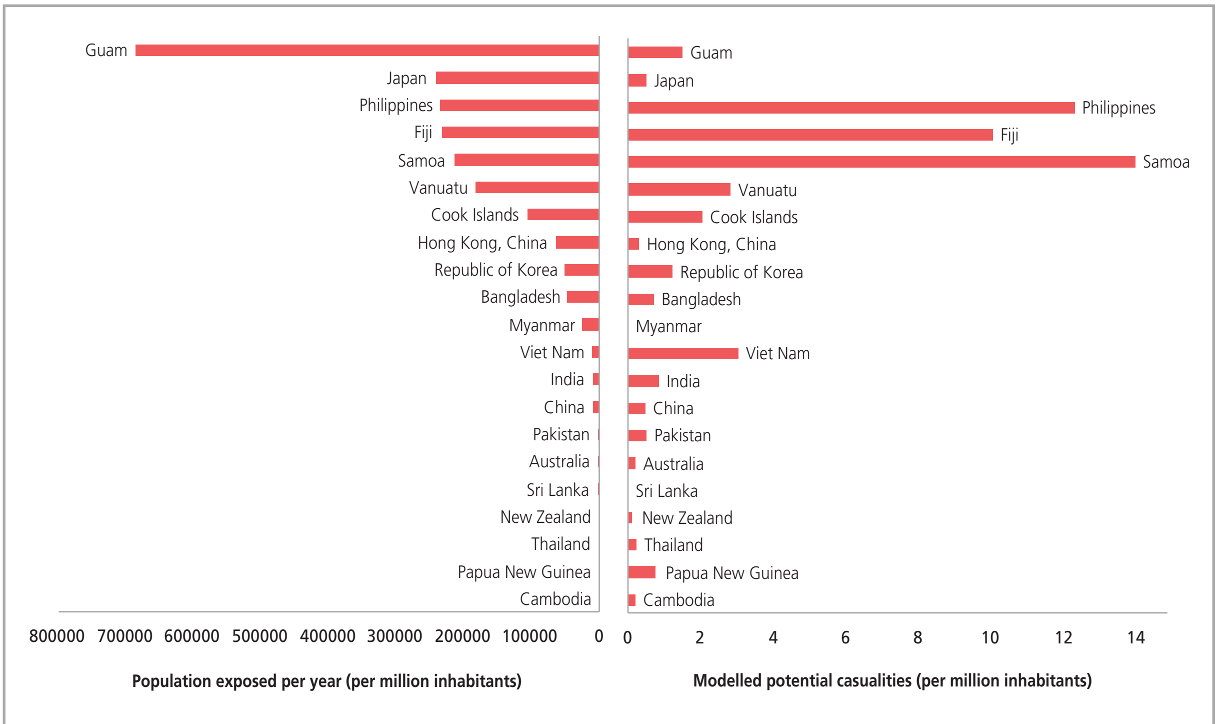
A similar analysis can be carried out for economic vulnerability. This shows that some of the Pacific Island countries are highly vulnerable. In Samoa, for example, even low-impact storms may cause damage equivalent to 30 per cent of GDP.

Figure II-2 Human vulnerability to high-frequency, lower impact floods



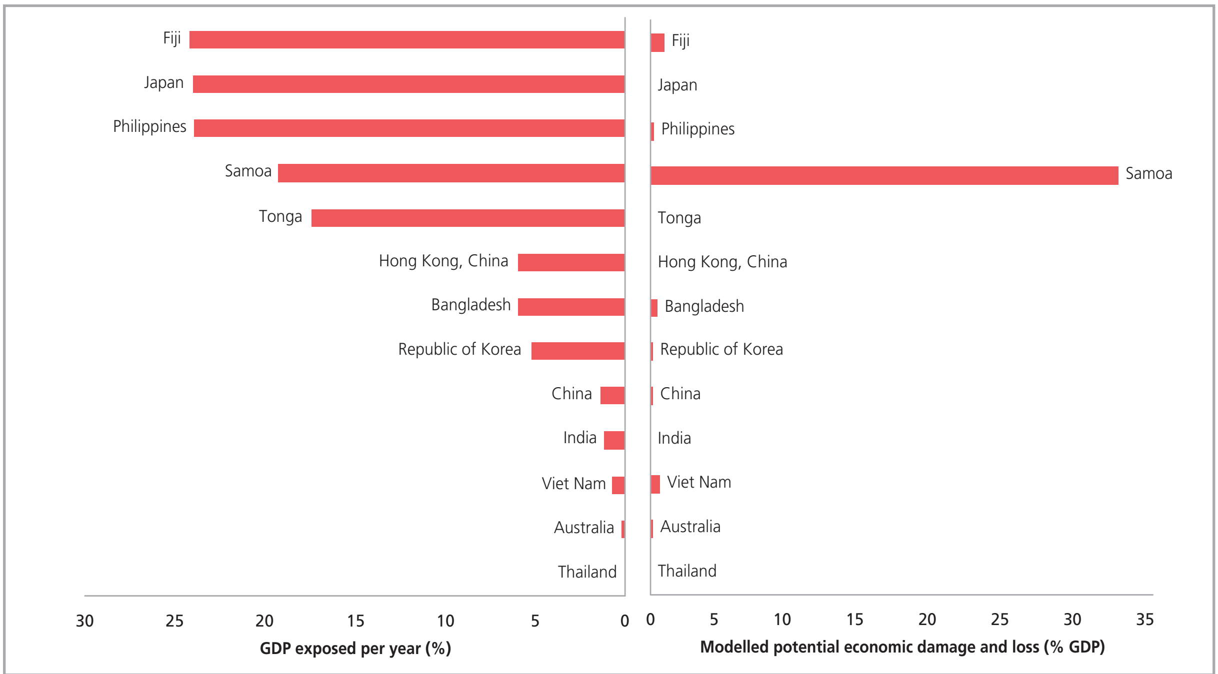
Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium. The estimates were calculated using probabilistic analysis of risk.

Figure II-3 Human vulnerability to high-frequency, lower impact storms



Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium. The estimates were calculated using probabilistic analysis of risk.

Figure II-4 Economic vulnerability to storms of high-frequency and lower impact



Source: ESCAP based on data from EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium. The estimates were calculated using probabilistic analysis of risk.

The Figure II-4 shows that small economies can experience huge falls in productive capacity even with low-impact disasters. Moreover, the decisions of the poor, in turn, can make them most vulnerable to hazards. They often live in substandard housing in dangerous locations – on flood plains, riverbanks or steep slopes. Without secure land ownership rights they have less incentive to invest in structural risk reduction. And with limited livelihood opportunities they may be forced to over-exploit the local environment, making it even more vulnerable. In rural areas with little access to financial services, farmers often have savings in the form of livestock, which may be killed in the event of a disaster. In Viet Nam, for instance, the poorest have proportionally better access to livestock than to land, and in 2007 natural hazards resulted in the loss of a quarter of a million pigs, many of which had been held as a form of household investment and income generation (Maltsoglu and Rapsomanikis, 2005).

Poverty can be further reinforced by the threat of disasters. Poor households faced with a precarious environment are less likely to take risks that might ultimately help them escape from poverty. In the Philippines, for example, marginal farmers often continue cultivating traditional lower-yielding rice varieties because they are relatively more hazard tolerant, reducing the risk of total crop failure but also limiting potential earnings (World Bank, 2007).

The poor also have fewer opportunities to recover from disasters. Since a disaster is likely to hit everyone in a small community its people have limited scope for formal or informal community-based support in the aftermath. And when it comes to humanitarian assistance and reconstruction the more marginalized groups in the population, such as women, children, the elderly and the disabled are often particularly vulnerable as access to evacuation centres, humanitarian assistance and support for reconstruction tends to mirror existing societal inequities. This is particularly true in the Asia and the Pacific region where public expenditure on social protection is extremely low, and such inequalities – and thus inequitable impacts of disasters – remain strong.

As well as causing hardship and distress, disasters can force the near-poor into poverty. There has been very limited quantitative analysis of this relationship, but preliminary research supports these linkages in a number of countries.

- *Philippines* – Estimates in 2009 suggested that Typhoons Ketsana (Ondoy) and Parma (Pepeng) could have increased the incidence of poverty in 2009 by as much as three percentage points in the worst affected areas of Luzon, and by 0.5 percentage points nationwide, whilst the total number of poor could increase by 480,000 people (Philippines and others, 2009).

- *Viet Nam* – A further four to five per cent of the population could be pushed into poverty in the event of a disaster – those whose expenditure is less than 10 per cent above the poverty line and who live in areas that are prone to floods, typhoons or droughts (ADB and others, 2004).

- *Nepal* – There is a positive correlation between the incidence of poverty and the incidence of landslides – that is, there are higher rates of poverty in parts of the country where more people and houses have been affected by landslides (NSET, 2008).

- *Iran* – In the most disaster-prone provinces, a negative correlation was found between the annual intensity of disasters and annual urban household expenditure (Kianpour and others, 2008).

- *Fiji* – There is a statistically significant two-way correlation between disasters (measured in terms of the number of people affected) and the national level of poverty (Lal and others, 2009).

The limited quantitative analysis of the inter-linkages between poverty and vulnerability partly reflects data constraints but also reflects the complexity of the relationship, involving a wide range of dynamic social, economic, political and environmental factors and many two-way flows of linkages, in turn creating difficulties in modelling causalities. For example, limited education contributes to poverty and thus vulnerability to natural hazards whilst disaster events, in turn, can reduce the quality and length of schooling further, leading to deepening poverty.

Disasters undoubtedly have adverse impacts on individual, sector-specific, measures of human development too, such as health status, levels of educational attainment, access to clean water and livelihood opportunities, in some cases temporarily and in some more permanently. For instance, disasters have exacerbated problems of water contamination in Nepal, leading to an increase in water-borne diseases, such as cholera and diarrhoea, and contributed to food insecurity, by destroying crops and agricultural land.

Household level data is particularly important in analyzing the impacts of floods, where there may be net gainers and losers within the same community. However, few, if any, countries collate systematic longitudinal data on such impacts and much of the limited snapshot information that is available, beyond initial assessments of physical damage to related infrastructure, sits in unpublished reports with limited circulations. Moreover, there are potential issues of bias in measuring some impacts. For instance, as observed in Pakistan following the 2005 Earthquake (Shortall, 2009), respondents of livelihoods surveys may under-report income and over-report expenses in the hope of securing more assistance.

To examine this relationship more closely, this report has extended the analysis across a larger dataset by considering all 68 official MDG indicators. The aim is to determine the extent to which an index based on the Millennium Development Goal (MDG) indicators can be used as a proxy for levels of vulnerability between countries that have similar physical exposure. The study suggests that the following seven indicators are correlated with the vulnerability to disasters across the world:

- *GDP per capita at 2005 constant prices*
- *Percentage of population undernourished (MDG1)*
- *Percentage of seats held by women in national parliament (MDG3)*
- *Infant mortality per 1,000 live births (MDG4)*
- *Tuberculosis prevalence per 100,000 population (MDG6)*
- *Proportion of the population using improved sanitation facilities (MDG7)*
- *Internet users per 100 people (MDG8)*

The selection of these indicators was made by statistical tests. The model proposed by Peduzzi et al. (2009) of factors that influence human loss caused by disasters was modified to include MDG indicators as explanatory factors. For each Goal, MDG indicators with data available for at least 30 ESCAP members were tested to verify whether they were associated with human loss, while controlling for the frequency of hazard, population size and GDP per capita at 2005 constant prices. Statistical tests were used to select which indicators provide the better fit of the model to the empirical data on human loss caused by disasters.

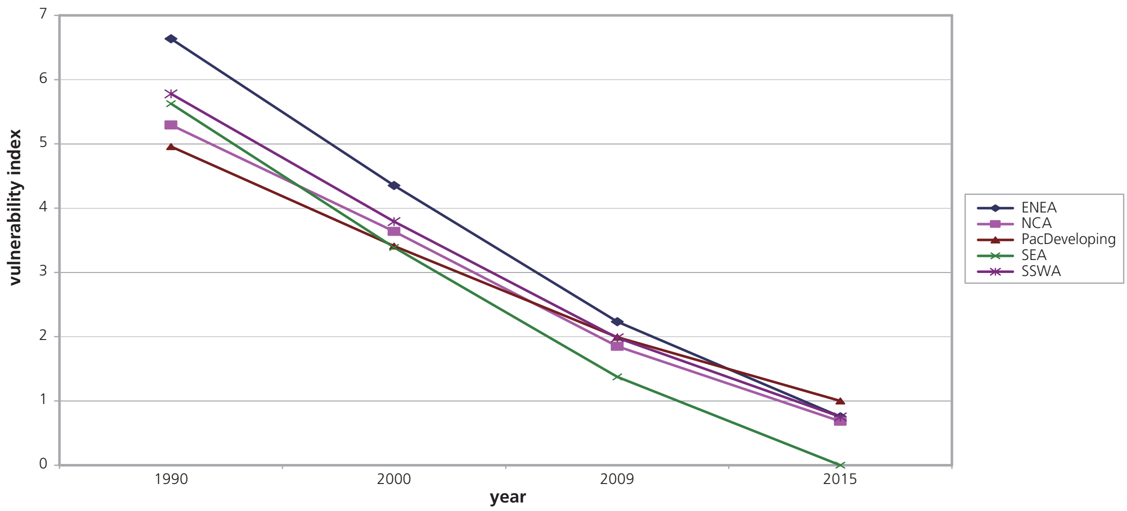
Multiple regression analysis has shown that between 1980 and 2009 for 95 countries the seven indicators outlined above explain 73 per cent of the variation in total casualties from floods, and among 79 countries 68 per cent of the variation on total casualties by storms. Based on these indicators and some statistical techniques to estimate the weight of each indicator in explaining the differences in human loss among countries. It is then possible to calculate for each Asia-Pacific subregion a composite index and use this to track how vulnerability has changed over time.

The good news is that over the past 20 years, all subregions have shown a reduction in vulnerability. This is illustrated in Figure II-5 for floods and storms, based on available historical GDP and MDG data until 2009, and on projected progress towards the MDGs for the period 2009 to 2015 (ESCAP/UNDP/ADB, 2010). Progress has been fastest in South-East Asia and slower among the Pacific developing countries. This also highlights the point that there is nothing inevitable about a country's level of vulnerability to natural hazards: policy makers can deliberately influence resilience.

Defending the poor by accelerating vulnerability reduction

As this chapter has demonstrated, those most at risk from disaster caused by natural hazards are the poor, who live in the most exposed environments and have fewer ways of protecting themselves against sudden emergencies. They are likely to be even more exposed as a result of climate change, so the next chapter looks at the role of socio-economic policies in protecting people against the hazards of disasters.

Figure II-5 Vulnerability to weather-related disasters, by Asia-Pacific subregion



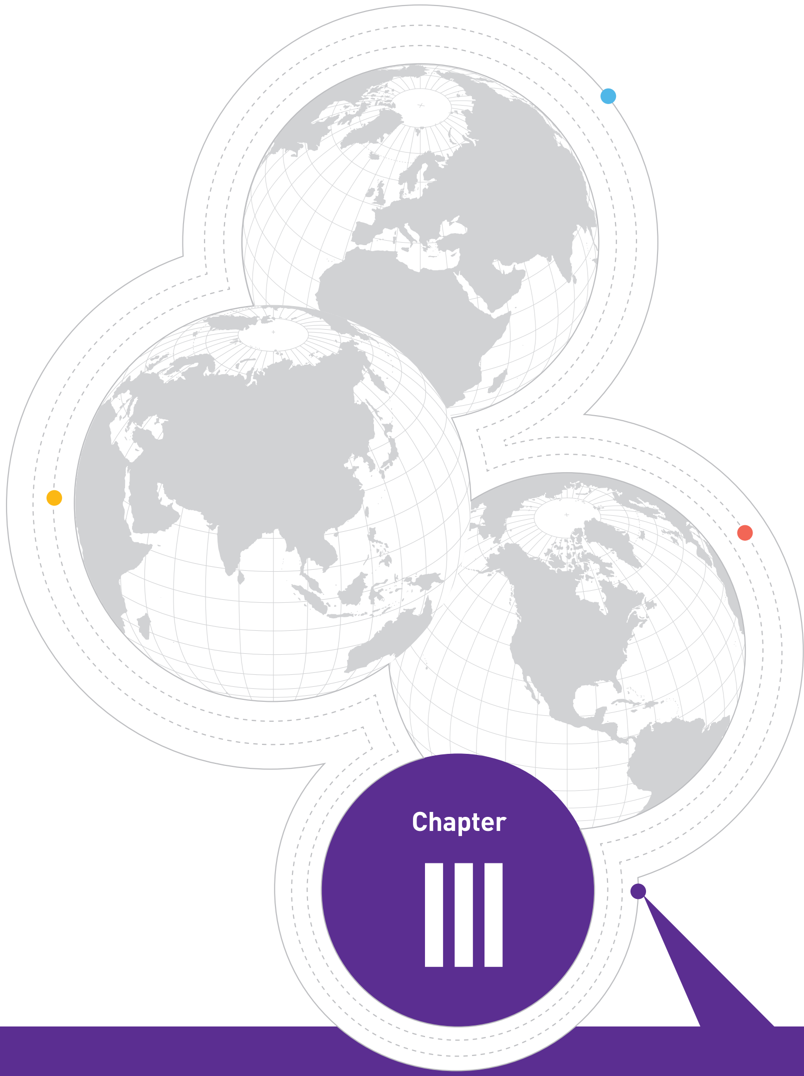
Source: ESCAP estimates 2010

Box II-1 Disasters in Pacific Island countries

Pacific Island countries with their small, highly dispersed land areas and populations are vulnerable to a range of natural hazards, such as cyclones, volcanic eruptions, earthquakes, floods, tsunamis, landslides and droughts. Many small islands are also affected by storm surges, which have inundated land, caused loss of life and severely damaged infrastructure. During these events, freshwater lenses may receive considerable inputs from seawater and subsequent infiltration, and many months may pass before they return to a potable condition.

Since 1950, disasters in the Pacific have reportedly directly affected more than 3.4 million people and led to more than 1,700 reported deaths in the region, excluding Papua New Guinea. In the 1990s alone, reported disasters cost the Pacific Islands region $2.8 billion in 2004 terms (World Bank, 2006a).

For these countries disasters can have a disproportionately high impact on their economies. Samoa, for example, has reported average economic disaster costs of 46 per cent of annual GDP (World Bank, 2006a). In the Solomon Islands, the 2007 Earthquake and accompanying tsunami cost the country around 90 per cent of the 2006 government budget (ADB, 2007a). In Niue in 2004, Cyclone Heta caused immediate losses amounting to over five times that of the GDP (SOPAC, 2008). In addition, there are many indirect costs through loss of infrastructure that reduces access to markets or educational opportunities.



Chapter

III

Reducing vulnerability, socio-economic perspectives

Reducing vulnerability, socio-economic perspectives

Reducing the risks of disasters require widespread and sustained commitment across a wide range of fields, as is well illustrated by the priorities for action and detailed tasks elaborated in the Hyogo Framework for Action (HFA), 2005-2015, the overall framework for reducing disaster risks. This 10-year framework has been endorsed by 168 nations and multilateral institutions and aims to ensure "the more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction" (UNISDR, 2005).

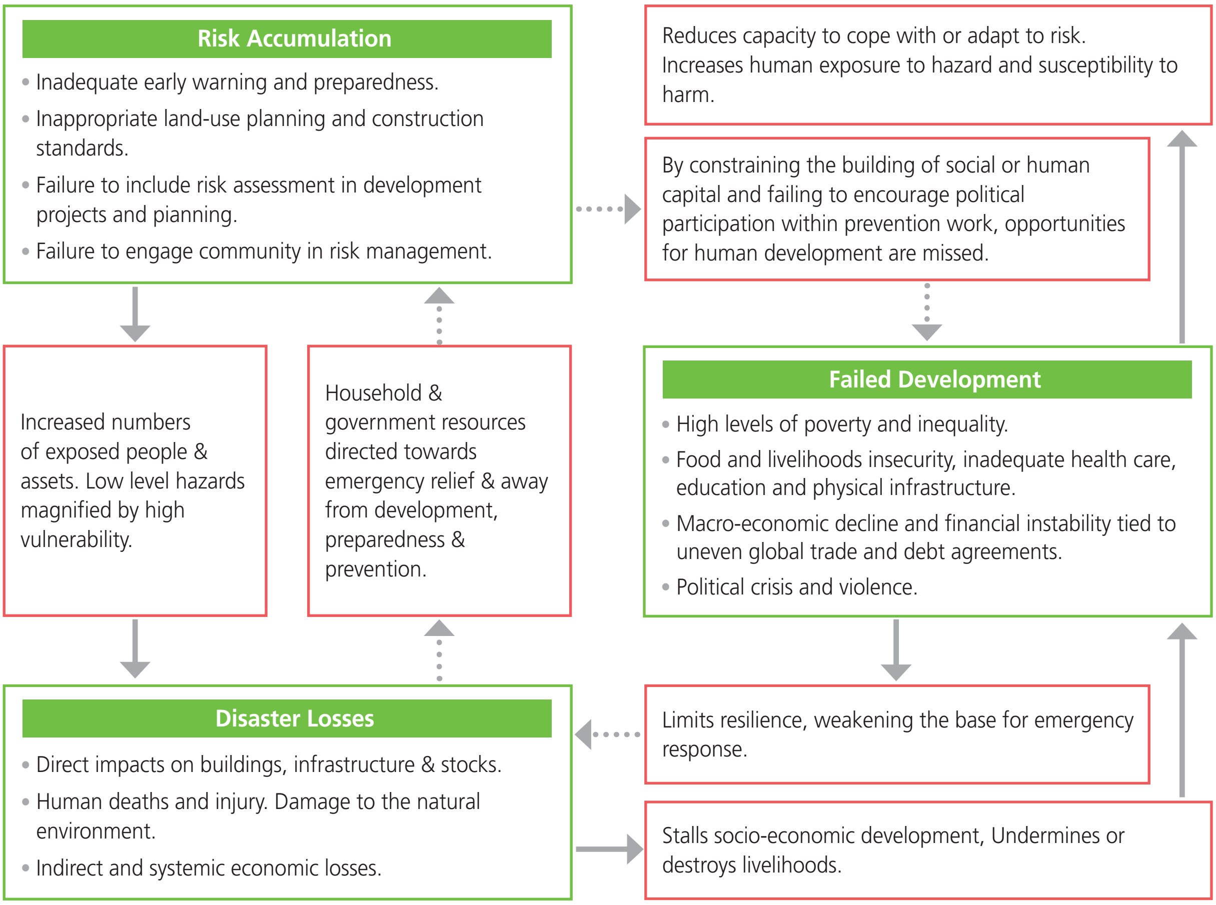
For reducing vulnerability, it is important to be pro-active, tackling the obstacles directly and exploring a wide range of opportunities. And since many of the hazards will intensify because of climate change, it is also vital to be approach these issues on a broad front, integrating disasters and climate change policies and socioeconomic policies aimed at reducing poverty and inequities.

Disaster development inter-linkages

"Disasters are pending issues and unresolved problems of development and governance" and require an "alternative perspective" to depart from a response based approach towards risk reduction and mitigation (Duryog Nivaran, 1996). The GAR 2009 also emphasizes on an integrated system of governance, a governance framework that factors risk reduction into development investments and builds on existing systems of public administration would be more effective in achieving better development.

Consequently, development can be identified as the cornerstone defining disasters. Natural hazards by themselves do not cause disasters. A hazard turning into a disaster depends on levels of risk, exposure, vulnerabilities and capacities of people, ability of structures and economies to withstand and recover. Risk, exposure, vulnerabilities and capacities of communities and societies are outcomes of development determined by the development approaches and policies pursued. The character of development over the last decades, which has a strong orientation towards maximizing economic growth has degraded the natural environment, undermined the livelihoods and socio economic status of large numbers of many poor people, and has expanded levels of risk, exposure and vulnerabilities. The potential for this kind of self-perpetuating spiral of destructive development and disaster risk is illustrated in Figure III-1. These processes are also contributory to climate change and events such as heat waves, heavy precipitation events, droughts and intense tropical cyclone activity (UNISDR, 2009a).

Figure III-1 Vicious spirals of disaster risk and development failure



Source: DFID (2005)

As Figure III-1 illustrates, economic and social development, risks, vulnerabilities and capacities, hazards and emerging hazards are intrinsically inter-linked. Failed or mal-development is characterized by disconnects between policies, data, planning and actual budgeting; target-setting in social sectors determined at the national level leaving local governance and administration confined to implementing agents without adequate skills and resources, and accountability mechanisms. Mal-development results in policy failures and wastage of resources, which adds to a country's debt. Also, it can lead to heightening hazards and to increased levels of risk and vulnerability. As noted by GAR2009, while not achieving development targets, it also results in risk accumulation particularly those related to poverty reduction and improvement of social equity.

All countries in Asia and the Pacific are already and will continue to be affected by climate change impacts to varying degrees, depending on factors such as their vulnerabilities inherent to their socio-economic development and their geo-physical characteristics. For example, the IPCC Fourth Assessment Report, IPCC AR4, already observed increased precipitation in Central Asia and drying in parts of South Asia (IPCC, 2007). The Small Island Developing States (SIDS) in the Pacific and many countries in SouthEast Asia are also vulnerable to the threat of sea level rise, with so much percentage of their human and economic assets in low elevation coastal zones (World Bank, 2007).

It is clear that anticipated development in the Asia and the Pacific region needs to be planned and implemented in such a manner that it reduces levels of exposure and vulnerability of people to disasters including those that are caused or aggravated by climate change. In addition, development should not lead to further risks and vulnerability.

Why is it difficult to make risk reduction a priority?

While there is general agreement on the inter-linkages between disasters and development, and the need for integrated planning and resourcing is strongly advocated; attempts to include risks and vulnerability reduction as a key aspect in development planning is yet to happen. The policy and programme planning and resourcing are highly compartmentalised at all levels. For instance, in the MDGs there is no emphasis to reduce disaster risks, and vulnerability reduction is not a goal in most Poverty Reduction Strategy Paper (PRSPs) or national development plans. Development induced vulnerabilities, which will aggravate climate change impact and increase disaster risk, are thus ignored.

National commitments to MDG, UNFCC and HFA separately address poverty. International discussions have recognized the need for an integrated approach but inadequate progress has this so far. Parallel international emphasis support agreements (MDG, HFA and UNFCC commitments for example) are easily translated to national policy and practice with the support of different UN and other institutions separately, the diverse emphasis at international level easily gets reflected at the country levels too. As a result, targets for MDG, HFA and UNFCC are set, and strategies and plans developed, implemented and monitored separately by different agencies. This does not facilitate inclusive and holistic development through existing sectoral or line agencies.

When budgets are tight, governments tend to spend less on prevention and risk reduction and more on post-disaster response and recovery. There are two main reasons for this. First, investments in disaster risk reduction may not yield benefits for many years, which make it difficult to justify diverting scarce funds from other sectors such as rural health where benefits are more upfront and visible. Second, even if measures to reduced risk are successful, it can be difficult to prove that it was due to investments in prevention. The problem is further compounded by the fact that there are more funds on offer for response than for prevention.

This however arises from treating and addressing disasters in isolation of development processes. A more integrated approach based on the two-way linkages between disasters and development as shown will determine that investment on risk reduction and prevention in effect lead to development and vulnerability reduction.

Implications of disasters and climate change for MDG targets

There is no explicit mention of disaster risk or climate change implications in the millennium development declaration, in the MDGs, or in its targets. However, each and every review of MDGs since their declaration flag the issues of increasing effects of disasters, environment degradation and climate change as barriers for achieving the targets. Climate change is projected to have serious economic and social impacts, which will impede progress towards the MDGs' (UN MDG Reports, 2005, 2007; UN, 2007).

The UN resolution at the end of the MDG Summit 2005 states disaster risk as a resolve to achieving sustainable development, and calls for the establishment of a worldwide early warning system for all natural hazards with regional nodes, and to fully implement the Hyogo Declaration and the Hyogo Framework for Action 2005-2015 adopted at the World Conference on Disaster Reduction.

ESCAP's monitoring and updates on progress in the region towards achieving MDG goals reports that of the 55 developing countries in the AP region only five are early achievers and 10 are on the track in integrating sustainable development principles into country policies and programs. The report also highlights the target on reversing the loss of environmental resources, over the period 1990-2000 the land under forest cover decreased in 18 countries (ESCAP, 2007).

ESCAP proposed remedial measures to address the setbacks posed by the threats of disaster caused by natural hazards and climate change. These measures include larger investments in key sectors such as health and agriculture, improving governance, and targeted strategies to reach the poorest (ESCAP, 2007; UN Millennium Project, 2005).

Even though initiatives to reduce risk will support the attainment of the MDGs, disaster risk reduction rarely features in generic or country-specific reports on the achievement of the MDGs. The recent disasters in China, Indonesia and Samoa, typhoons and floods in the Philippines, Cambodia and Lao PDR are all stark reminders that none of the MDGs can be achieved unless development investments are disaster proof, and disaster risk and vulnerability have been factored into development plans and strategies. Thus, when it comes to investing for the MDGs it will not be enough to build schools. These and other buildings exposed to natural hazard must be disaster resistant, and people using them need to have adequate preparedness for disasters.

Scaling up climate change adaptation in Asia and the Pacific

There have been two approaches taken so far in the region to implement adaptation. First is planned adaptation, those are based on national planning processes like the United Nations Framework Convention on Climate Change (UNFCCC) National Adaptation Plan of Action (NAPA), or the United Nations Convention to Combat Desertification (UNCCD) National Action plans (NAP). Second is autonomous adaptation, or activities that are initiated by communities with very little guidance or coordination from central bodies.

In South East Asia, planned adaptation has been undertaken mainly in the context of the NAPAs. Within the region, Cambodia and the Lao PDR are the only countries to have completed NAPAs. In Cambodia, the NAPA focuses on adaptive management systems of agriculture, water and coastal resources, forests, land use, health, forecasting and surveillance together with research and capacity building measures to support these programs, although with varying emphasis. While it discusses what is and the need for improved understanding of the social and institutional context to climate adaptation, its high priority recommendations focus on improving physical infrastructure (Royal Government of Cambodia, 2006). The recently completed Lao PDR NAPA prioritizes agricultural interventions, water management strategies and infrastructure development (such as bridges), although it also considers promotion of secondary professions in order to improve farmers' livelihoods. However, there has been no study of the socio-economic impact that climate change will have on the Lao PDR (Government of Lao PDR, 2008). At the national level, Thailand and Viet Nam have developed adaptation plans that concentrate on agriculture and water interventions, including the development of resilient crop varieties, cultivation practices, irrigation measures and coastal zone management (Nguyen, 2007). Planned adaptation strategies in Indonesia include the development of prediction and early warning systems, forest and agricultural development plans, that focus on rural irrigation and cropping management (Las, 2007), although a broader adaptation plan is in development.

In Nepal, the primary focus of adaptation work has been on the risk of GLOF with some consideration on the impact of water flow variability on hydropower production (Agrawala, 2003). The studies on GLOF are already in various stages, which are looked at within the context of development projects. Most of this work has concentrated on mapping of lakes with a focus on engineering of structures to lower the water level and prevent sudden breach of lakes. It is perhaps surprising, with Nepal already seeing large impacts from climate change, that adaptation has not yet gained policy importance. There is no specific policy on climate change, even policy work in the hydropower industry fails to recognize climate change impacts.

Though vulnerability is addressed within the implied context of adaptive capacity, there has been no direct attention to autonomous adaptation in South Asia. Since by definition autonomous adaptation will occur without outside assistance, perhaps this lack of research makes some sense as practitioners have first addressed the most obvious and simplest strategies. But autonomous adaptation is perceived to be more than coping and is key to shaping the cross scale and boundary inter-linkages between social, institutional, ecological, and physical systems.

Considering that adaptation action is mostly local, there is a need to link organized and autonomous adaptation strategies and approaches. This will not only provide the necessary understanding of how to improve coping and adaptation strategies by communities already impacted by climate change, it will also support an enabling environment to make such practices sustainable and more effective by fostering better participation, incorporating indigenous knowledge and empowering those who are actually taking action.

Scaling up disaster risk reduction in Asia and the Pacific

Within two years of endorsing the Hyogo Framework of Action, comprehensive disaster risk management programmes or action plans had been produced in a number of countries in the Asia-Pacific, including Bangladesh, Bhutan, Indonesia, Mongolia, Sri Lanka, Thailand, Vanuatu and Viet Nam. They have been followed more recently by many others, including the Cook Islands, the Marshall Islands, Nepal and the Philippines.

Twenty-five countries in the region have submitted national progress reports on the status of implementation of the HFA for the period 2007-2009. The review involved rating themselves on progress against the five HFA priority areas based on self-assessments. For example, for establishing national policy and legal frameworks for disaster risk reduction, with decentralized responsibilities and capacities at all levels, on average the countries in Asia and the Pacific gave themselves a score of 3.8 out of 5, compared to a global average score of 3.6. For the six indicators on progress in reducing underlying risk, many of them related to some aspect of mainstreaming, with an average score of 3.1, compared to a global average of 3.0.

HFA Priority Area 1 - Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation

Disaster risk reduction is also becoming a more significant part of PRSPs. A recent survey of 67 PRSPs found that 20 per cent of them devoted a whole chapter or section to disaster risk, while 55 per cent mentioned the relationship between disaster risk and poverty, and only 25 per cent made no mention of disaster risk at all (UNISDR, 2009). In Asia alone, of the 19 PRSPs studied, 15 per cent devoted a whole chapter or section to disaster risk, 65 per cent mentioned the relationship between disaster risk and poverty: and just 20 per cent made no mention of disaster risk. The 2005 Bangladesh PRSP is a notable example. This strategy identifies comprehensive disaster management as one of sixteen policy matrices and also includes various disaster risk management goals and actions under other policy matrices (Bangladesh, 2005). One of the 10 key goals on which the success of Bangladesh's strategy will be judged will be the extent to which it achieves comprehensive disaster risk management. Over the past two decades, a number of other countries such as the Philippines, have also moved from simply reacting to disasters to integrating disaster risk concerns into development.

Institutional capacity. Disaster risk reduction as development policy requires stronger and more capable institutions. Here progress has been mediocre and there has been little political support for building coherent administration. Although national disaster management offices are typically situated within relatively powerful ministries, such as the office of the president or the ministry of home affairs, they are often politically weak, poorly resourced, lack people with specific sectoral knowledge or with socio-economic policy or development planning skills, and far removed from central development and planning processes.

Ideally, national disaster management offices should be relocated into ministries of planning. This may take some time to achieve, so a simpler alternative may be to establish disaster risk reduction focal points within individual line agencies and local governments. These could identify and draw on existing disaster risk management expertise within each line agency, and provide sector-specific technical support and combine disaster risk reduction and climate change adaptation. For instance, a disaster management cell has been installed within the National Planning Department in Sri Lanka (Duryog Nivaran, 2009). Such initiatives should be encouraged but should not be perceived as relieving others of responsibilities for risk reduction. Instead, these focal points need to work hard to get risk reduction, coupled with the institutional arrangements for climate adaptation, onto everyone's agenda.

Supportive legislation and social protection systems. Governments and development partners have been overhauling their disaster risk management policies and strategies but these efforts also need to be supported by strong legislative and policy frameworks. Reforming disaster legislation can be slow and neither legislators nor their constituents have in the past considered this a very urgent matter. But there is growing awareness of the need for such change. In some cases, legislators can take advantage of recent disasters. In Indonesia, for example, the 2004 Indian Ocean Tsunami helped spur progress and resulted in new legislation by 2007 (Indonesia and UNDP, 2009). Progress in legislation, however, needs to be backed by enforcement in other areas including building codes, land use planning and environmental assessment.

Furthermore, the occurrence of other exogenous shocks may be used as additional leverages to gain higher priority for disaster risk management. The re-emergence of economic crisis in 2008, barely a decade after the Asian Crisis, is a case in point. It catapulted to the top of policy-making agendas, once again, the need for social protection. The difference this time around is that the debate has moved from the narrower definition of social safety nets to a more comprehensive and systemic approach that goes beyond protecting people to transforming their lives through social inclusion and empowerment.

This provides the opportunity to examine social protection approaches that enable the poor and socially excluded to reduce their risk to disasters and adapt to climate change. As has been argued earlier in the study, people exposed to the most severe climate related disasters are often those least able to cope with the associated impacts due to their limited adaptive capacity. Looking forward, at least three aspects will need particular attention in the future design of social protection systems. One is to evolve long-term perspectives so that social protection becomes part of a system of development planning that adapts to short-term and long-term exogenous shocks. Second, the "social" needs to be put back in developing such systems so that interventions are more people-centred and less concerned with resource efficiency and fiscal conservatism. The realities of varying types of poverty, as well as the socio-political and economic disenfranchisement of the marginalized and vulnerable, need to be tackled so that social protection transforms relations between the individual and the state. Third, effective cross-sectoral linkages need to be established at the institutional level.

Finding resources for disaster risk reduction. Governments may fail to address these issues squarely if they believe that disaster risk reduction requires considerable financial investment, and suspect that the benefits, often un-quantified, may only be reaped many years ahead, under the watch of succeeding administrations. However, the costs may not be as high as feared. In broader terms disaster risk reduction is less about expenditure than about a different attitude to development.

While it may be easier to see how much is being spent on reconstruction it is more difficult to track expenditure on risk reduction. This is rarely monitored and may be scattered across a number of sectoral budgets, or even simply be an indirect benefit of a wider development project such as irrigation that reduces the impact of drought (Benson and others, 2009b). However, it is clear that governments find it difficult to invest in disaster risk management for example, climatological forecasting, early warning systems, flood control measures or seismic strengthening of infrastructure. Recent research based on interviews with over 7,000 people from 48 countries across the globe found that local government officials, civil society organizations and community representatives had little access to financial resources for disaster risk reduction (GNDR, 2009).

Many developing country governments in disaster-prone countries make some limited regular budgetary provision. But as in India, Nepal and the Philippines, this is typically for humanitarian relief and early recovery and not part of a comprehensive disaster risk financing strategy. India, for example, has a Calamity Relief Fund, covering emergency repairs to approved items of physical infrastructure and statutory personal compensation (India, 2005; India, 2007). Viet Nam covers post-disaster relief and early recovery spending under a more general contingency budget line for a wider range of unforeseen circumstances. Many governments, such as Cambodia, also meet relatively small-scale disaster-related repairs by drawing on regular line agency funding, particularly maintenance budgets.

International donor support is a relatively small proportion of post-disaster expenditure. In Indonesia, for example, following the 2006 Yogyakarta Earthquake, only about 15 per cent of the reconstruction was funded by the international community whilst central government met about 75 per cent of the costs (Fengler and others, 2008). Moreover, aid for disaster relief may displace short- or medium-term development funding. Most support from the International Financial Institutions (IFIs), for example, consists of reallocations (Cummins and Mahul, 2008).

Countries will therefore need to establish dedicated lines of funding. These would not be necessary if governments were to integrate disaster risk reduction into overall planning, but in the shorter term dedicated funding is needed both sectoral and cross-sectional initiatives for disaster risk reduction and climate change adaptation. And in countries with considerable decentralization they should make these available to local government agencies.

Budget tracking. It is also important to establish systems for budget tracking. Relief and reconstruction efforts in particular may be funded by a wide range of national line agencies, local governments, local and international Non-Governmental Organizations (NGOs), private sector donations, United Nations agencies, bilateral donors and IFIs. For instance, in Indonesia, over 300 institutions contributed to the post-tsunami reconstruction efforts in Aceh and Nias, financing over 1,500 projects. This makes it difficult to track the funding, particularly where it is off budget, and to evaluate results (Fengler and others, 2008).

An example of what can be achieved in the aftermath of a major disaster is the work undertaken by the World Bank and the Indonesian government following the 2004 tsunami in Aceh and Nias. This led to a system for tracking resource allocations and disbursements by the government, international donors and the 20 largest NGOs – which together accounted for 80 per cent of total assistance flows. Combined with a joint needs assessment, this was a powerful tool for reconstruction planning and monitoring (Goldstein and Amin, 2008). This experience shows that such systems should focus on core sectors and be simple and basic, using low-tech, labour-intensive data collection and analysis, including proactive collection of data from key players. More technologically advanced, self-entry based solutions such as the United Nations Development Assistance Database, have mostly yielded disappointing results (Fengler and others, 2008).

To date, there has been much less experience in tracking expenditure on risk reduction. This is partly because it is inevitably cross-cutting expenditure which is difficult to track even for existing priorities such as poverty reduction, although know-how is slowly building up.

It is also important to track disaster-related external assistance. This will indicate whether development partners themselves place sufficient emphasis on risk reduction both within their own programmes and in policy dialogues with governments. Since 1995, the Organization for Economic Cooperation and Development (OECD) Development Assistance Committee (DAC) has, in fact, required donors when reporting aid flows to separate out spending on emergency aid. This category was subsequently relabelled humanitarian aid and, since 2004, has been divided into two categories: emergency and distress relief; and short-term reconstruction, relief and rehabilitation. In 2005, the DAC went a step further and introduced a new sub-category on disaster prevention and preparedness. These changes have yet to be reflected in recipient country reporting systems but could trickle through in future years.

In January 2010, to complement an existing DAC marker on climate change mitigation, the DAC introduced a marker on adaptation. Donors will identify which aid projects have climate change adaptation as their principal, or a significant objective (OECD, 2009b). These markers are only likely to give approximate indications since there is no internationally agreed methodology for tracking the exact share of aid activity expenditure that contributes to climate change adaptation or mitigation. Nevertheless, they are steps forward and will generate useful experience for both development partners and governments.

HFA Priority Area 2 - Identify, assess and monitor disaster risks and enhance early warning

Develop and maintain disaster data. Many countries lack comprehensive, accurate historical data on direct, physical disaster-related losses, or lack guidelines for systematic damage assessment. And where guidelines are in place they are not necessarily applied. Assessments are also often quite partial. Typically they concentrate on forms of loss that are eligible for public assistance. Private losses are recorded by the insurance industry, though because of very low insurance penetration these cover only a small proportion of total private losses. Moreover, governments often fail to assess small-scale localized events which, being very frequent, can have a substantial cumulative impact. And even for larger events, officials and volunteers may lack the skills and the funds needed to reach affected areas.

There have been some encouraging signs of improvement. The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) developed "comprehensive Disaster Damage and Loss Assessment" (DaLA)[3] (ECLAC, 2003). Now the development partners in other regions are applying these guidelines to carry out Damage, Loss and Needs Assessments (DLNAs). These are sometimes referred to as a Post-Disaster Needs Assessment (PDNA), Damage and Needs Assessment (DaNA) or, where multiple partners participate to produce a joint DLNA, a Joint Damage, Loss and Needs Assessment.

DLNAs have been undertaken in a number of countries in the region after major disasters: in Indonesia, Sri Lanka, India and the Maldives following the 2004 Indian Ocean Tsunami; in Pakistan following the 2005 Earthquake; in Indonesia, following the 2006 Earthquake in Yogyakarta and the 2009 Earthquake in West Sumatra; in Bangladesh following the 2007 Cyclone Sidr; in Myanmar following the 2008 Cyclone Nargis; in China following the 2008 Earthquake; in Bhutan following the 2009 Earthquake; in Samoa following 2009 Tsunami; in Lao PDR and in Cambodia following Typhoon Ketsana 2009 and in the Philippines following the 2009 Typhoons.

3 Methodology covers consequences of disasters at the household, provincial and national levels, including those to livelihoods, economic growth, a government's fiscal position, the balance of payments and levels of poverty.

These assessments have been used to design appropriate relief and reconstruction programmes and have also fostered a greater understanding of the links between disasters, socio-economic development and growth. Moreover, the assessments increasingly offer recommendations on preparedness and on ensuring that reconstruction incorporates measures of disaster risk reduction, an approach referred to as "building back better".

There have been parallel efforts to improve national damage assessment processes, enhancing the recording systems and providing related training. India and the Philippines, for example, have been adapting the DaLA methodology for use in on a regular basis, whilst the United Nations Development Programme (UNDP) is trialling a revised DaNA in Viet Nam.

Another complimentary tool developed in Latin America and the Caribbean, and now being applied in Asia and the Pacific, is DesInventar, a methodology for recording the impact of highly localized, small-scale events (see Chapter II). For instance, UNDP has supported its introduction in Iran, Indonesia, the Maldives, Nepal and the Indian states of Orissa, Tamil Nadu and Uttar Pradesh. However, if DesInventar is to fulfil its potential it will need to be developed to overcome some limitations with regards to sector-wise damage to infrastructure, industry and services (IDEA, 2004).

Vulnerability mapping. An impressive example of vulnerability mapping is in Cambodia where the Ministry of Planning and the World Food Programme (WFP) have produced a poverty map, which includes malnutrition, educational needs, and vulnerability to disaster caused by natural hazards. The map will serve as a basis for formulating targeted plans for various interventions carried out by the government and international donors, NGOs, and other organizations (WFP, undated).

In Indonesia, local governments have been empowered to take responsibility for natural hazard mapping. If they are to do so, however, they will need intensive support from agencies like the National Agency for Disaster Management as well as NGOs. One of the problems at present is the lack of a standard methodology. Some local governments have engaged in natural hazard mapping but have not followed any specific standard (Subagio and Amhar, 2009).

Developing appropriate solutions will require longitudinal analysis, using a combination of qualitative and quantitative tools, not just at the national level but also for single hazard events, for the impact will often depend very much on the local context. In countries such as the Philippines that experience many localized natural hazard events, this analysis is also required at sectoral and various sub-national levels down to individual communities. The analysis should also consider the impact on vulnerable groups such as women, children, the elderly and disabled persons, to ensure that disasters and related relief and reconstruction efforts do not reinforce existing patterns of social inequality.

The potential for disaster and the implications of climate variability and change should also be incorporated into economic forecasting and other econometric models. This has proved valuable in other global regions. In Ethiopia, for example, a macroeconomic forecasting model for investments in irrigation showed double the growth and poverty reduction returns by incorporating historically based inter-annual variations in rainfall (World Bank, 2006b). Yet few countries in Asia and the Pacific examine disaster scenarios as a regular part of economic forecasting.

Gender concerns in early warning, emergency and preparedness Gender sensitive participatory approaches help practitioners to better understand gender relations that exist in a particular social system. This understanding helps build in strategies to shift towards improved attitudes and behaviour that foster gendered vulnerability reduction to disaster risk and Climate Change. Such approaches can also inform targeting preparedness programs to ensure certain sections of population do not become more vulnerable due to reduced access to resources and information.

Strengthening local risk management by linking Local Government and community at risk in Navua, Fiji is being undertaken through a pilot project by the National Disaster Management Office (NDMO), Fiji and the Secretariat of the Pacific Islands Applied Geosciences Commission (SOPAC). Participatory Vulnerability and Capacity Assessment (VCA)[4] is used to collect first-hand data from the community with particular attention to the participation of women and men. Preliminary findings revealed that despite having active women's groups, women have small roles in community or local development. Decision making not being equitable with low/no involvement of women, inefficient dissemination of early warning to the women creating difficulties for preparedness work, were among the issues highlighted by the VCA. Gender sensitive participatory approaches were used to improve attitudes and behaviour.

HFA Priority Area 3 - Use knowledge, innovation and education to build a culture of safety and resilience at all levels

Knowledge and education on Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) are recognized as important first steps in increasing resilience. Goal 2 of the MDGs discusses importance of primary education in lowering poverty; HFA's priority 3 focuses on

4 The VCA is used worldwide by the International Federation for Red Cross/Red Crescent (IFRC) in the most vulnerable communities to identify local capacities to cope with issues ranging from socio-economic phenomena like unemployment to natural hazards like flood.

increasing resilience and building a culture of safety and resilience at all levels through the use of knowledge, innovation and education.

Knowledge and education on risks and vulnerability and their increasing trends as well as options for reducing vulnerabilities are important in creating required culture to facilitate risk reduction. Public awareness and education as well as specific knowledge programmes targeted at community, local and national governments, and international levels depending on requirements are also focus under the theme of knowledge and education. Development interventions such as compulsory primary education and optional higher education systems as well as other systems such as media need to be used as vehicles for sharing knowledge and providing education on vulnerability reduction.

New knowledge is an important aspect to understand vulnerability trend particularly in the context of changing climate. Similarly local knowledge especially traditional systems of knowledge also provide options to engage in invulnerable development. It is important that systems of knowledge sharing and education take this into consideration and facilitate sharing of such knowledge across levels effectively.

The informal networks and community institutions are important vehicles to disseminate/share knowledge and promote education at local levels. Communities need to be aware and know of emerging/changing risks, options for vulnerability reduction, developing their skills and capacity.

A community disaster museum set up in Indonesia shows effective practices of local resource centres. The museums transfer information and facilitate education and communication in a lively way and institutionalise local disaster memories. The Tsunami Resource Centre (TRC) situated in the Teachers' Training Institute of the Syiah Kuala University in the city of Aceh is an example. It was started by Civil Society Organizations (CSOs) with the support of the Faculty of Education of the University. It is located appropriately for dissemination of education and awareness. The building demonstrates earthquake–resistant technique, and consists of a large photo gallery, a formal training centre and a mini library.

The Mobile Knowledge Resource Centres in Myanmar has a similar concept of bringing knowledge to communities (e.g communities affected by Cyclone Nargis) and sharing information through discussions and demonstrations.

Retrofitting schools in Pakistan in post South Asia Earthquake 2005 is another example of knowledge demonstration and sharing at local level. While making school children safe, the schools are considered as effective channels to spread DRR awareness to local communities. In Nepal and India, there have been some further interventions that include training of masons, engineers and officials on safety of school buildings, and training and education of students, teachers and parents on disaster risk reduction actions.

Initiatives towards mainstreaming DRR into school curriculum have taken place in a number of countries. In Indonesia, for example, a Presidential Decree was issued to relevant ministries to integrate disaster risk reduction into the school curricula, although implementation is pending until a suitable instrument is devised at national level. Including DRR in an already heavy curriculum, resource and capacity issues seem to be the key challenges. In some agencies, guidelines to integrate emergency awareness into the school-based curriculum have been introduced, some guidelines related to educational materials and disaster-related trainings have been prepared, although focused on emergency preparedness, emergency response or emergency management. Post-graduate programmes and elective courses on disasters have been set up in institutions of higher education (Caritas, 2010), but overall DRR training remains limited.

School safety is one of the areas that has made considerable progress; however, a school safety audit in India has shown that despite information being made available, attention is not paid to constructing safe buildings. Factors emerging from this audit highlighted the necessity to include disaster risk reduction strategies into development efforts; that in post disaster reconstruction, emphasis is on the safety of big buildings instead of schools; that sharing good practices among schools is not happening enough, and teachers who are keen on learning disaster safety are unaware of information sources and hindered accessing such sources due to financial and time constraints; and that follow up efforts on the school safety programmes is minimal.

CSOs carry out similar work with children in more localized way. For example, a project[5] engaged with teachers and children on school disaster education in three schools in Indonesia has succeeded in integrating DRR into formal school curriculum in 2010. Kaeru-Dal-Caravan Japan is a similar example of a programme[6] where children were encouraged to sketch the house, arrange paper made furniture inside the house and observe earthquake effects by shaking the table.

Participatory Vulnerability Analysis (PVA) in schools (Nepal, Bangladesh, and India), through a project by Action Aid, aims to make schools in high-risk areas safer by enabling knowledge transfer and demonstration. PVA is an approach used in emergency contexts to involve local people in doing their own analysis of their situation, strengthening their voices in planning effective responses. The project aims to adapt PVA for use in schools and to help build the awareness of children, parents, teachers, district officials and agency staff on disaster risk reduction, although the outcome of the project has not been stated.

There is much networking and knowledge sharing initiatives as well as huge support for it. It happens at many levels and in a impressive manner. Knowledge sharing at international level in both the DRR and CC arena has seen a lot of progress, with the Global Platform for DRR as the main international forum on disaster reduction, providing strategic guidance and coherence for implementing the Hyogo Framework. A key emphasis is on sharing knowledge and expertise. Between the sessions of the Global Platform, Regional Platforms are convened to focusing on issues of particular concern to the regions. The above are also linked to officially declared national coordinating multi-sectoral and inter-disciplinary mechanisms for advocacy, coordination, analysis and advice on DRR. On the CC front, the COPs looked at with a regulatory framework. The environmental focal point, most often the Ministry of Environment, takes the lead on the discussions on this front.

At regional level, the ISDR Asia Partnership for DRR, Asia Disaster Risk Reduction and Response Network (ADRRN), Duryog Nivaran, Climate Action Network are some examples of networks that facilitate knowledge sharing. Training and Resource centres such as the Asian Disaster Preparedness Center (ADPC) and Asian Disaster Reduction Center (ADRC) facilitate training, capacity building and knowledge sharing events.

With reference to climate change, while conceptual knowledge is readily available and quite updated, knowledge required to translate this to practical level is not readily available. There is a gap in learning from and learning with communities to apply strategies on ground. As seen by the examples, sectors such as health are at the forefront of participatory research and learning and these would be equally useful for vulnerability reduction. The private sector is engaged in creating

5 by SEEDS Asia
6 ibid

and sharing knowledge on their own, particularly in the area of CC. While this is encouraging, it is good be involved and to learn from and influence their agendas if necessary.

Community-based Networking for Sharing Knowledge and collaboration has been recorded in many instances. For example, promotion of traditional rice cultivation in Sri Lanka is facilitated through a National Farmer Federation; a farmer-to-farmer network. They are also linked to the Asian Farmer Association where they help each other on gaining recognition for their adaptive livelihood strategies in the market context.

The inter-village networking aspect for Natural Resource Management (NRM) in Pang Ma Pha District, Mae Hong Son Province in northern Thailand is another example. The network facilitates three villages to come together to agree on and develop guidelines to manage harvesting of bamboo shoots for livelihoods.[7]

HFA Priority Area 4 - Reduce the underlying risk factors

Community participation. The importance of community engagement to resilience building cannot be overemphasised. Often such participation is limited to consultation. This is better than not engaging with communities at all, but does not contribute fully towards local empowerment and decision-making. It is also important to ensure that such consultations reflect the needs and priorities of vulnerable groups.

Preparedness activities should be based on an understanding of local capacities, local knowledge and the social factors that affect the ways communities respond. Unfortunately budgets for such work are generally inadequate and local monitoring and risk management capacity is still in short supply. This is especially true in high-risk communities where preparedness activities are sporadic, dependent on external aid and insufficiently harmonized (UNISDR, 2008).

A project in Tongi and Gaibandha in Bangladesh, for example, has hazard risks identified and ranked by communities to develop municipal hazard maps. Trained volunteers assessed risks with the community and produced ward-level maps which were manually compiled to produce municipality level maps. Sharing these back with the community further increased awareness of their vulnerabilities, preparedness and mitigation options and individual and community responsibilities. This was funded by CARE Bangladesh with technical and financial support through ADPC's Asian Urban Disaster Mitigation Program.

Similarly, Wanduruppa and nine other coastal villages in Ambalantota, in south Sri Lanka, face recurrent flooding, 12 to 20 times a year, as a result of the natural build up of a sand barrier across a river mouth. With assistance from an NGO and the local authority, the community has been implementing a flood risk management plan that builds on traditional community practices. After receiving a warning, the community in the affected villages works to clear the sand barrier either manually or with use of machinery, for which the local authority provides limited funding. In 2008, community had to clear the sand barrier 15 times, effectively avoiding floods, but had to draw on additional funds only twice. The community has now been accepted by the local authorities as the body to carry out the flood mitigation mechanism (Practical Action). Similar examples of community engagement in risk assessment can be found in the Philippines, Viet Nam, Indonesia, Nepal, India, Maldives, Vanuatu, and the Solomon Islands.

Guidance for this kind of participation has also been produced in Viet Nam. City Mayors now have

7 www.rmportal.net/library/content/tools/biodiversity-support-program/copy_of_cbnfm/USAID-BDB-cd-2-data/thailand-jantakad.pdf/view (Accessed 8 October 2010).

a user-friendly practitioners' guide for step-wise risk assessment developing "Local Resilience Action Plans". The guide was based on a project carried out in three cities: Hanoi, Can Tho, and Dong Hoi. Communities can complement scientific geo-spatial analysis with rapid qualitative vulnerability self-assessments, not only making the analysis more robust but also ensuring that the assessment itself acts as an agent of change.

Participatory risk assessment can thus be used to integrate local knowledge and stakeholders' perspectives into more technical assessments to produce "participatory geographic information systems". In Naga City, in the Philippines, this has been used to incorporate local knowledge of urban flooding and vulnerability as well as coping strategies (Peters, 2008). Another technique, known as participatory three dimensional modelling, integrates people's knowledge and spatial information to produce stand-alone scale models that not only support relatively accurate data and analysis, but are also very user-friendly and are excellent means of communication.

A GLOF risk assessment project in India, Pakistan, Nepal and Bhutan aims to complement the structural approaches towards GLOF risk reduction, with sociological and community-based strategies. The past GLOF/flash flood events were studied to assess GLOF hazards and capacities/gaps at community and local administration levels. Participatory consultative and interactive approaches with community and local stakeholders were adopted while consultations with national stakeholders such as administrators, technical and research institutions and civil society organizations working with mountain communities were also held. Observations were shared with stakeholders and attempts to identify appropriate mitigation and preparedness measures were made. These include community-based approaches/techniques and other interventions with national partners and institutions for GLOF risk reduction. Developing research on GLOF risk reduction using both community-based and non-structural approaches is envisaged.

Community participation can also be encouraged through imaginative forms of communication. One option is a local resource centre, which can act partly as was discussed above.

Community-based DRR. Community based and local level disaster management is accepted as effective in disaster management, particularly in the event of a disaster. It is important that formal systems acknowledge local contribution and include it in development plans budgetary allocation. Effective policy and strategies are essential to establish and ensure early warning to reach and serve communities, and reduce damage to lives and property. As exemplified in the National Level Preparedness Efforts of Bangladesh's Cyclone Preparedness Programme (CPP), the Government introduced standing orders on CPP laying down various actions needed at different stages of CPP. CPP plays a crucial role in the dissemination of Cyclone warning, evacuation, rescue, first aid and emergency relief work including mobilization of people toward cyclone shelters through its volunteers in the coastal districts. CPP is a mechanism which relies on technical skills and commitment for ensuring that all potential victims of an approaching cyclone are given sufficient warning to 11 million coastal people in order to enable them to move to safe sites including cyclone shelters and buildings. The system starts with the collection of meteorological data from the Bangladesh Meteorological Department (BMD), which issues bulletins including the designated warning signals of an approaching cyclone. The bulletins are transmitted to the six zonal offices and the 30-upazila level offices (sub-district) over HF radio. The upazila office in turn passes it to unions and lower levels through VHF radios. The union team leaders the unit team leaders immediately. The unit team call leaders with volunteers spread out in the villages and disseminate cyclone-warning signals almost door to door using megaphones, hand sirens and public address systems. CPP comprises over 40,000 volunteers (close to 15,000 female) who are respected and becoming increasingly integrated and influential within their community and with local government agencies.

In Lao PDR, mechanisms for early warning seem to be spelled out fairly well in terms of lines of communications, starting from the Department of Meteorology and Hydrology to the local disaster management organizations. The information consists of weather forecast (rainfalls, storms, typhoons) and information on water level along the main river and its tributaries. Community based early warning systems are developed in parallel by NGO projects which include setting up monitoring equipment (flood mark) along the river, system of monitoring and reporting to the village disaster protection unit head, district authority and province. Further, village disaster risk maps are produced and placed within the village head. The disaster risk maps consist of information on disaster types in different areas within the village, elements at risk, and evacuation routes. Government has yet to build on this and sustain useful practices on community based disaster risk management developed with the support of donor agencies.

Overall, in many instances, institutional commitment has been attained, where national DRR plans identify Community-based Disaster Risk Management (CBDRM) as a priority. In the national plan for DM 2007-2015 of the Ministry of Food and Disaster Management, Bangladesh recognized community empowerment (building capacity, community based early warning system, community based risk assessment and preparedness planning, etc.) which is practiced through the CBDRM programmes in the country. In Indonesia, National Action Plan for DRR 2006-2009 prioritised integration of CBDRM with local development master plan. Following successful implementation this is included in recently developed National Action Plan for 2010-1012. The Philippines Strategic National Action Plan (SNAP) on DRR 2009-2019 recognises the cross cutting issues of community participation in the process of mainstreaming DRR in various sectors. Similarly in Sri Lanka the Road Map for Safer Sri Lanka 2006-2015 prioritises CBDRM as one of its seven programmes, with an aim of having a sustained national programme to build the resilience and capacity of at-risk communities for response and Disaster Risk Management (DRM). Similarly in Lao PDR, Provincial Disaster Management Committee (PDMC), District DM Committee (DDMC) and Village Disaster Protection Unit (VDPU) have been established.

However, achievements are neither comprehensive nor substantial. For example, in the case of Lao PDR, where the mechanisms face many challenges due to inadequate financial resources, lack of capacities of disaster management committee members, lack of facilities, equipment, and operational systems. There is abundant knowledge, both in the local traditional domain as well as the available technological fields on early warning. Deployment of this range of knowledge to effective use is, however, very limited due to lack of organised and user-friendly availability of the knowledge where and when it is required. The sophisticated systems put into place have yet to show evidence of smooth implementation in case of emergencies, although there are a few rare cases.

Gender issues in risk and vulnerability. Gender, age, class and poverty based differential impacts of climate change is confirmed in the 2007 Assessment Report of the IPCC. The progress reviews on MDGs clearly state that goals and targets on gender are of crucial relevance to achieving the rest of the MDG targets. UNFPA make specific reference to the goals related to women, stating that "achievement of the eight MDGs by 2015 is in jeopardy. Climate change is reducing the likelihood of reaching a number of the Goals related to gender and sustainable development that are already at risk as a result of the deep and continued bias against women and girls" (UNFPA, 2009).

The United Nations International Strategy for Disaster Reduction (UNISDR) and the United Nations Development Fund for Women (UNIFEM) review (2009) of the selected country HFA progress reports from the Asia and the Pacific, and the global HFA guidance material reveal that cross-cutting issues do not currently receive meaningful or sustained attention, with gender and culture least likely to be considered in most sectors.

According to the Gender and Disaster Network, while progress has been made in gender and DRR, it has been slow and inconsistent (2009). National policies rarely state gender issues explicitly, and it is often an implicit part within larger goals such as implementing HFA or achieving MDGs. Gender issues are still marginalized at national levels. Only 19 out of the 118 countries prepared reports for the World Conference on Disaster Reduction 2005, and only eight among 61 countries at Global Platform for DRR 2007 mentioned gender or women's issues in their national reports. A recent UNISDR Review on gender Issues in DRR in India and Sri Lanka, too, shows that while national policies acknowledge women's vulnerabilities and the need for empowerment, budgetary allocations are not available; where practice is limited to including women as members of local disaster management committees, that too is an afterthought, rather than a systemic provision to ensure gender equity. Oftentimes women's involvement is generally limited to lesser-recognised voluntary work. View from the Frontline (VFL) 2009 confirms this based on the analysis of information from 12 countries, relatively high volunteer women participation at a grassroots level and low participation in decision-making. Further, while commitment, local capacities and initiatives are high amongst women, access to formal decision-making process, and consequently access to resources by women remains low. In both India and Sri Lanka, women's and men's roles and responsibilities in disaster management tasks are stereotyped based on traditional gender assumptions. Women are also active in the maintenance of both contemporary and indigenous early warning systems in the two countries, yet are not officially recognized in policies and programmes.

There are similar issues in the Pacific. In Fiji, for example, the National Disaster Management Office and SOPAC have used a participatory vulnerability and capacity assessment to collect first-hand data from Navua communities. Preliminary findings indicate that although there are active women's groups these have a small role in community or local development. Women have little involvement either in decision-making and are less likely to be involved in early warning systems.

Unsurprisingly, therefore, during and after the disasters, women and children suffer most (Global Fund for Women, 2005). For example, women accounted for 61 per cent of deaths in Cyclone Nargis in Myanmar (Joint Assessment Report), and 70 to 80 per cent of those who died during the Indian Ocean Tsunami. In the 1991 Bangladesh Cyclone, death rates among women were almost four times higher than those among men.

Women are also affected differently during the recovery. As caretakers they have to take most of the responsibility for sick and injured family members while having less access to formal recovery assistance when they are not the head of the household. They may also be offered limited opportunities for employment and education. In families under stress women also face increased violence. A post-tsunami assessment in Thailand, for example, reported that young women who lost their jobs were in danger of being forced into commercial sex work. At the same time there were fears of increase in HIV infections and other diseases (UN Country Team Thailand, 2006).

An important point of observation, which needs attention at the levels of policy and practice, is the lack of consideration of women's capacities. Due to the socio-cultural prejudices in the region, women are frequently labelled as weak and as victims. However, it is evident that despite the lower socio-economic status and oppressive social and institutional structures which reinforce gendered imbalances in Asia and the Pacific region, women possess and apply skills and capacities that are key for disaster risk reduction and preparedness, post disaster recovery and rehabilitation, and climate change adaptation, which often go unnoticed and formally not recognised (Ariyabandu, 2004; UNFPA, 2009; ICIMOD, 2006). This invisibility is reflected in the disaster preparedness and early warning programmes, in recovery plans and investments, which are often gender blind and lack systematic and inbuilt gender analysis. As demonstrated in the Indian Ocean Tsunami and Kashmir Earthquake recovery and reconstruction, gender stereotypes prevailed. Technology up - gradation, access to credit, livelihood capacity development opportunities were not gender equitable and reinforced existing gender imbalances (UNDP, 2006; IFRC, 2007; Duryog Nivaran, 2006).

Children, elderly and disabled are also identified as particular groups that become marginalized. International organizations such as Plan International and Save the Children have initiated work on child rights and children's needs in DRR. Although some agencies such as Handicap International and Help the Aged have started some work, much less attention is paid to disability and elderly issues.

HFA Priority Area 5 - Strengthen disaster preparedness for effective response at all levels

Losses from disasters can be reduced substantially by making adequate preparations. Disaster preparedness must integrate structural and non-structural, human-oriented interventions and end-to-end early warning systems. The benefits of preparation were evident from the experience of two recent cyclones: Nargis, which struck Myanmar in 2008 and Sidr which struck Bangladesh in 2007. The cyclones were of similar strengths and struck countries with similar levels of poverty among people living on extensive coastal tributary systems. But while Nargis cost 300,000 lives, Sidr cost only 3,500 lives. The difference was that while Myanmar had made little preparation for such an event, Bangladesh had invested in protective embankments and preserved its mango forests and also had people-centred early warning systems and well prepared communities (AUSAID, 2008).

Table III-1 **Preparedness makes a difference - same levels of hazards but different impacts**

	Bangladesh Cyclone Sidr, 2007	Myanmar Cyclone Nargis, 2008
Tidal wave (and storm surge)	5 metres (up to 6 metres)	3.5 metres (up to 7 metres)
Wind speed	240 km/hr	255 km/hr
Population evacuated	3 million	None
Deaths	3,406	84,537*
Missing	1,001	53,836
Population “severely” affected	1 million	2.4 million
Total loss and damage	$1,674 million	$4,134 million
Human Development Index (2007)	140	132
Per capita GDP ($PPP, 2007)	$1,400	$1,900
Population below poverty line (2004)	45%	33%

Source: AUSAID, 2008

Effective Community-based Disaster Preparedness (CBDP). Community-based Disaster Preparedness Programme facilitated by OSDMA, the State Nodal implementing and monitoring agency was launched in 10 coastal blocks (Kantapada, Ersama, Kujang, Balikuda, Balianta, Astarang, Mahakalpada, Rajnagar, Ganjam and Bahanaga) of seven coastal districts (Cuttack, Jagatsinghpur, Khurda, Puri, Kendrapara, Ganjam and Balasore) of Orissa. Active involvement of Panchayati Raj Institutions (PRI) the local government authority in the context of devolved power was helpful. The Village Disaster Management Committees (VDMC) consisting of villagers, ward members and village level government functionaries implemented the programme at village level. Community mobilization with special focus on vulnerable groups was carried out by local CSOs and members of PRIs and it facilitated preparation of Village and Panchayat level Disaster Management Plans. Capacity building on risk analysis and management led to community identifying specific risk reduction measures and recognizing their own capacities and coping mechanisms and using this as basis for linking preparedness to local developmental planning. The experience was also replicated by implementing the same in 145 blocks of 16 districts (3,005 Blocks and 23,234 villages).

How the community in the Barangay of Talba, the Philippines prepared for the volcanic eruption of Mt. Pinatubo in Central Luzon, is a good example of how informed community can take responsibility for not only preparedness measures, but also in mitigation actions and mobilize local resources towards this. The eruption in 1995 destroyed the village of Talba. The government communication system were disrupted and failed to warn the community. The parallel community warning system, however, worked and it helped to avoid loss of life. Resources of the community, such as privately owned small boats, jeeps and trucks were used to move the villagers to safety. The CI also facilitated service delivery by the government at evacuation centers and facilitated relocation of community by negotiating on behalf of community with Authorities.

Similar approaches on CBDRM are adopted across the region, with donor and government support highlighting the value in mobilizing communities and local resources, while building their capacities and social capital, and paying attention to locally important issues including those that are important to marginalized groups. Good examples on CBDRM for disaster response and preparedness can be found in India, Lao PDR, Malaysia, Mongolia, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand, Bangladesh, China, Viet Nam and Cambodia.[8]

Implementation challenges

Despite the advances made, there is still a long way to go, the most challenging aspect being the integration of DRR into development and acting upon DRR challenges of climate change. Low income countries report little progress in integrating disaster risk reduction considerations into social, economic, urban, environmental and infrastructural planning and development. The governance arrangements for disaster risk reduction in these countries do not facilitate the integration of risk considerations into development. Often, the organizations responsible for disaster risk reduction lack the political authority and the technical capacity to influence development sectors (UNISDR, 2009a). For instance, the national report from Cambodia states that "[t]here is no common understanding of multi-sector integration approaches and lack of comprehensive understanding of disaster risk reduction and vulnerability reduction development agencies" (UNISDR, 2009).

Participants at the Fourteenth Regional Disaster Managers Meeting in Fiji in 2008 reported that some of the activities including legislation

8 Case studies archive. www.cbnrm.net/members/cases/cases.html

approval strategy have stalled (Lal and others, 2009). Bangladesh national review emphasises attitude related challenges in changing the previous emphasis on response: "Introducing DRR culture and practices takes time to replace age-old relief culture." Moreover, the approach is often traditional – conceived within a narrow project-based framework, focusing on structural risk reduction measures, particularly flood control, enhanced early warning systems, and strengthened response capabilities.

National – local coordination gaps

For risk and vulnerability reduction, governance systems need to be effective at local, national, regional and international levels. Progress in risk reduction is particularly difficult and slow at local levels. While Indonesia, Nepal, and the Philippines express clear institutional commitment to the delegation of authority to local levels, all remaining countries emphasize the importance of local and community level empowerment and the challenges of highly variable local level capacities. Local officials are not necessarily familiar with new regulations and there is a lack of dedicated organizational local capacity for planning and implementation. In the absence of clear monitoring and evaluation criteria, the enforcement of new regulations poses major challenges. This is compounded by a general lack of clarity on the roles of local government and/or competition of different administrative levels over authority and resources (UNISDR, 2009d).

These are supported by findings from the 2009 study "Clouds but little rain: views from the frontline - A local perspective of progress towards implementation of the Hyogo Framework for Action" by the Global Network of Civil Society Organisations for Disaster Reduction. This study found that nationally-formulated policies are not generating widespread systemic changes in local practices; resources are scarce and considered one of the main constraints to progress. However, there are also resources at local level which remain untapped. The foundation for building resilience is people's awareness and understanding of the risks that they face; climate change provides an opportunity to address underlying risk factors, raise external resources and political commitment for building resilience, and turning policy into practice requires finding the appropriate balance between top-down and bottom-up engagement (Global Network of Civil Society Organisations for Disaster Reduction, 2009).

It is also important to acknowledge that subnational planning systems are often weak, and there are significant disconnects between different levels of government. In the Philippines, for example, provincial investment plans and regional and national investment plans are formulated independently (ADB, 2007b). It can also be difficult to implement national policies and regulations at the local level in countries where local chief executives, rather than national line agencies supervise local officials and largely determine the use of funding (Benson, forthcoming).

Similar limitations are evident in programmes and projects. Many of the identification and appraisal processes pay little explicit regard to disaster risk concerns, missing the opportunity to optimize projects and ensure that they do not inadvertently aggravate vulnerability to natural hazards.

Typically, disaster risk concerns are limited to environmental assessments. Even these may focus primarily on the impact of proposed projects on the environment, rather than on the potential impact of environmental hazards on the project, for example, when schools are built in hazard-prone areas. More fundamentally, the environmental assessment process is often applied only loosely, particularly at the subnational level, and the resulting recommendations are not necessarily acted upon.

The situation is usually better for infrastructure. Major roads, for example, are usually designed to take into account the danger of floods. However, this may not apply to small-scale constructions and even for major infrastructure, the design parameters are typically based on historical records and do not take into account potential changes in the frequency and intensity of hazard events over the life of an investment, particularly as a result of climate change.

The most fundamental task for integration is to ensure that the importance of disaster risk reduction is appreciated at all levels of government. This is particularly important for ministries of finance and planning – which determine broad development objectives, coordinate sectoral activities around cross-cutting issues, set guidelines and criteria for designing and prioritizing individual development initiatives and allocate budgetary resources. In practice, many finance and planning ministries still have relatively limited knowledge and understanding of the socio-economic impacts of disasters and faced with many pressing demands on limited budgetary resources, giving a low priority to disaster risk reduction.

Conclusions

It is evident that progress on mainstreaming disaster risk reduction and climate change into development planning and practice has been disappointingly slow. However, it should be emphasized that this process inevitably takes time, since it involves knowledge, awareness and capacities, changes in attitudes and thinking at all levels of government and civil society, as well as changes in legislative, institutional and policy frameworks and adjustments in project and budgetary procedures.

Opportunities for cross learning

A number of overlapping experiences exist between the three frameworks: sustainable development, UNFCC and HFA in relation to reduction of vulnerability. In areas, where more advanced learning has happened and lessons exist, opportunities are there for information exchange and scaling up of actions and practices across development, DRR and adaptation communities. What has not happened yet is a systematic approach to analyze what practices are best suited for sharing across these issues.

A summary of what would constitute inclusive risk reduction that meets sustainable development goals is shown in Table III-2. The table attempts to capture the characteristics of an "ideal scenario": characteristics of resilient communities and of the enabling environment at national, regional or international levels of resilience, and places them against the five key themes of HFA. Table III-2 is adapted from the framework "Characteristics of a Disaster-Resilient Community" guidance note (Twigg, 2007)[9] in order to list key aspects of DRR that effectively addresses vulnerability reduction and climate change in an inclusive development context on the ground. These were derived through the analysis of current thinking related to poverty, development, disaster risk and impacts of climate change. The table facilitates the understanding of how interventions and practices for risk reduction in the region can contribute to moving a community towards resilience and a desired state of development.

The analysis and the criteria presented in the table can be used to help decision makers to get a realistic indication about pace and direction of ongoing work, prioritise and target the gaps which are essential to achieve sustainable development in their individual countries and in Asia and the Pacific region.

This section outlines socio-economic approaches needed to scale up work in reducing disaster vulnerability in Asia and the Pacific. The next section outlines how we can take advantage of a disaster to make the recovery more resilient.

9 John Twigg, "Characteristics of a Disaster-Resilient Community", A Guidance Note, for the DFID Disaster Risk Reduction Interagency Coordination Group, Version 1. June 2007

Table III-2 Key features of an inclusive and environmentally sustainable disaster risk reduction strategy

	Features of a resilient community	Features of an enabling environment for gaining resilience
HFA Priority for Action 1 **Governance**	Strong and representative community institutions that can engage with local governments, NGOs and other key actors. Community institutions that represent the diverse members of the community and their priorities.	Political consensus on reducing vulnerability: decision makers authorise policies and allocate budgets based on long-term cost benefit analysis. Policy makers use participatory methodologies and enable decentralized and community-based actions for effective planning and implementation of development work.
HFA Priority for Action 2 **Risk assessment**	Local risk and vulnerability assessments through participatory analysis, with all stakeholders recognizing local knowledge.	Research and academic institutions see value in assessing risk through participatory research. Budget allocations reflect cost of participatory risk assessments.
HFA Priority for Action 3 **Knowledge and education**	Communities know of risks and options for vulnerability reduction. Communities have climate information access and skills to interpret and use forecasting for community level decision making. Social networks help in skills and capacity development, and knowledge sharing. Vulnerability reduction learning and practice are built on traditional knowledge systems. The community can work effectively with markets and understand issues of financial risk transfer. Sustained community engagement in public education, debates, campaigns and consultations.	Knowledge and education prioritized at national and local levels. The links between development climate change and disaster risk reduction are taught in schools, universities and technical colleges. Local politicians, officials, scientists, researchers, practitioners and community leaders have the knowledge and capacity to understand the linkages and act accordingly. The media stimulate a culture of disaster resilience.
HFA Priority for Action 4 **Risk management and vulnerability reduction**	Communities are aware of and understand risk management options. They adhere to agreed standards, and engage in sustainable risk management practices such as risk-sensitive housing construction, infrastructure development, and livelihood practice. Communities engage in scenario-based plans and options, avoid damaging and risk-increasing practices. Communities apply codes of practice to arrest risk increasing behaviour. Communities are linked to government social protection and have their own risk sharing means.	Vulnerability reduction is a poverty reduction and development target. Officials have the necessary skills and engage in vulnerability reduction. Tools and guidance for risk-sensitive planning and scenario-based planning is available. Environmental and natural resource management is considered a core value in development programmes. Project and programmes have adequate guidance to plan and implement risk-sensitive development. Financial institutions and insurance companies align their services to promote risk-sensitive development. The Local government leadership and decisions are respected.
HFA Priority for Action 5 **Disaster preparedness and response**	Communities take responsibility for planning and implementing emergency, preparedness and contingency plans independently of NGOs and others. Communities have scenario-based preparedness plans for unforeseen or unpredictable situations. Community is active in early warning systems and works alongside local research and institutional mechanisms to predict local risks, vulnerability and solutions. Community has skills to lead or contribute to handling emergency, preparedness and recovery actions.	Development plans and budgetary allocation include and facilitate community based preparedness. Support for community based preparedness for uncertainty and aggravated disaster risk. Early warning systems usefully serve communities. Development targets reduce damage to lives and property through adequate emphasis on preparedness, and related education and skills development. Practical plans that local stakeholders can adhere to.

Source: Duryog Nivaran 2010, derived from Twigg, 2007

Box III-1 – Disaster risk reduction and poverty reduction

One example of a project that embraces the concerns of resilient community is the food security project in Samoa. This aims to reduce vulnerability while building sustainable livelihoods. Organized by a civil society organization with the Food and Agriculture Organization (FAO) assistance, this involves the supply of seeds and vegetables as well as their piggeries to support the needs of rural families. Although the project focuses on food availability, it also addresses health and nutrition, income generation, budgeting and reduced reliance on remittances, and even household planning. Vulnerable families are learning about ways to enhance their resilience to risks – be they related to disasters and climate change, or financial risks related to fuel and food prices (FAO, 2009).

There have been similar initiatives, related to drought recovery, for example, in Gujarat in India. The district of Kutch has an arid coastal climate and has always been prone to droughts but the previous 5-year cycle has now fallen to two or three years. In response, The Nehru Foundation for Development has introduced a "drought proofing programme" creating local dams to secure water, to decentralize rural drinking water and sanitation. At the same time it has been promoting alternative livelihood options based on handicrafts, especially for women (Kyoto University, 2005).

Box III-2 – Mal development examples

There are examples of how certain development decisions based on market demand tend to ignore increases in Vulnerability.

Narmada projects[10] which caused a lot of debate and dissent amongst environmentalists and government is an example where development priorities were questioned in relation to its impacts on community, environmental degradation and vulnerability. The proposed damming of Narmada river for electricity generation to support growth and industrial development, irrigation and drinking water would have caused eviction of one million people, mostly poor peasants and tribes, inundation of forests and heightened vulnerability. The Government supported this option despite the possibility of achieving similar results with alternative options that are small scale, decentralized, ecologically sustainable and integrated with local communities. Finally large-scale proposal was suspended after a long standing protest of community and a Supreme Court judgment.

Up to 1.6 million trees would have had to be cut to build New Murree City Pakistan[11], a mega city, which would have caused severe ecological and social consequences. This Punjab government project was only abandoned after a protest was held by civil society, environmentalist, media and local people, backed up by a Supreme Court Decision.

Box III-3 – Development projects contribute to disaster risk

Development projects can contribute to the root causes of disaster risk. For example, two reviews by the World Bank's Independent Evaluation Group examined 7,000 projects from 1990 to 2007 worth $400 billion in investments. One review found that the Bank and its sister institutions, including the International Finance Corporation, did not put into practice its own environmental policies. Another review found that even within disaster response projects, the Bank did better at reconstructing damaged infrastructure and housing than it did in reducing vulnerabilities and addressing their root causes. Moreover, in almost half of the countries where the Bank was later called on to finance disaster reconstruction projects, disaster prevention did not play any role in the country's overall development strategy. The reviews recommended that disaster risk be built into development planning from the start, and the Bank and its partners intensify their focus on measurable environmental protection.

10 The Right Livelihood Award; www.rightlivelihood.org\narmada.html

11 Duryog Nivaran Secretariat and Practical Action "South Asia Disaster Report 2008". p. 46

Box III-4 – Economic benefits of investment in disaster risk management

A number of international and regional organizations have carried out cost-benefit analyses on the value of investing in disaster risk management.

Indonesia – The German development agency, Gesellschaft für Technische Zusammenarbeit (GTZ) has examined a number of large-scale flood protection measures. It has, for example, estimated benefit to cost ratios of 2.5 for an integrated water management and flood protection scheme in Indonesia (Mechler, 2005).

The Russian Federation – The World Bank analysed a $110-million modernization programme of the Russian Federation's National HydroMet system to improve the quality and timeliness of weather forecasts. It found that, over a seven-year period, the benefit-cost ratio would between 5 and 10, as a result of reducing preventable losses in weather-dependent sectors, such as agriculture, power and gas and water resources (World Bank, 2005).

India – The NGO Tearfund analysed the net benefits of interventions to reduce the impact of annual flooding for periods of three to four months in five villages in Bihar. These included placing hand pumps higher to protect them ensure year round water supplies. An escape road was also installed and boats were provided for more rapid evacuation. The analysis estimated that this package of interventions had a benefit cost-ratio of 3 (Cabot Venton and Venton, 2004).

Nepal – The Nepal Red Cross examined a disaster risk reduction programme in South East Nepal, focusing on those components for which costs and benefits could be easily quantified over the assumed 15-year project life. Assuming a discount rate of 10 per cent this found a benefit to cost ratio of 18.6. The analysis was re-run excluding a component involving the installation of gabion boxes, resulting in a benefit to cost ratio of two and an internal rate of return of 14 per cent (Cabot Venton and others, 2008).

Samoa – SOPAC analysed various structural and non-structural flood management options for the lower Vaisigano catchment area. For an improved flood forecasting system the benefit to cost ratio ranged between 1.72 and 1.92 depending on the choice of discount rate. For the construction of new wooden homes with elevated floor heights in the floodplain the range was four to 44. And for cement block homes it was two to 28. Two other options, involving the construction of floodwalls and a diversion channel, were not found to be economically viable (Woodruff, 2008).

Fiji – SOPAC analysed a flood warning system for the town of Navua where the last major floods in 2004 cost at least $8.7 million. SOPAC concluded that a flood warning system, which would reduce loss of possessions, protect health, and reduce relief costs, would have a cost-benefit ratio of 3.7 to 7.3, depending on the frequency of major floods on the 2004 scale over the 20-year life time of the system. The analysis ignored additional benefits in the event of other floods (Holland, 2008a).

Box III-5 – Planned adaptation to climate change

While many forms of adaptation to climate change are undertaken by local communities others are planned using national planning processes like the UNFCCC National Adaptation Plan of Action (NAPA), or the UNCCD National Action plans (NAP).

South-East Asia – In Cambodia, the NAPA focuses on adaptive management systems of agriculture, water and coastal resources, forests, land use, health, forecasting and surveillance, together with research and capacity building measures to support these programmes. While it discusses the social and institutional context the main focus is on improving physical infrastructure. The NAPA in Lao PDR prioritizes agricultural interventions, water management strategies and infrastructure development, but there has been no study of the likely socio-economic impact of climate change. At the national level, Thailand and Viet Nam have concentrated on agriculture and water interventions, including the development of resilient crop varieties, cultivation practices, irrigation measures and coastal zone management (Nguyen, 2007). Planned adaptation in Indonesia includes the development of prediction and early warning systems, and forest and agricultural development plans that focus on rural irrigation and cropping management, although a broader adaptation plan is in development (Las, 2007).

South Asia – Here a major issue is water availability. In India, for example, proposals include direct surface flows into aquifers (Gupta and Deshpande, 2004). In Nepal, there is surprisingly little specific policy on climate change. The primary focus has been on the risk of glacial lake outbreak floods, with a focus on structures to lower the water levels and prevent sudden breaches (Agrawala, 2003). In Bangladesh, activities are almost entirely concentrated on engineered physical systems such as dykes, levees and emergency shelters, with some attention to ecosystem solutions such as mangrove protection, seacoast tree planting and alternative cropping (Ali, 2000).

Box III-6– Integrating disaster risk reduction into development plans in the Philippines

Over the years, development plans in the Philippines have put steadily more emphasis on disaster risk reduction. The 1987-1992 Medium-Term Philippine Development Plan (MTPDP) only mentioned natural hazards in the context of more effective assistance for "disasters victims", further investments in flood control and efforts to improve disaster preparedness. However, following particularly heavy disaster-related losses in 1991, the 1993-1998 MTPDP moved a step forward, identifying disasters as hindering social welfare and community development and hampering the development of infrastructure. The plan identified a number of disaster-related needs, including investments in flood control; enhanced relief, rehabilitation and preparedness capacity and operations; the strengthening of crop insurance; and studies on disaster risk mapping, damage assessment and the socio-economic impact of disasters (Philippines, 1994).

The 1999-2004 MTPDP, following heavy agricultural losses after the severe 1997/98 El Niño event, placed further emphasis on risk reduction, particularly on resilience to drought. The plan aimed to reduce vulnerability to adverse climatic conditions as a way of enhancing competitiveness and outlined the need for investment in various structural and non-structural flood control measures, farm reservoirs and small water impoundments. It also identified the need to strengthen disaster risk management, put more emphasis on rehabilitation rather than relief alone improve the use of local calamity funds, and strengthen climate forecasting capabilities (Philippines, 1999).

The most recent MTPDP, covering the period 2004-2010, aims to integrate a "disaster preparedness and management strategy" into the development planning process at all levels. Measures will include periodic risk assessments, updating land use policy, disaster management for local government officials, and community-based mechanisms for disaster management (Philippines, 2004). The plan lays out a series of disaster risk reduction measures including flood control, geo-hazard mapping, and enhancing the resilience of the poor via training and education.

Source: Benson, 2009

Box III-7– Some issues arising from mainstreaming

The chapter makes the case for disaster risk reduction to be mainstreamed in development assistance. At the centre of the approach is the idea that disaster risk reduction should be related to reducing poverty and redressing socio-economic inequities. Both developing and developed countries are called on to do certain tasks. Developing countries should include disaster related spending in their development investments, for example by providing affordable insurance against disasters, ensuring that flooding and soil erosion damage is minimized through zoning laws, building adequate infrastructure and installing early warning systems that reduce loss of life and damages from these disasters. Developed countries should be prepared to provide relief assistance quickly and attain their development assistance benchmark target of 0.7 per cent of GDP (most do not reach it). Both for developing and developed countries the distinction between disaster assistance and development assistance is narrowing considerably.

One concern with this approach is that the case for disaster relief, both in its scale and urgency, could be diluted by mainstreaming in future. Related to this is the question of whether exogenous events like disasters should be treated as separate and extreme events that merit their own attention and resources specifically dedicated to that acute emergency, or whether responses should be factored into overall development assistance. Since speed and size of response are of the essence, one approach would be to build provisions into existing development assistance mechanisms that would automatically trigger minimum amounts of disbursements from Official Development Assistance (ODA) by each country when a disaster strikes. An international cooperation agreement could be sought to resolve problems related to each country's contribution of funds, how the minimum disbursement would be triggered and by how much. Such an agreement could go a long way in building global solidarity around the sharing of disaster relief assistance, particularly for those disasters that are related to climate change, where there are common but differentiated responsibilities, while an immediate reaction to disasters would be guaranteed. Some might contend that voluntary contributions should play a bigger role, citing highly successful fundraisers launched by various celebrities, actors, singers, artists, philanthropists, often in close cooperation with media networks. While such contributions have proven to be generous and laudable, private contributions could be captured by self-interest groups with unclear agendas. The state remains the institution with the legitimacy, resources and clout to reach those in most need. Insisting that developed countries meet their existing commitment to the 0.7 per cent of GDP target and building automaticity in disbursements for disasters would ensure more substantial and more predictable forms of financing for disaster relief and disaster risk reduction.

Another issue that needs further resolution is to determine where does "relief assistance" end and where does "development assistance" start? Even more difficult to determine is the point where relief start to impinge on autonomous development initiatives and possibly crowd out such efforts? For example, when does food aid start to displace local agricultural production? The question has not been answered properly, yet. The experiences emerging from the 12 January 2010 Earthquake that devastated large swathes of Haiti and killed more than 220,000 people are relevant. Two months after the quake struck, the President of Haiti asked for international food aid to be scaled back so that the quake-ravaged nation could find its feet through its own domestic production and employment. President Rene Preval said that if food and water continue to be sent from abroad, that will undermine Haitian national production and Haitian trade. He was of the view that Haiti would need to move more and more towards creating jobs so that people were paid, and that they themselves step in to help Haiti. He noted that a historic opportunity of reinventing Haiti and reinventing Port-au-Prince had presented itself. At the same time, the President warned that preparations for the hurricane season should start, and that external financing amounting to some 38 million dollars was still lacking.[12]

Box III-8 – Planning for flood management in Pune, India

The city of Pune in India has a comprehensive climate change adaptation and mitigation plan. The city had suffered a number of severe floods over the last six decades, the most significant being the 1961 flood that involved a major dam failure. With the threat of more flooding due to climate change the city has developed a comprehensive plan, driven by the elected municipal government, the municipal commissioner and an active citizen group called Alert. The first step was to assess the flood risks, by analysing hourly rainfall intensity and examining the impacts in low-lying areas and places where construction of houses or roads had blocked natural drainage. The city then produced a detailed city drainage map and plans to restore natural drainage, widen streams, extend bridges and apply methodologies for natural soil infiltration. For the hilly zone it also envisaged watershed conservation techniques such as forestation and building small earthen dams. These efforts complemented other improvements in flood monitoring and warning systems and social protection for affected families. Households were also given property tax incentives to encourage them to recycle wastewater or use rainwater harvesting by storing run-off from their roofs.

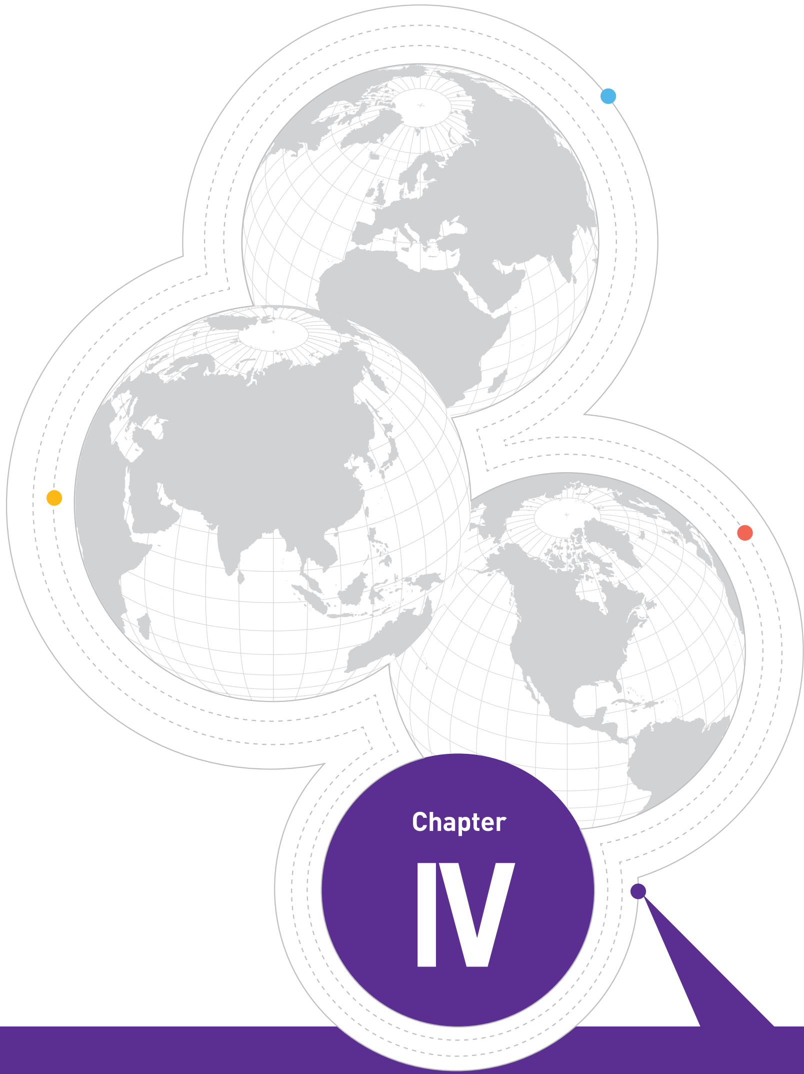
Source: UNISDR, 2009

Box III-9– Successful crop insurance in India

An alternative source of funding is private-sector insurance. In India, for example, the insurance company ICICI Lombard, in collaboration with a Hyderabad microfinance institution BASIX, has been providing rainfall-indexed insurance to protect farmers from drought during the groundnut and castor growing season. This was the developing world's first weather insurance initiative. It started in 2003, with coverage for 230 farmers, but within three years had been extended to 7,685 policies in 36 locations across six states. The Agricultural Insurance Company of India now offers similar products, and the scheme has achieved wide acceptance among farmers. Indexing the insurance to the weather, rather than to individual crops simplifies the system since the weather indicators are easily measured and publicly available, so the system is transparent, transaction costs are low, and payments are triggered automatically. However, it also has the disadvantage of a potential mismatch between losses and payout. Some farmers may suffer losses in specific localities, but get no payment, while others might get a payout while suffering no losses. This will increase the "basis risk" and the insurance will not be attractive if the basis risk becomes too high. According to ICICI Lombard, weather insurance needs extensive government support. In Haryana, for example, out of a total premium of Rs. 1,158 per acre, the government pays a subsidy of Rs 910, so the farmer pays only Rs 248 which provides coverage of up to Rs 15,000 per acre. Nevertheless, weather-related insurance is likely to become more important when it comes to addressing climate change.

Source: Mechler and others, 2006

12 Reuters. www.reuters.com/article/idUSTRE62752W20100308: (accessed 30 September 2010)



Making the recovery resilient

Making the recovery resilient

Countries afflicted by disasters have to address immediate issues of relief and reconstruction. But they also have the opportunity to "build back better", and in particular to improve their institutional and legislative arrangements for disaster risk reduction (aiding in making) and make a resilient recovery.

Much of this chapter is based on communications with 40 people in key regional and national posts in Asia and the Pacific. Approximately one-third of respondents were from national governments or the ASEAN secretariat, one-third from international agencies such as the International Federation of the Red Cross and Red Crescent Societies (IFRC) and international NGOs, and one third from the UN, the World Bank, academia and donor communities.

Allowing sufficient time

One of the most important requirements for a resilient recovery is to allocate sufficient time. This represents something of a change in thinking. Following the 2004 Indian Ocean Tsunami, for example, some donors were initially allocating less than one year, whereas for the Haiti Earthquake in 2009 they were proposing a recovery process of 10 years.

If the time frame is too short, the danger is that the recovery processes may build back vulnerabilities or even increase them, while risk reduction will amount to little more than a series of add-on training programmes (Tsunami Global Lessons Learned Project, 2009). Short-term planning and rapid disbursement also tends to focus on projects rather than adopt a systematic programme approach (International Recovery Platform, 2007).

One frequent problem is conflict between donor timeframes and real timeframes. Donors are under pressure to disburse funds quickly, typically within two or three years, whereas the recovery phase for a major disaster is likely to be three to five years. The period required will depend on a number of factors, including the goals of the recovery, and how far the countries have progressed with pre-disaster HFA policies. Much too will depend on the capacities of communities and local government and leadership – and a number of underlying risk factors, which may include centuries-old social fault lines, based on gender, social exclusion or marginalization (Cosgrave, 2008).

Governments in disaster-hit countries have to observe both timetables, as well as balancing the political expediencies of short-term measures against the needs for longer-term recovery. The World Bank's evaluation of its disaster assistance noted that "It often happens that activities that might contribute greatly to the recovery effort (and to the borrower's subsequent long-term development) are not included in Emergency Recovery Loan (ERL) projects because they cannot be completed in the three years allotted" (IEG, 2006).

It takes time to build institutional capacity and to mainstream disaster risk reduction and climate change adaptation into development policies, and to align initiatives with local or national government budget cycles. It also takes time to pass the necessary laws and build the mechanisms to enforce local regulations. After the tsunami in Aceh Indonesia, for example, most people understandably wanted to get on with their lives. However, "reconstruction is far more complex and takes far longer than anyone would like or might imagine," says Kuntoro, head of the Agency for the Rehabilitation and Reconstruction of Aceh and Nias (BRR). "The public, the media and the rest of the world needed to be educated about the challenges and length of time required to deliver an effective post-disaster reconstruction programme". While it is extremely hard to win the battle to manage expectations, BRR was able, with time, to reduce some of the pressures to show faster progress which could have led to bigger programmatic problems (Tsunami Global Lessons Learned Project, 2009).

Local governments should therefore set the timeframe for recovery based on community capacities and communicate this to donors and other stakeholders. Recent large disasters have shown that donors are becoming more aware of such concerns. For example, during the response to the Gujarat Earthquake, the UK's Disasters Emergency Committee (DEC) initially increased the maximum period during which funds should be spent from six to nine months. An evaluation criticised even this period as being too short, and suggested doubling it to 18 months. For the 2004 tsunami response, the DEC raised such a large sum, over £350 million that it increased the period of expenditure to three years. An evaluation proposed raising this to five years, though this was not accepted (Cosgrave, 2008).

A window of opportunity

Before a disaster, progress on the HFA is often constrained by poor governance, weak policy and regulatory frameworks, and low political and administrative will and capacity as well as by nonchalant attitudes towards disasters. After a disaster, however, attitudes change – from "it will not happen to us" to "what can we do about it?" This creates a window of opportunity to remove barriers and creates new and enforceable regulations

For example, following a major cyclone in 1991, the Bangladesh authorities reassessed their risk reduction strategies. They redesigned cyclone shelters, enlarged them and relocated them closer to current population centres – taking into account cultural traditions and behaviour, as well as accommodation for economically important domestic livestock. It was decided shelters and all new official buildings in the future are to be elevated two stories to protect families displaced by floods. Shelters primarily took the form of schools, subsequently for health dispensaries or other public facilities to ensure that they were well maintained, and more importantly, that the public associated them with disaster preparedness. Over the years, these community cyclone and flood shelters have become the integral part of an overall local risk reduction strategy that has further developmental benefits. Local preparedness committees also use them for emergency exercises and evacuation drills for people "living with floods" (IRP, 2007).

The recovery process can also be used to accelerate pre-existing development initiatives and incorporate stronger elements of disaster risk reduction. Again, Bangladesh provides an example. The largest NGO working in Bangladesh on DRR is the Bangladesh Rural Advancement Committee (BRAC), the BRAC works with three million poor individuals, mainly women. Following flooding in 1998 BRAC was able to use its presence in 55 districts to assist 850,000 flood-affected women from landless and marginal farming households. The strategy was to help people get back to their own homes with regular income-generating activities, so most of the activities also fed into longer-term development programmes that BRAC was already running (BRAC, 2000).

Recovery plans should also take into account climate change projections – especially critical in countries at high risk of hydro-metrological disasters.

Planning for recovery

About half of respondents, mainly donors and governments, argued that countries could achieve more sustainable recovery if they had effective pre-disaster planning. This would include building community and social resilience and investing in monitoring and learning systems. National and international actors can make efforts to predict disasters, while also having in place recovery policies and strategies.

Planning should also involve preparing for ex-post recovery. This has been developed in other parts of the world. In Latin America, the Organization of American States Unit for Sustainable Development and Environment has undertaken ex ante planning for housing reconstruction to ensure adequate materials are available following a disaster and that builders, homeowners and government agencies are aware of damage reduction measures and construction techniques that can result in more hazard-resistant housing. This includes guidance for governments, the construction sector, the finance and insurance sectors, and homeowners, with in-depth information on construction techniques, standards and materials (OAS, 2001).

Post disaster planning should aim to ensure efficiency and public safety and take place swiftly so as to preserve social and economic networks. And from the outset authorities should be concerned with equity, since those with the fewest resources generally get less attention from aid organizations, and those with more resources get immediate attention. However, the people with fewer resources get the attention in later part. People who are better integrated into economic and social network recover faster.

In China, for example, following the Wenchuan Earthquake, restoration and reconstruction planning started soon after the earthquake. Starting early allowed both development and disaster managers to identify the problems, and it enabled decision makers to allocate the resources to meet short, medium and long-term needs. The process was led by the National Development and Reform Committee which worked with 45 ministries, provincial governments, and state institutes to prepare a recovery plan, while also seeking good practices and advice from the international community. When the consultations were completed, the authorities started to implement the recovery plan – "The State Overall Planning for Post-Wenchuan Earthquake Restoration and Reconstruction".

It should be emphasized, however, that such assessments are not single events but ongoing processes involving monitoring, evaluating and learning. This can be achieved by integrating capacity building, disaster risk reduction, climate change scenarios and development plans into ongoing post-disaster assessments. Initial rapid survey work should be followed up with more detailed analysis to help identify corrective actions (Beck, 2005).

At present, however, recovery programmes are rarely subject to systematic assessments. Generally the reports are piecemeal and review the performance of one agency, rather than the programme as a whole. As a result, despite expenditures of billions of dollars, there is limited information on whether recovery programming has been pro-poor or supported livelihoods. Government, international agencies, and other organizations active in recovery should jointly assess the programme as a whole. After the 2004 Indian Ocean Tsunami, for example, key actors did invest in an impact assessment and monitoring system.

Governance and local leadership

Effective recovery depends on good governance, particularly at the local level. Strong local leaders will understand this and meet the needs of the affected population, listen to their concerns, ensure that they are properly informed and engaged and raise their awareness. Local leaders can also ensure that the recovery incorporates measures to address future multiple hazards including climate change (Natural Hazards Research and Applications Information Center, 2001).

Local governments will also need to institutionalize disaster risk reduction into their day-to-day operations, including development planning, land use control and the provision of public facilities and services. In Indonesia, for example, following the 2006 Java Earthquake, based on its post-tsunami experience, the government invested in local leadership – delegating to the provinces the day-to-day management and decision-making, thus increasing their sense of ownership and responsibility. The effective recovery in Yogyakarta was in part the result of strong individual leadership, in particular from the Sultan as Governor; and secondly from the Bupati (district head) of Bantul, the worst affected district. Nevertheless, almost all provincial and district government respondents spoke of the continuing lack of clarity in the regulations covering responsibility for disaster response and recovery, underlining the importance of effective laws and local regulations.

Finance

The scale of financial resources available for recovery, especially from non-governmental sources, generally depends less on need and more on media attention. High-profile disasters such as the 2004 Indian Ocean Tsunami will attract much more funding than small or medium-sized disasters. Typically, donors respond with only half of the funds requested by governments. This may prove problematic – as it did, for example, for the post earthquake housing programme in Pakistan (Beck, 2005). Governments will therefore need mechanisms to allocate financial, human and material resources and focus on the activities most likely to reduce poverty and vulnerability.

Governments, however, reallocate offer more resources of their own by rearranging their national development priorities. They should also be able to rely on funds from local governments and communities. For example, after the 2006 Yogyakarta and Central Java Earthquake, the first housing reconstruction programme for the people of Kasongan village, came from the government of the province of Bengkulu. Since these funds were not sufficient to meet the housing needs, the community met to determine a fair way to distribute them. They decided to use the funds to purchase construction materials and rebuild the houses themselves, organizing neighbours into self-help labour groups. Members of each group worked together to rebuild each other’s houses, one at a time, giving priority to houses that were in poor condition and to households with elderly family members or children under five. As a result, funding that was initially intended for 40 houses was used to build 70 (IRP, 2010).

Another option for financing the recovery is to twin provinces or municipalities. This involves pairing an economically strong local government with a less developed one. China, for example, has introduced a twinning programme, which involves allocating one per cent of the annual income and technical capacity from the economically strong province to fund recovery projects in the less developed one for three years. For example, after the 2010 Earthquake, Shandong Province and Shanghai

Municipality provided assistance to Beichuan County and Dujiangyan City. They provided funds to rebuild schools and hospitals to higher standards, as well as upgrade their management and professional capacity. They also deployed some of their own staff to the newly built institutes to provide on-the-job guidance or brought teachers, doctors and managers to receive training. Such twinning arrangements are best established before disasters, however, so as to be part of ongoing development programmes.

Building on cultural and social resilience

Almost half of the respondents contacted for this report, mostly international organizations, emphasized the importance of ensuring community participation. People and communities make decisions every day that will influence the inherent risks. Their choices will be influenced by their available livelihood opportunities, their living arrangements, their treatment of social inequities, and the type of buildings they live in. Some people will be more vulnerable as a result of social exclusion or marginalization – or of cultural attitudes and a lack of capacity to interact with government and the outside world.

Some may also be hampered by fatalistic thinking. But a disaster may offer an opportunity for people to change the way they think – if they are offered sufficient information and options. In Indonesia, for example, up to two-thirds of people living in earthquake zones consider major disasters to be "takdir Tuhan" ("pre-ordained by God"). Government and NGO representatives from faith-based and secular organizations have concluded, however, that such beliefs are not lasting constraints, but rather coping strategies and symptoms of powerlessness. And even if a disaster is considered pre-ordained, this does not imply that mitigation is impossible. When religious leaders take responsibility for explaining this, and governments perform their proper duties to the community in a transparent and accountable manner, perceptions can soon start to shift (UNDP Early recovery Assistance programme, 2009).

Recovery thus provides an opportunity not just to reconstruct physical infrastructure but also to build on community's inherent cultural and social resilience. For this to happen, however, communities need to be involved very early in the recovery process. Governments therefore should develop standards and strategies for community participation and input, based on social mapping and a close understanding of community strengths and weaknesses – so that programmes can capitalize on local leadership and the often-latent capacities, especially of women. This community-driven approach to post-disaster recovery requires significant investments of time and human resources but results in greater stakeholders satisfaction, quicker disbursement of aid, and local empowerment. One strategy is to support local networks – which may be as simple as enabling people to contact other members of another network, or it may consist of strengthening such networks by asking for their assistance and providing them with some additional resources (Cosgrave, 2008).

Communities can also be supported to enable them to respond better to a changing climate. For example, floods are common in Asia and climate change is likely to alter rainfall patterns, affecting people's livelihoods and food production capacities, especially in coastal deltas. In Bangladesh, the NGO, Practical Action, helped families displaced by flooding and river erosion to diversify their incomes by establishing a fishing scheme managed by a community committee. The government has granted them a lease to use a government-owned pond and also trained women in cage aquaculture fishing techniques. As a result they have been able to increase their income using resources created by increased flooding, using closed fish cages in an existing pond without destroying sport fishing and without requiring large amounts of capital (Practical Action, undated).

Among the available tools for engaging communities are:

People consultations – developed by the Fritz institute and used in Pakistan and Java (Fritz Institute, 2006);

Beneficiary surveys – used widely in the Maldives, for example, following the 2004 Tsunami (Tsunami Global Lessons Learned Project, 2009);

Beneficiary profiles – These can be used to develop specific recovery strategies for the landless poor, squatters, and female-headed households, who may require different forms of assistance (Beck, 2005);

Help desks – These are places where people can enquire about eligibility for assistance, report potential cases of corruption, or file a complaint. After the 2004 Indian Ocean Tsunami, By October 2006, such help desks had received 17,000 complaints and most were successfully resolved;

Social equity audits – Used in Sri Lanka and India these can be carried out by trained auditors. Some NGOs have used such audits to increase the proportion of assistance going to the poorest;

Baselines – These should be based on relevant community indicators, developed at the start of the recovery programme and against which progress can be measured. However, perhaps the most valuable benefit of participation is something that is not easily quantifiable: a feeling of individual empowerment and of ownership of community resources, and the unleashing of people’s own capacities to cope.

Gender imperatives

Disasters often kill more women than men, but organizations under time pressure tend to overlook gender-specific needs and capacities. Following 1991 Cyclone and Flood in Bangladesh, for example, the death rate was almost five times higher for women than for men. Warning information was transmitted by men to men in public spaces, but rarely communicated to the rest of the family. Many women do not leave the house without a male relative and consequently perished waiting for their relatives to return and take them to a safe place. Moreover, as in many other Asian countries, most women have never learned to swim, which significantly reduces their survival chances.

Gender concerns should be integral to all reconstruction programmes. Culturally and gender appropriate protection and mitigation strategies will not only promote gender equality and address gender-based vulnerabilities, but also ensure faster, deeper recovery and are grounded in the coping strategies, knowledge, and energy of local communities.

Some governments and organizations invest in gender surveys to tap into gender specific knowledge, resources, capacities and vulnerabilities. The National Committee of Women in Sri Lanka, undertook a survey in early 2005 with UNIFEM support, involving more than 53,500 households and eliciting information on women’s pre-tsunami livelihoods, psychological effects of the disaster and preliminary data on gender-based violence. The survey documented differential impacts, including disparities in loss of life among women, especially women likely to have young children, obstacles to economic recovery faced by women, the conditions facing female-headed households, and other concerns (Tsunami Global Lessons Learned Project, 2009).

Some of the critical issues concerned land and inheritance rights, equitable access to decision-making roles and livelihood opportunities. Programmes should promote equity-based policy changes, such as joint housing rights for spouses, and funds for the education and resettlement of orphaned adolescent girls and unmarried women. In the state of Tamil Nadu in India, for example, following the 2004 Tsunami, the government mandated joint housing rights for spouses, disallowed transfers of the wife's share to the husband, and ensured that reconstruction work included consultations with women. In addition, it made abandoned and destitute women eligible for pensions; distributed initial relief packages to women family members; and provided more than $6,800 to orphaned adolescent girls and unmarried women for education.

Similarly in Aceh, Indonesia, following the tsunami, women who had lost their husbands and children had no rights to the land on which they lived, so were ineligible for housing assistance. In September 2006, therefore the government adopted a joint land titling policy for women and men – the first for Indonesia. Many people said joint land titling "was impossible because Muslim Sharia law is very strong in Aceh," noted Eddy Purwanto, BRR's Chief Operations Officer, "But we saw the opportunity, as did many women at community level". Erna Heryani, BRR's Director of Land Administration and Mapping agrees: "People generally understand this as a good thing, most wives or widows never expected they would get land in their names" (Tsunami Global Lessons Learned Project, 2009).

It is also important to invest in women's grassroots organizations. Women's community organizations have insights, information, experience, networks, and resources vital to increasing disaster resilience. In Sri Lanka, for example, the Batticaloa Women's Disaster Management Coalition, or Gender Watch, arose along with a larger network of women's groups known as the Coalition to Assist Tsunami-Affected Women. They offered spaces for women to discuss their experiences and challenge state officials on violations of women's rights. In addition, a representative of the network was present at all planning meetings of the post-tsunami psychosocial and protection task force. Achieving gender equality will also require better data. IFRC in Sri Lanka, for example, has established a gender-working group. Moving beyond the baseline of sex-specific data in programme planning and management, the IFRC aims to develop gender indicators and reporting mechanisms (Tsunami Global Lessons Learned Project, 2009).

For equity gains to be sustained, it is necessary to anchor innovative practices in the institutional infrastructure rather than a piecemeal approach. Countries succeed best, when high-level managers are committed to gender equity.

Recovery for resilient development

Resilient recovery means compressing decades of development into a few years while reducing future risks, including those from climate change. But disasters themselves also offer opportunities – driven by changes in attitude, technical and financial resources, as well as political support. These changes can be short lived without an impulse for resilient development. Despite the stresses after a disaster, it is still important therefore to step back and plan a resilient recovery based on local capacity and the pace and needs of the affected population. Recovery offers the opportunity to address the underlying risk factors from multiple hazards as well as to "build back better." For this purpose, there are many opportunities to take advantage of new technologies, which are the subject of the next chapter.

Box IV-1 – The cyclone preparedness programme in Bangladesh

The government of Bangladesh has an extensive Cyclone Preparedness Programme. This includes disseminating Cyclone warnings to 11 million coastal people to enable them to move to safe sites including cyclone shelters and buildings – along with procedures for evacuation, rescue, first aid and emergency relief work. The system starts with the collection of meteorological data by the Bangladesh Meteorological Department, which issues bulletins, including the designated warning signals of an approaching cyclone. The bulletins are transmitted to the six zonal offices and the 30 upazila (sub-district) level offices over HF radio. The upazila office in turn, passes it to unions and other lower levels of administration through VHF radios. The union team leaders immediately contact the unit team leaders who, with their volunteers, spread out in the villages and deliver Cyclone warnings almost door to door using megaphones, hand sirens and public address systems. The programme has over 40,000 volunteers, of whom 15,000 are women who are becoming increasingly influential within their communities and with local government agencies.

Source: Miyan, undated

Box IV-2 – Working with communities on climate resilient recovery in Viet Nam

In the north-central coast of Viet Nam, villages have about 30 days of flooding each year. In 1999, one of the worst floods cost hundreds of lives, along with property and other economic losses. In future, climate change is expected to result in more frequent and intense cyclones, floods and droughts. The government has responded with a community-based adaptation programme in four communes and eight villages. Villagers contribute their time and resources to adaptation measures that address recurrent climatic catastrophes and minimize the loss of lives and property.

The process started with interviews, focus group discussions, field surveys and historical profiling, followed by mapping vulnerable sites to assess the current situation and future scenarios related to climate change. The project also identified household and community adaptation mechanisms and the social institutions that could contribute to hazard and disaster management strategies.

This was followed by a planning stage involving leaders of social groups and organizations, such as farmers, women, youth, and other village political associations. Local government officials were also engaged to ensure acceptance and implementation of the plan and increase the likelihood that the government would co-fund some subprojects. The main output for each village was a "safer village plan".

Source: Francisco, 2008.

Box IV-3 – The Tsunami Recovery Impact Assessment and Monitoring System

The Tsunami Recovery Impact Assessment and Monitoring System (TRIAMS) is a project of the governments of India, Indonesia, the Maldives, Sri Lanka, and Thailand, with support from the IFRC, WHO, and other UN agencies, to measure the impact of the recovery efforts in response to the Indian Ocean Tsunami.

TRIAMS represented an important breakthrough by proposing one framework of core indicators for use across different countries. The framework looks not just at infrastructure, but also at social services, livelihoods and vital needs from the relief phase.

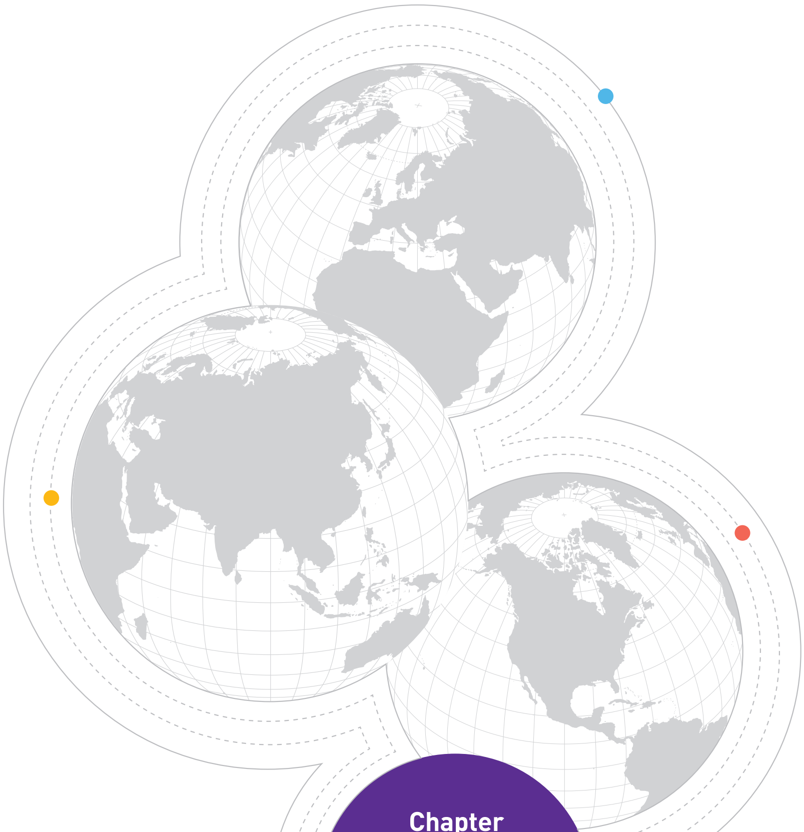
TRIAMS includes output and impact indicators across the primary recovery sectors, quantitative and qualitative data on beneficiary perspectives, and additional qualitative data to help explain findings of key output and outcome indicators. The overall aim of the TRIAMS process was to inform governments, donors, NGOs, civil society and other stakeholders about the progress of the recovery efforts, so that they could adjust their programmes to address un-met needs and the existing inequalities.

Source: Tsunami Global Lessons Learned Project, 2009

Box IV-4 – Recovery and reconstruction of Tsunami-hit Samoa

A tsunami generated by an 8.3 magnitude earthquake hit the southern coastal areas of Samoa on 29 September 2009, causing 143 deaths, with five people missing, and affecting about 5,274 people. The Government of Samoa requested the UN system to develop a recovery framework and ESCAP and UNISDR joined the multi-agency Early Recovery Team. ESCAP also joined the World Bank, ADB and the UN country team in a damage and loss assessment that would lead to a post-disaster needs assessment. In cooperation with relevant line agencies, team members estimated sector-wise damage and losses and what it would take to achieve full recovery and reconstruction while increasing resilience to future hazards.

Disaster risk management will be based on the Strategy for the Development of Samoa 2008-2012, using a cross-sectoral and multi-hazard approach. Key recommendations include strengthening national policies and institutional arrangements in disaster risk management, reducing immediate to longer term vulnerabilities, raising awareness of communities, and increasing their resilience and capacity in disaster preparedness. An estimated $4.8 million is required to support disaster risk management efforts, to relocate some communities, and to "build back better".



Chapter

V

Capitalizing on new technology

Capitalizing on new technology

The levels of risk and uncertainty on natural hazards can be reduced by making full use of information, communication and space technologies – particularly remote sensing, satellite and cellular mobile phones and Geographic Information Systems (GIS).

With disaster management information systems, satellite-based Earth Observation (EO) can be complemented with ground-based monitoring and reporting to provide real-time information about the severity of disasters. Together with vast pools of indigenous knowledge, background information and decision supporting tools, the integrated information also assist pre-disasters risk mapping, vulnerability identification, risk mitigation and response planning and implementation. Communications, as one major life-saving capacity, have demonstrated its critical importance in many recent disaster response actions.

The Indian Ocean Tsunami in 2004 and Cyclone Nargis in 2008, for example, showed the disastrous consequences of a lack of early warning and communication capacity. On the other hand in Bangladesh, the Cyclone Preparedness Programme has demonstrated how high-end space and communications technology can be seamlessly linked with community-based disaster management practices to build a strong and coherent system. Similarly, in China in 2008, the response to the Wenchuan Earthquake showed how such technology can be harnessed for an effective response.

Bridging information gaps

The starting point is to gather pre-disaster cross-sectoral baselines data on hazards, vulnerabilities, exposures and possible disaster risks and impacts. This can be used as fundamental information to construct large-scale risk maps. This involves GIS which, together with digital elevation models, can give a picture of the infrastructure of roads, rail-lines and settlements. They can also incorporate scientific and indigenous knowledge, historical records and other demographic, social and economic data to estimate the risks of possible disasters and their impacts.

At regional and national levels these maps can cover major hydro-meteorological and geological hazards, while local-level maps can cover risks of earthquakes, floods, sea wave surges and landslides. These maps can then be used to position early warning systems, to reach out to the communities at risk, and to build awareness in multi-hazard prone areas. They can also be used during recovery and reconstruction to help restore the flow of economy.

Almost all countries in Asia and the Pacific have conducted risk mapping and assessment. But many face severe limitations. Most activities take the form simply of hazard mapping and are often too coarse, in terms of spatial and temporal resolution, to provide sufficient information to address complex and dynamic risk patterns. Many countries also lack the appropriate cartographic and attribute data needed for complex modelling; the geographical coverage may be incomplete, at unsuitable scales, outdated, or of dubious quality. Some countries also lack the technical capacity to use remote sensing and GIS tools operationally.

Integrated information systems with decision support tools

Disaster management will also mean integrating information from many different sources – governmental, academic and industrial – and comprehensive analysis of all relevant information to simulate and visualize different disaster scenarios and compare various mitigation, prevention and response options, thus making relevant plans and decisions optimized, and response drills be simulated. These tools for information integration and comprehensive analysis can be combined into centralized or distributed information systems and sub-systems using either powerful computers at national level, or open-source disaster information management software at local and community level, such as Sahana, which was first used by Sri Lanka in the aftermath of the 2004 Indian Ocean Tsunami and later adopted by Indonesia, Pakistan and the Philippines. These models can simulate different disaster scenarios, for example, compare various mitigation, prevention and response options, and optimize relevant plans. The information can also be used to simulate response drills and produce valuable feedback.

One of the most important functions of these information systems is to ensure adequate early warning. Early warning systems have three major information components. First, there is background information on the hazard and vulnerabilities – which is held in the early warning centre. Second, there will be an information acquisition network – ground-, satellite-, sea-surface- or seabed-based, or various hybrids – which will detect and acquire precursors related to the hazard and transmit these rapidly to the early warning centre. Third, there will be comprehensive data analysis to create early warning alerts which, when authorized by relevant government bodies, can be disseminated with associated guidance for public action.

Following the Indian Ocean Tsunami in 2004, many countries invested in national or subregional early tsunami warning systems. These should be extended to cover all major disasters. The gaps are both technological and institutional. To address these, ESCAP, the Intergovernmental Oceanographic Commission of UNESCO (IOC) and WMO have taken steps to strengthen coordination and move towards a regional multi-hazard early warning system.

When a disaster occurs, it is important to have immediate and accurate reporting on the location, nature and severity of the disaster. For this purpose some countries, such as China, are considering disaster reduction information networks. This will involve training a range of people in reporting skills and ensuring that they have the appropriate means of communication.

To understand the situation of major disasters that cover large geographic areas, objective information are urgently needed: for assessing damages, losses and the needs for rescue, relief and mitigation actions; for identifying locations for evacuation, recovery and rehabilitation; for effective deployment of on-site human and material resources. Such information for rapid mapping is provided complementarily from ground-, air- and space-based observations. It is a challenge to less capable countries in timely accessing and processing such data and turning them into decision supporting products. It is well recognized that EO satellite information are also important for rebuilding and reconstruction phases.

The Figure V-1 gave an example of how timely acquired satellite data have assisted in determining the affected areas of a major flood disaster caused by the Cyclone Nargis on 1 and 2 May 2008 in Myanmar: the flooded areas of the central Irrawaddy division were derived from SAR data of 6 May 2008 taken by Japan's ALOS satellite (in light blue), with normal water levels as shown by Landsat-7 data from 2000 (in dark blue). Flooded areas may also contain regions covered by water before the disaster due to the prevalence of wet rice cultivation.

The effectiveness of disaster reduction and response rely greatly on the effectiveness of managing relevant information. In addition to building infrastructure and accessing information resources and decision supporting tools, countries should also have disaster information strategies to manage critical baseline information, which could be used for pre-disaster preparedness, during-disaster emergency response, and post-disaster needs for damage and losses assessment, rehabilitation and reconstruction. Such baseline information could be collected through intensive risk mapping and assessment of major disaster prone areas.

Recent advances

Recent years have seen rapid advances in information, communications and space technology that have helped improve early warning systems and response actions.

The most dramatic change has been the spread of cellular mobile handsets, most of which, in addition to telephony, can receive SMS messages and some have embedded GPS functions. In Sri Lanka, for example, a study by LIRNEasia tested the use of mobile handsets for receiving disaster warnings in tsunami-affected villages where the participants had been trained for emergency response. The study concluded that mobile phones are a reliable, effective and affordable solution. Another useful complement to other public warning methods, such as radio and television, is cell broadcasting, which involves sending text messages to all mobile telephones within a certain area (Rohan Samarajiva, and Nuwan Waidyanatha, 2009).

The most widely used cellular mobile and broadband internet systems connect the local networks to the global backbone mostly through terrestrial infrastructure like optical fibre. In many emergency situations, however, this infrastructure would either have been destroyed (e.g. Wenchuan Earthquake, 2008) or was not available even before the disaster (e.g. the Muzaffarabad Earthquake, 2005). It is important therefore to have wireless backup systems with rapid deployment capacity - one of the most effective forms being satellite communications. The Asia-Pacific region has more than 70 Geostationary Earth Orbit (GEO) communication satellites. Of these, more than 10 are operated by government agencies; the others are providing various commercial services such as television and radio, internet and mobile telephony. Internet Protocol (IP)-based services can also now reach under-serviced areas through satellite broadband, and during emergency response actions can be accessed using Very Small Aperture Terminals (VSATs) or other mobile devices.

The most popular media for delivering information before and after disasters to the public, however, is still television and radio. Japan, for example, can disseminate disaster alert and relevant information through television and radio channels within seconds of the warning being issued. Most areas are now covered by television and radio, though some of the least developed low population areas may be out of range. As they can also be at high risk in disasters, they will need to be identified in risk mapping and given specific consideration in disaster communication response plans.

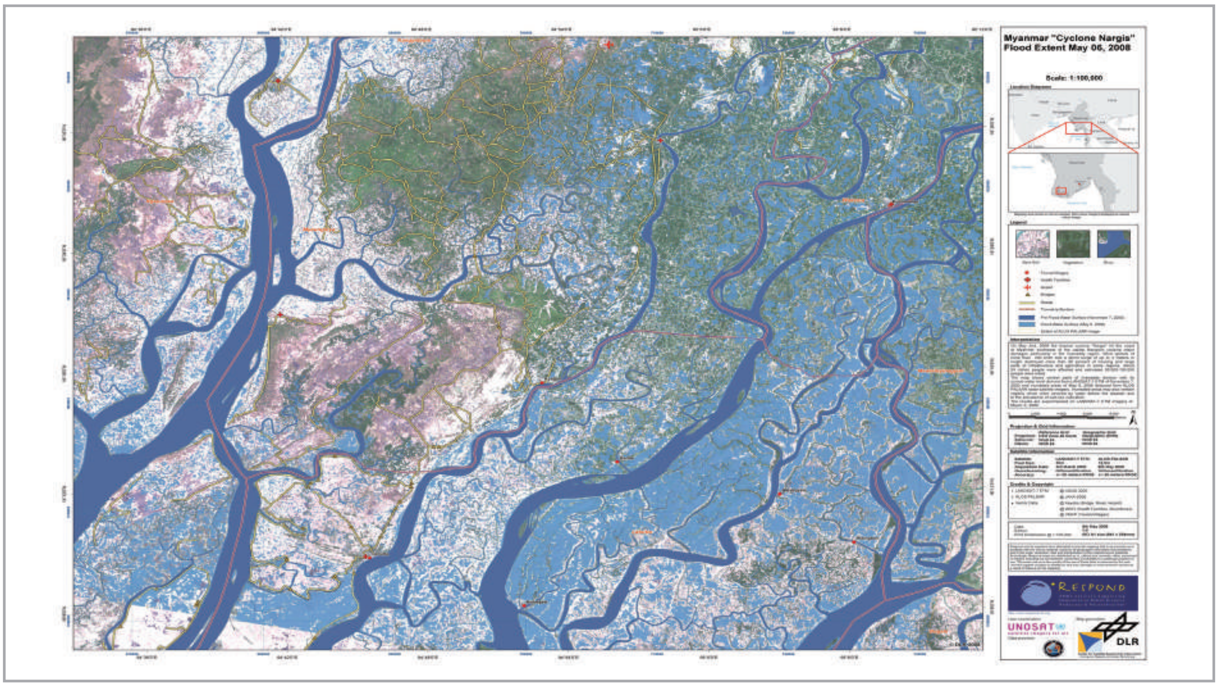
Regional communication capacity for emergency response

During emergencies, it is important to ensure or expand communications capacity. This can involve restoring or establishing wireless telephony and internet services; expanding the capacity of local cellular mobile systems and internet bandwidth to accommodate sudden increases in traffic; and deploying standby communication facilities to service links between field teams and their headquarters. It may also be important to restore or expand the communications capacities of local airports for flight control and transportation management.

While some of these preparations can be made locally, most will need to take place at a national or regional level, since few developing countries have the resources to deploy sufficient communication means to support search and rescue field teams that should be dispatched within the critical first 72 hours after a destructive catastrophe.

The most convenient and rapidly deployable means for telephony and internet access is satellite mobile. This is particularly important where terrestrial services are unavailable. The two global satellite mobile constellations are Inmarsat and Iridium, and the regional Thuraya has two satellites cover most Asian and West Pacific countries. All have dual module handsets that automatically switch to cellular mobile systems when these are available.

Figure V-1 **Rapid mapping image of Cyclone Nargis damage**



Credits: DLR ZKI, Charter and EO data of ALOS - JAXA 2008; Landsat-7 - USGS 2000. (Extended cyclone relief efforts aided from space, www.esa.int/esaEO/SEM68CSHKHF_environment_1.html#subhead4)

The most commonly used cellular mobile, which may access SMS and internet services, could be effectively used by field workers if the services could be restored and handling capacity expanded in a timely manner after major disasters.

Most communication needs can be met through IP platform which, when coupled with wireless facilities, can provide the most convenient, low-cost networking system connecting cellular mobile base stations to their networks, allowing the organizing of video conferences, accessing tele-medicine support, and making IP phone calls around the world. When ground-based broadband internet is unavailable, such connectivity could be achieved through either satellite broadband services or terrestrial microwave relay from nearby areas. Many communication satellites provide such services with different geographical coverage and technical systems. There are also many kinds of terminals suitable for rapid deployment, which can be air-dropped or carried to geographically difficult mountainous areas. Thaicom's IPStar satellite, for example, has established the broadest service network and covers many Asia-Pacific countries.

Field teams can also deploy emergency communication vehicles. Most have satellite communication capability now and some can provide comprehensive services with fast data transmission, including cellular mobile services and television transmissions. In some cases they support private networks for field teams. However, such vehicles might be unable to reach remote locations due to obstacles, destruction of roads and/or difficult geographic conditions.

Satellite short message service through the compass satellite navigation system has proven its value as the only communication means not disrupted by the Wenchuan Earthquake in May 2008. It may cover the region with a service network to be developed.

Another option is Citizens' band (CB) radio which is used particularly in island countries, like Indonesia and also by members of disaster response teams for voice communications. But there are a limited number of channels, so there is a risk of interference among different user groups, and CB cannot thus be used for confidential topics.

Field rescue and mitigation action teams also rely on Global Navigation Satellite Systems (GNSS) to determine their positions and routes. Access to GPS is now included in many mobile handsets. Many more GNSS would soon be available to the Asia-Pacific region, including those developed by China, India, Japan and the Russian Federation. China's Compass system is also stated to provide satellite short message service.

Earth Observation (EO) data for disaster risk and response

Disaster risk reduction and management over large geographic areas rely critically on EO satellites. Without real-time or near real-time meteorological satellite data, early warnings and monitoring of extreme weather-related disasters cannot be realized. Their usefulness depends both on their accessibility and their resolution – how much of the Earth's surface they cover in a single pixel. A coarse resolution is over one kilometre provided by most meteorological satellites, a moderate resolution is 250 metres by the Moderate Resolution Imaging Spectroradiometer (MODIS) onboard the Terra and Aqua satellites, medium resolution is at the order of tens of metres provided by most EO satellites, and a high resolution is less than one metre provided mainly by commercial operators.

Within the Asia-Pacific region, China, India, Japan and the Republic of Korea have geo-stationary meteorological satellites. Many polar and quasi-polar orbit meteorological satellites are operated by China, the Russian Federation, the United States of

America and Europe. Since the 1970s, the coarse data from meteorological satellites have been used to follow extreme weather events, such as tropical cyclones, windstorms and strong rainfall, and for slowly developed drought risks. As with the most widely accessible information, most of such satellite data are free for reception directly from the satellites, and are accessible through the web, or are broadcasted through satellite channels. India, for example, broadcasts weather data to its network members, and China broadcasts such data across China and many Asian countries.

For mapping vulnerability and risks, the most useful data is of moderate and medium resolution, which can be used, for example, to monitor drought and wildfires and to estimate damages. Many countries in the region can receive data directly from the polar orbit satellites and MODIS or get their data and value added products from relevant websites.

Almost all public operators of EO satellites from the countries in the Asia-Pacific region including China, India, Japan, the Republic of Korea, Thailand and Turkey, are committed to share their satellite information during major disasters. On top of these, in many disaster situations, some private operators also provide additional supplemental high-resolution imagery, though without full commitment.

Satellites do, however, have their limitations. One is that those using optical sensors can only gather useful information during daytime and when there are few clouds, though satellites using Synthetic Aperture Radar (SAR) can penetrate clouds and work at night. Another concern is the frequency of the imaging: an orbiting satellite may only cover a defined area every few days. Having more satellites or harmonizing existing satellites to work as virtual constellations can address this, which is the approach taken by the Disaster Monitoring Constellation (DMC). The DMC consists of satellites operated by Algeria, China, Nigeria, Turkey and the United Kingdom - all manufactured by Surrey Satellite Technology Ltd. Each partner agrees to provide satellite images to partners and non-partners free of charge. China is developing an 8-satellite constellation, comprising four optical and four SAR satellites, to ensure a maximum 12-hour revisiting interval during a disaster emergency. Under this constellation, two optical satellites are already in operation and an SAR satellite will be launched soon.

Most Asia-Pacific countries have developed technical and institutional capacities in EO satellite applications – using them for managing natural resources, for environmental monitoring and for disaster management (Box V-1). Some countries have full capacities in operating and applying EO satellites for disaster risk reduction and management, though in many developing countries the capacities are more limited while most of the least developed countries, Pacific Island states and economies in transition have yet to develop this capacity (Table V-1).

There have been significant efforts at regional cooperation in using space technology for disaster risk reduction and management – promoted by the Regional Space Applications Programme of ESCAP, the Asia-Pacific Regional Space Agency Forum and the Asia-Pacific Space Cooperation Organization. While human resources development is still a focus of the cooperation efforts (Box V-2), there have been some initiatives to help less capable countries establish collaborative operational capacities.

Disaster risk reduction and climate change adaptation

Adaptation to climate change is closely linked with reduction of disaster risks, particularly those related to hydro-meteorological hazards. Assessments require, however, large amounts of data on climate – on rainfall, tropical storms, temperature, sea surface temperature, sea level rise and the frequency - and intensity of events. These need to be considered along with other data on water resources, agriculture, the environment and ecosystems. These data and analysis can then feed into climate-smart disaster risk reduction programmes.

Climatic data are mainly provided by national meteorological and hydrological departments and relevant subregional, regional and global networks – using many of the same systems or capacities that are used for disaster risk reduction. These include those for early warnings, weather forecasting, storm monitoring, flood management, coastal zone management and land use planning.

Ensuring that all these data are harmonized and consistent requires close coordination between data providers. Considerable progress has been achieved through regional cooperative mechanisms such as the Mekong River Commission, the Typhoon Committee and the Panel on Tropical Cyclones, but there is considerable room for improvement at national, subregional and regional levels.

Even when the data are available, many countries will find them difficult to analyze. This demands a range of models, tools and methodologies. Most of existing ones operate at global and regional levels, and are fairly coarse in scale. Those at national levels are more limited mostly drawn from global or regional models, though many countries lack the data and technical expertise to downscale the global or regional models to the national level. Some of these issues have been addressed through regional cooperation. The Mekong River Commission, for example, through its CCA Initiative offers knowledge, data and assessment tools. One of the priorities for the years ahead must therefore be to develop a regional database on climate change and the protocols for sharing the data between countries and regional organizations.

Table V-1 EO satellite application capacities in the Asia-Pacific region

Country Groups	Operational EO data receiving facilities	Operational MetSAT/ MODIS receiving facilities	Operating EO satellites	Operating MetSAT/ MODIS satellites	Capacities in applications for DRR/M	Operational service capacities for DRR/M	Capacities in service development for DRR/M
China, India, Japan, Republic of Korea, Russian Federation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indonesia, Malaysia, Thailand, Turkey	Yes	Yes	Yes	No	Yes	Yes	Yes
Australia	Yes	Yes	No	No	Yes	Yes	Yes
Singapore, Viet Nam	Yes	Yes	Developing	No	Yes	Yes	Developing
(Hong Kong, China)	Yes	Yes	No	No	Yes	Yes	Developing
Mongolia	No	Yes	No	No	Yes	Yes	Developing
Bangladesh, Islamic Republic of Iran	Developing	Developing	Developing	No	Yes	Developing	Developing
Philippines, Kazakhstan	No	Yes	No	No	Yes	Developing	Developing
Sri Lanka	No	No	No	No	Yes	Developing	Developing
Fiji, Samoa	No	No	No	No	Developing	Developing	No
Myanmar, Nepal	No	No	No	No	Yes	No	No
Azerbaijan, Kyrgyzstan, Pakistan, Uzbekistan	No	No	No	No	Yes	Developing	No
Other developing countries of the region	No	No	No	No	Developing	No	No

Source: ESCAP, IDD 2010

The SAARC Action Plan on Climate Change, for example, has identified areas of action. It recommends cooperation on climate risk modelling, sharing information and capacity building in early forecasting and warning and adaptation measures. A priority area of the Action Plan is the exchange of meteorological data.

Integration with indigenous knowledge

Long before modern early warning systems, local communities used indigenous knowledge, methods, tools and technologies to deal with natural hazards (SDMC, New Delhi, 2008; Srivastava, SK, 2009). These include:

- *High-risk mountainous region* – building technologies and land use
- *Flood plains* – low cost housing, land use and settlements
- *Drought-prone areas* – water harvesting, cropping systems, prediction and early warning
- *Coastal areas* – land use, shelters, storm prediction and early warning.

Indigenous knowledge and forms of communication can then be blended with modern scientific knowledge and equipment. The flood warning in Dagupan City, the Philippines, for example, has an early warning system that combines radio messaging with the use of the kanungkong, a bamboo instrument traditionally used to call people to the village hall for meetings (UNISDR, 2008).

Coping with major disasters

ICT and space technologies thus have enormous potential for climate-smart disaster risk reduction but they have already proven their worth in many different environments:

Afghanistan drought, 2008[13] – Afghanistan had a severe drought in late 2007 and early 2008. The satellite-based drought early warning system of the US Department of Agriculture enabled timely reporting of food and water insecurity and helped Afghanistan get $400 million in assistance for 4.5 million affected Afghans, from international donors, financial agencies and other governments.

Japan, flood early warning – Information obtained through radar, rain gauges and telemeters at about 1,300 sites enables the Japan Meteorological Agency to issue warnings about heavy rain that could cause serious flooding, and the Ministry of Land Infrastructure Transport and Tourism to provide hydrological assessments for selected rivers, lakes, marshes or sea coasts (OECD, 2009a). Its website displays real-time information on river water level, rainfall and dam storage levels on the website: www.river.go.jp. Citizens are also warned through the Internet, mobile phones, television and radio. For large-scale flood disasters, the Central Disaster Management Council takes responsibility based on data collected around the clock by the Cabinet Information Collection Centre.

Nepal-India, Kosi River Flood 2008 – On 18 August 2008 an embankment of the Kosi River in South Nepal inundated large areas of Nepal and the state of Bihar in India, affecting nearly four million people. Nearly one million people were evacuated to relief camps for more than three months. The Response Force of India, along with armed and paramilitary forces carried relief materials to remote areas by helicopters and boats. All these efforts were guided by the Flood Management Information System, which included

13 United States Department of Agriculture, [Access on 8 October 2010], www.pecad.fas.usda.gov/highlights/2008/09/mideast_cenasia_drought/

satellite phones and satellite-based dynamic observation maps – with support from the National Remote Sensing Centre and the Indian Space Research Organization. More than 200 maps showing river course changes at three-to-four-day intervals were distributed to end users including NGOs and international organizations.

China, Wenchuan Earthquake, 2008 – The response to this earthquake, 8.0 on the Richter scale in May 2008, involved many Information and Communications Technology (ICT) and space application tools (ESCAP, 2009). Within two hours the National Disaster Reduction Centre had submitted a map to the highest decision makers. In the following days, the Centre and its cooperative partners prepared 120 maps and reports derived from satellite and aeroplane images. These provided critical information on the severity of the catastrophe, indicating collapsed buildings, the dynamics of quake-lakes and roadblocks, and helped identify relocation sites. More than 1,300 images from 23 satellites were used, including those from foreign space agencies from which most images were free of charge. Manned aeroplanes and micro unmanned aerial vehicles equipped with remote sensors flew over the quake-hit-areas. Around 25,000 persons were mobilized to restore damaged telecom facilities, 383 emergency communication vehicles were dispatched and more than 2,000 satellite mobile handsets were deployed. Broadband links were established by more than 1,300 VSAT terminals for networking, transmitting remote sensing images, holding videoconferences and using telemedicine among field teams and major supporting hospitals. Decision makers used electronic maps and a three-dimensional digital model of a quake-lake, which contributed greatly to the efforts of eliminating the risk of outburst. Most rescue teams had compass satellite positioning handsets using short messaging services.

Australia, bush fires, 2009 – Bushfire monitoring, management and analysis require various kinds of information – on rainfall, vegetation, wind speed and direction, hot spots of present fires, historical fire areas - along with other fundamental geo-spatial information. The State of Victoria has a bushfire control information system that assesses the areas prone to bushfires, and in 2009 identified 52 towns at high risk. With the integrated analytical power of remote sensing and GIS, the country's fire authority is constantly identifying hot spots from remotely sensed images with information from meteorological services on precipitation and wind direction. As a result, a number of bushfires have been contained before they became disasters.

Bangladesh, Cyclone Sidr, 2007 – With wind speeds of 240 kilometres per hour, this cyclone hit the Bangladesh coast in November 2007. It was tracked by meteorological and oceanographic agencies at international, regional and national levels. Based on previous experience, the Bangladesh national early warning system was able to predict precisely the landfall and storm surges and provide actionable information. The warning messages were disseminated to 15 of Bangladesh's 64 districts, and a network of 40,000 Red Crescent volunteers was mobilized. Warning alerts were cycled around the country using megaphones to order residents into the 1,800 cyclone shelters and 440 flood shelters. More than 320,000 people were evacuated. By the time Sidr slammed into the coast, around two million people were already sheltered. Later, high-resolution satellite data were used for damage and loss assessments to guide efforts at recovery and reconstruction.

Myanmar, Cyclone Nargis, 2008 – The cyclone struck the Ayeyarwady Delta and Yangon from 27 April to 3 May. Wind speeds of 190 kilometres per hour were reported by Myanmar's Department of Meteorology and Hydrology. The Regional Specialized Meteorological Centre (RSMC) - Tropical Cyclones, New Delhi, under the WMO/ESCAP Panel on Tropical Cyclones, has the responsibility of issuing tropical weather outlook and tropical cyclone advisories for the member countries bordering the Bay of Bengal and the Arabian Sea: Bangladesh, Pakistan, Maldives, Myanmar, Oman, Sri Lanka and Thailand. Nargis was detected by RSMC. From 23 April, RSMC issued regular bulletins. The Post-Nargis Joint Assessment (PONJA) report used high-resolution satellite data for damage assessments, especially for the agricultural and coastal sectors. Other publications prepared by ASEAN, UNEP, UNISDR and the government of Myanmar, also relied on remote sensing and GIS-based damage assessment.

Iran, Bam Earthquake, 2003 – This earthquake, at 6.6 on the Richter scale, struck South-Eastern Iran on 26 December 2003, killing more than 26,271 people, more than a quarter of Bam's population, with huge losses to infrastructure and property. Since local ground-based telecommunication networks were seriously damaged, HF radio and satellite handsets were brought in to support rescue and relief actions. Remote sensing and GIS tools were used for damage assessment and subsequent research. Satellite information, including high-resolution products, was provided through the International Charter Space and Major Disasters, which was activated by France, Germany and Portugal simultaneously. Rapid mapping products of the mostly damaged areas, which were produced based on EO satellite data, were delivered within a very short time, and a fault undetected previously was found with new satellite technical tools. Other space-based technologies used were: three-dimensional imaging systems, Laser Imaging Detection and Ranging, Web GIS and mobile GIS systems. Many rural ICT centres established under the Rural ICT Strategic Plan were used to disseminate early warning information.

Pakistan, Muzaffarabad Earthquake, 2005 – At 7.6 on the Richter scale, this was the largest recorded seismic event in the Himalayas, killing 87,352 people. Most of the affected hilly areas lacked effective communication networks and the limited infrastructure was damaged. In the absence of satellite communication services, RF (ham) radio was used. High-resolution satellite remote sensing data were used primarily for damage assessment and to the lesser extent for recovery and reconstruction.

Indonesia, Earthquake Padang, 2009 – When this 7.6 magnitude earthquake hit Padang, Sumatra in September 2009, terrestrial communication infrastructure was interrupted or degraded, so search and rescue operations relied primarily on amateur radio. Two non-profit organizations, the Indonesian Amateur Radio Organization and the Indonesian Inter-Citizen Radio, provided important services (GTZ, 2009). Amateur radio services, including citizens' band radio, were deployed swiftly for relief and rescue operations through the established local community networks. Recognizing the importance of amateur radios, Indonesia in 2010 decided to launch an amateur radio satellite to further expand the communication network to remote districts.

Indian Ocean Tsunami, 2004 – This was one of the region's most destructive disasters. Since land-based communications infrastructure was severely damaged, satellite links, including mobile and internet services, demonstrated their value in transmitting information among rescue and rehabilitation teams. High-resolution imagery from many commercial satellites helped target rescue efforts in Indonesia, Sri Lanka, India, Thailand, Maldives, Myanmar and Malaysia.

Archived images from more than 30 EO satellites, including small satellites from the joint DMC, were used to compare before and after conditions and to construct maps indicating the condition of infrastructure and key facilities, identify croplands damaged by seawater, and assess the impact on wetlands, mangroves, forests and groundwater. Commercial operators provided their images immediately without seeking payment. Furthermore, the tsunami provided a strong motive for nearly 60 nations to reach an accord on a 10-year programme of international cooperation on EOs. This agreement to establish a Global Earth Observation System of Systems was signed at the Third Earth Observation Summit in Brussels in February 2005. The response to this tsunami also set in motion the integration of space technology with disaster reduction activities.

Turkey, 1999 Earthquake – The Marmara and Duzce Earthquakes caused economic losses of 11 per cent of Turkey's GDP. Following this, the government reorganized the disaster management strategy. This experience has proved that disaster-resilient societies can only be created by strong institutional bodies for information sharing and by enhancing public education and awareness, in addition to carrying out field exercises and scientific research. Turkey has established a new disaster management system by giving greater emphasis to disaster risk reduction (Abbas and others, 2009).

Initiatives for sharing space information and products

These and future uses of technology have benefited from a number of initiatives to share information and products, particularly in providing urgently acquired and achieved satellite data for free access to all stakeholders, as demonstrated by the initiatives of EO satellite operators and value-adding partners responding to Cyclone Nargis (Figure V-2).

These initiatives include:

Sentinel Asia

Sentinel Asia is a voluntary initiative of the Asia-Pacific Regional Space Agency Forum for providing disaster-related satellite information and products (Sentinel Asia, 2010). It is led by the Joint Project Team (JPT), which consists of 54 organizations from 23 regional countries and nine international organizations.

Many space-based images are currently provided by EO satellites operated by Japan, India, Thailand, Republic of Korea and Taiwan, Province of China. At the same time, various added-value products are provided by more than 10 partner institutions located in China, Indonesia, Japan, Kyrgyzstan, Nepal, Singapore, Sri Lanka, Thailand and Viet Nam. When a disaster occurs, members of the JPT and ADRC may submit an emergency request to Sentinel Asia while others can also request support by email. To improve access to less connected countries, the experimental Wideband International Engineering Test and Demonstration Satellite of JAXA has been utilized from 2010 for transmitting disaster image data to around 10 Earth stations. Sentinel Asia is also providing precipitation data and inundation information from GFAS and space-based three-dimensional images.

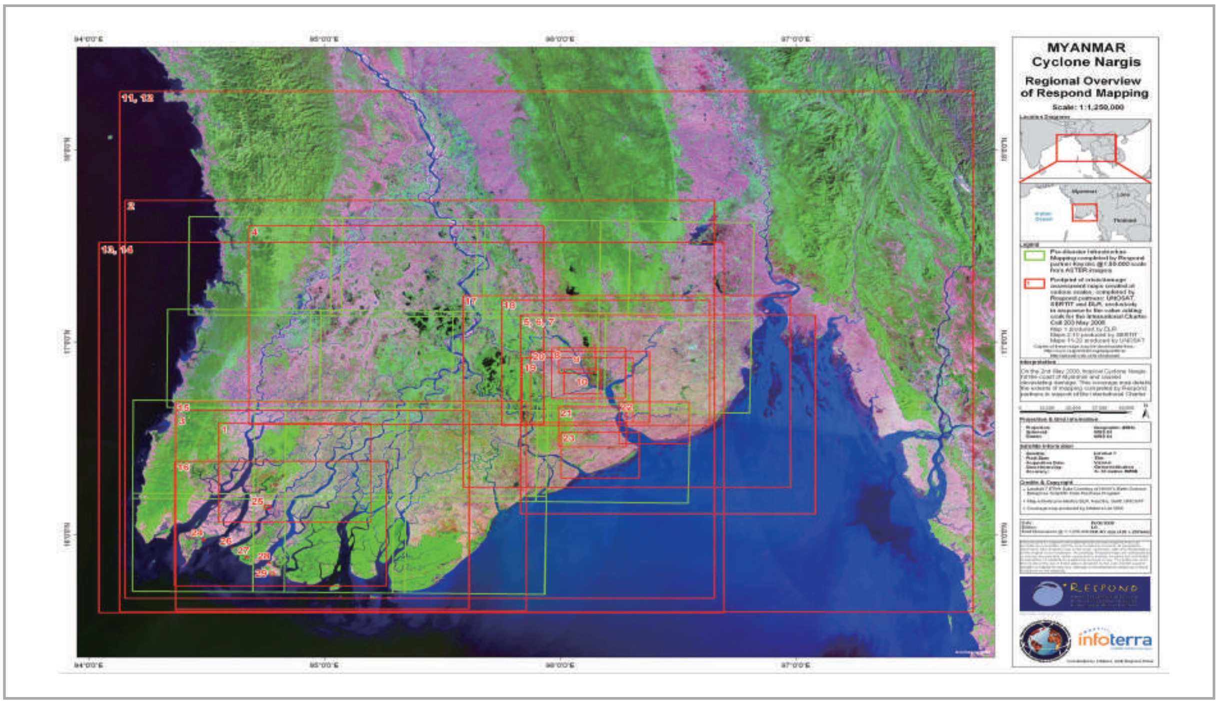
International charter space and major disasters

This charter, which has been operational since 2000, aims at providing a unified system for rapid EO satellite data acquisition and delivery at no cost to countries affected by natural or man-made disasters. Currently, 10 of the world's space agencies are members, offering more than 21 EO satellites. In Asia and the Pacific, the members are the China National Space Administration, the Indian Space Research Organization and JAXA, which between them have more than six committed EO satellites. The authorized users of the charter are the space agencies and civil protection, rescue, defence or security bodies from the countries of charter members, as well as some authorized United Nations entities and international organizations like the UN Office for Outer Space Affairs, the United Nations Institute for Training and Research (UNITAR) Operational Satellite Applications Programme and ADRC.

UN-SPIDER

The UN Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) is a gateway to space information for disaster management support and serves as a bridge between the disaster management and space communities (UNOOSA, 2010). Promoted by the UN Office for Outer Space Affairs (UNOOSA), this will ensure that all countries and international and regional organizations can use all types of space-based information. UN-SPIDER is an open network of providers. Besides Vienna, where UNOOSA is located, the programme also has an office in Bonn and an office in Beijing. There is also a network of regional support offices in Asia and the Pacific, including offices in Iran, Japan and Pakistan. The UN-SPIDER achieves this by offering a technical advisory support at the national level, facilitating the capacity building efforts and ensuring cooperation with the UN, regional and international organizations/ initiatives involved in disaster risk reduction and emergency response.

Figure V-2 **Overview of all crisis mapping and damage assessment maps**



Produced by RESPOND partners using Charter data (in red) and pre-disaster topographic mapping delivered by RESPOND partner Keyobs (in green) a month before Cyclone Nargis hit. (Credits: Infoterra UK) (Extended cyclone relief efforts aided from space, //www.esa.int/esaEO/SEM68CSHKHF_environment_1.html#subhead4)

Group on Earth Observations (GEO)

The intergovernmental GEO was established by governments and international organizations for coordinating international efforts to build a Global Earth Observation System of Systems (GEOSS) (www.earthobservations.org). Many regional countries operating EO satellites are members. GEOSS promotes the sharing of information for climate change study and adaptation with linkages to disaster risk reduction. GEO has recommended that satellite data with spatial resolution coarser than 30 metres should be shared free of charge or at minimum cost. This would be used for societal benefit areas, including climate change study and adaptation, and to better understand the behaviour of monsoons, high mountains, West Pacific warm pools and sea currents. GEOSS focuses more on large-scale scientific studies but also encourages countries to make the data available for a wide variety of users – connecting them to existing databases and portals providing reliable, up-to-date and user-friendly information.

World Meteorological Organization (WMO) Global Observation System

WMO has a Global Observing System based on a uniform international standard, using reliable facilities on land, at sea, in the air and in outer space. It aims to analyze and forecast weather and to release disaster warnings. These facilities are owned and operated by member countries but they also undertake certain responsibilities in the agreed global scheme (WMO, 2010).

Global Flood Alert System (GFAS)

GFAS is an internet-based system developed by Japan, which converts satellite precipitation estimates into useful information for flood forecasting and warning, such as global and regional rainfall maps with precipitation probability estimates. This system is currently running on a trial basis, posted on the website of the International Flood Network (GFAS, 2010).

Regional cooperative mechanisms promoted by ESCAP

As the regional arm of United Nations, ESCAP has been promoting a number of regional mechanisms to help its members gain better and affordable access to technical tools and data on space, information and communication technology.

Regional Space Applications Programme (RESAP)

The intergovernmental programme has been, since 1994, promoting regional cooperation to assist ESCAP members in applications of space technology for sustainable development, environment and disaster management, in the technical fields of remote sensing, satellite communications, GIS and satellite based positioning. Its current focus is on promoting regional cooperative mechanism on key space application capacities for disaster risk reduction and management, such as drought disaster monitoring and early warning, disaster communication capacities and sharing of satellite information products and services. Under RESAP, a regional training and education network is supported by China, India and Indonesia, which cover all local costs for trainees from least developed countries and other developing countries, with current relevant interest on the use of remote sensing and GIS technology for disaster management.

Asia-Pacific gateway

The ESCAP Committee on DRR, at its first session in March 2009, recommended that the ESCAP secretariat promote an Asia-Pacific gateway for information sharing and analysis for DRR. The gateway will provide a portal for easy access to information, including space-based products and services, and will function as a platform for ESCAP-promoted activities and initiatives related to DRR and development. The gateway will have an emphasis on social and economic development and will offer access to value-added services and resources available from ESCAP, while also providing links to other resources. The gateway will target policy-makers but will also cater to researchers, academics and staff of various NGOs and Inter-Governmental Organizations and donor agencies. The public will also be free to visit the web portal.

Regional platform for sharing satellite information products and services

Many developing countries in the Asia-Pacific region lack the technical capacity to access relevant satellite information sources and process the information consistently from different satellites for decision makers or the institutional capacity to provide operational support to different departments. Although much of the final products will have to be processed locally, there is an opportunity to develop a regional platform, which could provide consistent interim products and services to these less capable countries. The platform could also serve as the basis for substantive national services with minimum technical capacities. The platform will be developed as a core component of the Asia-Pacific gateway, jointly supported by all contributing initiatives.

Regional cooperation for drought monitoring and early warning

With technical support from China, India and Thailand, and the cooperation of other stakeholders, ESCAP has launched a regional cooperative mechanism for drought disaster monitoring and early warning. This will help countries develop operational capacity for drought monitoring and early warning. The permanent secretariat, operational modalities and structure of the mechanism are to be finalized, but it will include: an information portal for sharing national strategies, profile data, and mitigation experiences; a technical support platform for no- or low-cost space-based products for drought- relevant analysis, particularly in those products derived from medium resolution EO satellites; and a platform to encourage technology transfer and capacity building.

Collaborative communication infrastructure

Asia and the Pacific would benefit from a collaborative disaster communication capacity at regional or subregional levels. This could involve national disaster and telecom authorities, public and private service providers and equipment vendors, UN entities, humanitarian assistance agencies and development assistant agencies. For this purpose, ESCAP and relevant international organizations, such as the International Telecommunication Union and the Asia-Pacific Telecommunity, can work with national disaster management and telecom authorities to develop a strategy for incorporating collaborative disaster communication capacities and resilient telecoms networks within disaster risk reduction frameworks. Costs for equipment and services can be shared among relevant stakeholders, with the funding support of international/regional development assistance agencies.

A learning experience

By using ICT, especially space applications, during major disasters, the region has gained much experience and major lessons have been learnt.

Building capacity – ICT empower the disaster management agencies and communities. But such capacities should be established beforehand as part of disaster reduction strategies and action plans. While this is the responsibility of governments, regional cooperation may assist in building such capacities more cost effectively, through sharing relevant technical and information resources. Some key technical supporting capacities can be built collaboratively at regional and subregional levels.

ICT infrastructure – Critical telecommunications infrastructure needs to be resilient, with sufficient back-up capacity.

Public-private partnerships – Governments can work with private satellite operators, equipment vendors and local service providers to make relevant facilities and services more accessible and affordable with special arrangements for disaster early warning and reporting and collaborative standby capacity for emergency response. Many communication satellite operators, such as Inmarsat, SpeedCast, Thuraya and ThaiCom, and wireless equipment vendor of Motorola have expressed interests to join the effort of building collaborative disaster communication capacity. Almost all governments have requested local telecom service providers to ensure emergency communication services as a condition for granting operating licenses. Governments can also work with the insurance industry to achieve long-term finance arrangements. At the same time, many private EO satellite operators, such as DigitalGlobae and GeoEye, have recently provided high resolution satellite images (better than 1 metre) with no-cost or reduced price through the International Charter to many countries suffered from major disasters. These positive actions of relevant private sector have provided the basis for development of a more institutionalized public-private partnership at regional level.

Ongoing access to satellite data – Disaster management authorities usually have good and free access to EO satellite data during emergencies. But they also need better access before the disaster, so they can maintain up-to-date baseline information, and afterwards be readily used during the response phase. This can be arranged through inter-governmental cooperation.

Climate change adaptation – Ongoing access, using GIS databases can also help bridging the information gaps between disaster risk reduction and climate change adaptation.

Technical support capacities for disaster risk reduction and climate change adaptation are thus closely linked – and also contribute to other challenges in sustainable development. Activities in this area, however, rely strongly on international and regional cooperation, which is the subject of the next chapter.

Box V-1 – Technology for the Safe Island Programme in the Maldives

With its low elevations and population dispersed across many small and remote islands, the Maldives is very vulnerable to natural hazards and climate change. Its economy is too fragile, highly dependent on tourism and imports, and with few potential economies of scale.

In response, the government has developed the Safe Islands Programme, which involves building economic opportunities on the larger, safer islands that have greater environmental resilience, and offering incentives for voluntary migration from smaller to larger islands.

The programme has been supported by high-resolution satellite data which have been used for an island risk assessment prepared by UNDP, with technical support from RSMC. This has resulted in detailed analysis of the risks and identified changing patterns of vulnerability. It has also allowed the programme to recommend mitigation measures, including limits to expansion and regulations that take into account vulnerabilities of the natural and built environment.

Source: UNDP Maldives

Box V-2 – Training on ICT for disaster risk reduction and management

In partnership with the Asian Disaster Preparedness Center (ADPC), the Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) has prepared a new module on ICT for disaster risk management as part of its training programme. APCICT, a regional institute of ESCAP based in Incheon, Republic of Korea, and its Academy of ICT Essentials for Government Leaders, aims to enhance the knowledge and skills of policymakers in ICT for development.

The new module offers a framework for matching available technology with disaster risk management processes, and provides examples of a range of ICT applications across Asia and the Pacific. These will be presented as case studies on ICT for disaster preparedness, response and relief, and recovery and reconstruction. The key message of the module is that disaster risk management can be significantly facilitated and enhanced through effective use of ICT.

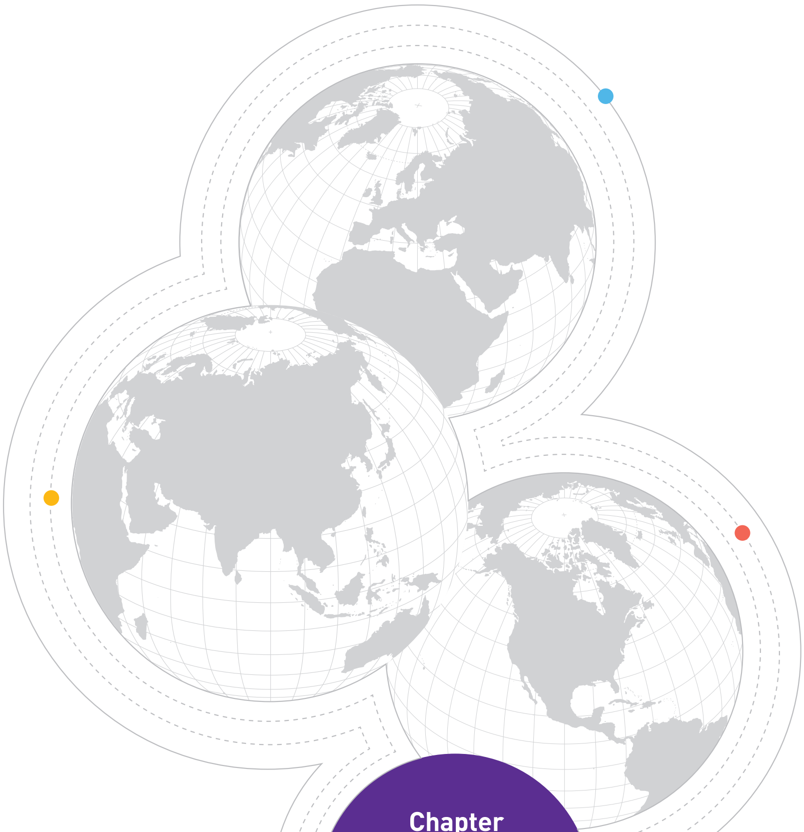
Box V-3 – Indigenous forms of disaster risk reduction

All over Asia and the Pacific, local communities have long experience of coping with disasters and reducing risks. This includes water harvesting technology, management of land and cropping pattern, land use strategies and house building techniques. Such practices can form the basis for a holistic approach to disaster reduction and climate change that links indigenous and modern technologies.

Floods – In Morobe Province, Papua New Guinea, Singas village is a small community situated along the banks of the Markham River which is affected by yearly flooding. The community has been treating the flood not only as a potential hazard but also as the source of the community's livelihood. Their approach towards river basin management has helped in flood risk reduction.

Earthquakes and tsunamis – Tribes in the Andaman and Nicobar islands lost relatively fewer lives in the Indian Ocean Tsunami 2004 even though they were close to the epicentre. The Simeulueans living off the coast of Sumatra, Indonesia and the Moken, living in the Surin Islands off the coast of Thailand and Myanmar also used indigenous knowledge to survive the Tsunami 2004. Similarly, when an earthquake with a magnitude of 8.1 and its subsequent tsunami hit the Solomon Islands in April 2007, both indigenous and immigrant coastal populations had little time to respond because their villages were very close to the epicentre. Fortunately, the indigenous populations recognized the signs of the impending disaster and lost relatively fewer lives.

Droughts – There are some evidence of advanced water harvesting systems to mitigate drought even from pre-historic times. Indigenous systems fit the ecology and culture in which they evolved. They are based on sound principles of ecological conservation and include water conservation and harvesting, coping mechanisms, seasonal climate forecasts, long-term mitigation measures, and adaptation strategies.



Chapter VI

Cooperating across the region

Cooperating across the region

The hazards of nature are embedded deep in geography and geology, so disaster caused by natural hazards and climate change do not respect national boundaries. This means that the response must also be at cross-national level, but more specifically at regional and subregional level, relying on cooperation between countries that share common geography, history, cultures and economies.

Regional cooperation among the nation states in different geographic regions and beyond is therefore emerging as an important and effective mechanism to address to the causes as well as consequences of disasters. Such cooperation can take place among the government and non government organizations of the region in diverse ways – through sharing of knowledge, information and good practices, developing common frameworks and understandings, agreeing with common laws, institutions and protocol and by pooling common resources, human, material and financial, to address to the regional issues of disaster risk reduction that cannot always be effectively tackled at the national level. Various types and forms of regional cooperation have been developed in different regions of Asia and the Pacific, with varying degrees of successes and failures. The strength and effectiveness of such cooperation have been influenced to a large extent by the complementary, competing and sometimes conflicting political and economic interests and ideologies of the nations. This chapter traces the genesis and development of such regional cooperation, analyzes their achievements and failures, examines the constraints and challenges and explores the future potentialities for growth, strengthening and sustenance of such cooperation in the Asia-Pacific region, especially in the context of climate change and disasters.

Drivers of regional collaboration

The regional collaboration for disaster reduction in the Asia-Pacific region, as in other regions of the world, have been driven by the necessities of securing better living conditions of the people that would be safe from the rising trends of disaster caused by natural hazards. Large scale human sufferings caused by the loss of lives, property and livelihood and the repeated setbacks to development due to damages to houses, infrastructure and other productive assets have triggered the process of a paradigm shift in disaster management. The age old perception that disasters are caused due to the angers of God or wrath of nature has given way to a more rational understanding of the forces and factors that contribute to the hazards of nature and the vulnerabilities of the socio-economic conditions of the people. The same process has driven home the realisation that the efforts of the national governments alone would not be adequate to reduce the risks of disasters as some of the root causes of disasters are transnational in nature and can only be addressed in regional settings through regional collaborations.

A number of initiatives had been taken by the regional entities of the Asia-Pacific to strengthen cooperation among the member States for better understanding, preparedness and management of disasters. While the process has been ongoing, two factors provided a big push to the momentum. The first was the India Ocean Tsunami of December 2004 that caused widespread devastations in at least eight countries of the South East and South Asia. It strengthened the resolve of the leadership to develop institutions, systems and processes that would strengthen the regional cooperation among the countries.

The second impetus came from the World Conference on Disaster Reduction held in Kobe Japan during January 2005 and the Hyogo Framework of Action: Building the Resilience of Nations and Communities to Disasters that was adopted by the 168 participating countries including countries of the Asia-Pacific. The HFA called upon the regional organizations to undertake the following five specific tasks within their mandates, priorities and resources:

a) Promote regional programmes, including programmes for technical cooperation, capacity development, development of methodologies and standards for hazard and vulnerability monitoring and assessment, sharing of information and effective mobilization of resources;

b) Undertake and publish regional and subregional baseline assessments of the disaster risk reduction status;

c) Coordinate and publish periodic reviews on progress in the region and on impediments and support needs, and assist countries in the preparation of periodic national summaries of their programmes and progress;

d) Establish or strengthen existing specialized regional collaborative centers to undertake research, training, education and capacity building in the field of disaster risk reduction; and

e) Support the development of regional mechanisms and capacities for early warning to disasters, including tsunami.

Based on the HFA, many regions of the Asia and the Pacific developed their own regional frameworks for disaster reduction. The South Asian countries adopted a Comprehensive Framework on Disaster Management. The Pacific Island countries developed a regional framework for disaster risk management known as “An Investment for Sustainable Development in the Pacific Island Countries – Disaster Risk Reduction and Disaster Management A Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters”. The ASEAN countries went a step ahead in signing an Agreement on Disaster Management and Emergency Response in July 2005.

Architecture of regional cooperation

Regional cooperation among the countries and the communities of the Asia-Pacific region, like in other regions, has taken place in four different but interrelated circles.

The first and the foremost is the cooperation among the sovereign states of the region through legally established regional Inter-Governmental Organisations, like the ASEAN, SAARC, SOPAC, etc. Different regions of the Asia-Pacific have been able to achieve different levels of progress in institutionalizing inter-governmental cooperation on disaster risk management, based largely on the profile of risks of the region, vision of the regional leadership and the history of conflicts or cooperation among nations in the region.

The second circle of regional collaboration has developed around a wide range of institutions and organizations that are regional in nature but are not based on the initiatives of the sovereign states, although national governments may be associated with such ventures. Such organizations may broadly be of four different types: (a) organizations created with support of national governments and other agencies, (b) scientific, technical, academic and professional organizations working on different aspects of disaster risk management, (c) regional associations of media, corporate sectors etc taking occasional interests and initiatives in disaster management, and (d) regional NGOs, voluntary and humanitarian organizations involved with disaster response, relief and community based disaster risk management.

The third circle of regional cooperation has evolved around the United Nations and its various agencies, through the coordinated efforts of the ESCAP and UNISDR. The multi-lateral financial institutions like the World Bank and its trust fund - the Global Facility for Disaster Recovery and Reduction - and the region's own ADB have also joined the efforts of supporting the national and regional initiatives for disaster risk reduction in the region.

The fourth and the central circle of regional collaboration is a pan Asia-Pacific phenomenon of a more recent origin where all the stakeholders of regional cooperation – the national governments, the regional and subregional organizations, the non-government organizations including the scientific, technical and academic institutions, the media, the corporate sector and the humanitarian agencies and the international organizations and the multi- financial institutions have joined together to support the movement for regional cooperation.

A more detailed analysis of the achievements, strengths, limitations and challenges of each of these four tracks of regional cooperation in the Asia-Pacific is provided in the following section.

Figure VI-1 **Forms of regional cooperation on disaster risk reduction**

Regional intergovernmental organizations

Subregional intergovernmental organizations have usually been created through regional treaties or charters which establish a wide range of issues for cooperation, such as security, trade and immigration, customs, environment, science and technology. The charters do not usually mention disaster risk reduction specifically but cover this under broader objectives such as "sustainable development", "welfare of people" or "protection of environment". But many subregions, concerned about the increasing incidence of disasters, are now strengthening cooperation for reducing the risks of disasters and for responding to them in a coordinated manner.

The extent and pace of cooperation varies between on sub-region and another. This partly reflects the overall general level of cooperation which is conditioned by the countries' strategic economic and political interests, the legacies of past conflicts, and differences in the vision of political leadership. But it also varies according to their recent experience of disasters.

Cooperation usually follows a general pattern. It starts with a phase of declarations and resolutions. This is followed by the stage of building systems and institutions and finally by the creation of action plans and programmes. Some regions have remained locked in the phase of declarations while others, with varying degrees of success, have graduated to active collaboration.

North and East Asia – progress without cooperation

East Asia has three of the world's towering economies – China, Japan and the Republic of Korea – which together account for nearly 60 per cent of the Asia-Pacific region's total wealth. All three have made progress in disaster risk reduction at the national level. Japan has set global standards, and here, as in the Republic of Korea, the recurrent hazards of nature no longer create huge humanitarian or economic crises. China too has proactively reduced the risks of recurrent floods and droughts and is making the country safer from earthquakes and landslides.

On the other hand, the sub-region as a whole has yet to develop even a rudimentary general organization or a specialized body on disaster management. Nevertheless, there have been some efforts in the recent past to develop cooperation among the three major economies. The first Japan-China-Korea Trilateral Summit in 2008 agreed to hold heads of government agency and expert level meetings in rotation. In 2009, an expert level meeting in Seoul was followed by a ministerial level meeting in Kobe in October which adopted a Tri-lateral Joint Statement on Disaster Management Cooperation. This identified three broad areas of cooperation: countering the disasters which are expected to increase due to climate change; promoting earthquake-proofing of buildings; and utilizing satellite technologies for disaster management. The next meeting will be in China in 2011.

South-East Asia – significant cooperation

The greatest subregional cooperation has been in South-East Asia under the aegis of ASEAN. The ASEAN countries have benefited from statesmanship from national leaders and from the relative absence of hostilities among the countries. But they have also had much to gain from greater connectivity and share a need to cope with various types of disaster caused by natural hazards that regularly straddle their borders. ASEAN was established in 1967 by five countries – Indonesia, Malaysia, the Philippines, Singapore and Thailand – and gradually expanded its membership to 10 with the inclusions of Brunei in 1984, Viet Nam in 1995, Lao PDR and Myanmar in 1997, and Cambodia in 1999. ASEAN has had a phase of declarations: Bangkok 1967, Kuala Lumpur 1976, and the concords of Bali 1976 and 2003. It has also had a Treaty of Amity and Cooperation (1976), a Vision 2020 (Kuala Lumpur 1997), and a Plan of Action (Hanoi 1998). These declarations culminated in 2007, on the fortieth anniversary, with the adoption of the ASEAN Charter.

In 1976 in Bali, in Concord I, the leaders identified disaster management as one of the eight principles and objectives for ASEAN cooperation – and issued the ASEAN Declaration on Mutual Assistance on disaster caused by natural hazards. This called for mutual assistance in mitigation, rescue and relief of victims. From the 1990s leaders were very concerned about haze pollution and in 1998 produced the Regional Haze Action Plan, which they institutionalized in 2002 by signing the ASEAN Agreement on Trans-boundary Haze Pollution. National leaders again emphasized disaster management in 2003 in the Declaration of Concord II in which they resolved to establish an ASEAN Community by 2020.

For over three decades, ASEAN's disaster reduction efforts were coordinated by one of the seven subsidiary bodies under the ASEAN Committee on Social Development: the ASEAN Experts Group on Disaster Management. In 2003, this group was elevated as the ASEAN Committee on Disaster Management (ACDM) consisting of the heads of national agencies responsible for disaster management.

In 1996, with technical support from the Asian Disaster Preparedness Center (ADPC) and financial support from the European Commission Humanitarian Aid Office, the organization initiated the ASEAN Regional Programme on Disaster Management (ARPDM). This was then the subject of a series of meetings and workshops which culminated in a draft ARPDM 2002 which was finally approved in December 2003. ARPDM 2004-2010 has five major components and 29 sub-components, as in Table V-1. However, most of these were largely intentions with no specific regional projects and there was no mechanism for monitoring progress.

One programme that has achieved great success is the ASEAN Regional Disaster Emergency Response Simulation Exercise. Each year one country, by rotation, tests its own preparedness and that of the regional response team that could assist it, through a simulation exercise, with full logistics support on disaster response and relief, including search, rescue and evacuation of affected communities. So far, five such exercises have been conducted – in Malaysia, Cambodia, Singapore, Thailand, and the Philippines. Based on these experiences, the countries have developed and adopted the ASEAN Standard Operating Procedure for Regional Standby Arrangement and Coordination of Joint Disaster Relief and Emergency Response Operations.

This ASEAN disaster management system was fully tested in May 2008 by Cyclone Nargis in Myanmar. This system was especially valuable because the government of Myanmar was reluctant to accept assistance from the UN and the World Bank. ASEAN was able to act as a bridge between Myanmar and the international community in the Post-Nargis Joint Assessment and in coordinating international assistance on recovery and reconstruction.

A priority project under the ARPDM was the establishment of an ASEAN Regional Disaster Management Framework. Work on this was already underway when four ASEAN countries were hit by the devastating Indian Ocean Tsunami. On 6 January 2005 the ASEAN leaders held a special meeting and issued the Aftermath of Earthquake and Tsunami Declaration on Action to Strengthen Emergency Relief, Rehabilitation, Reconstruction and Prevention. There then ensued a process of discussion and negotiation which resulted in the

ASEAN Agreement on Disaster Management and Emergency Response (AADMER) which was signed by member states in July 2005 and came into force in December 2009 after being ratified by all 10 member states. AADMER is the world's only HFA-related binding instrument.

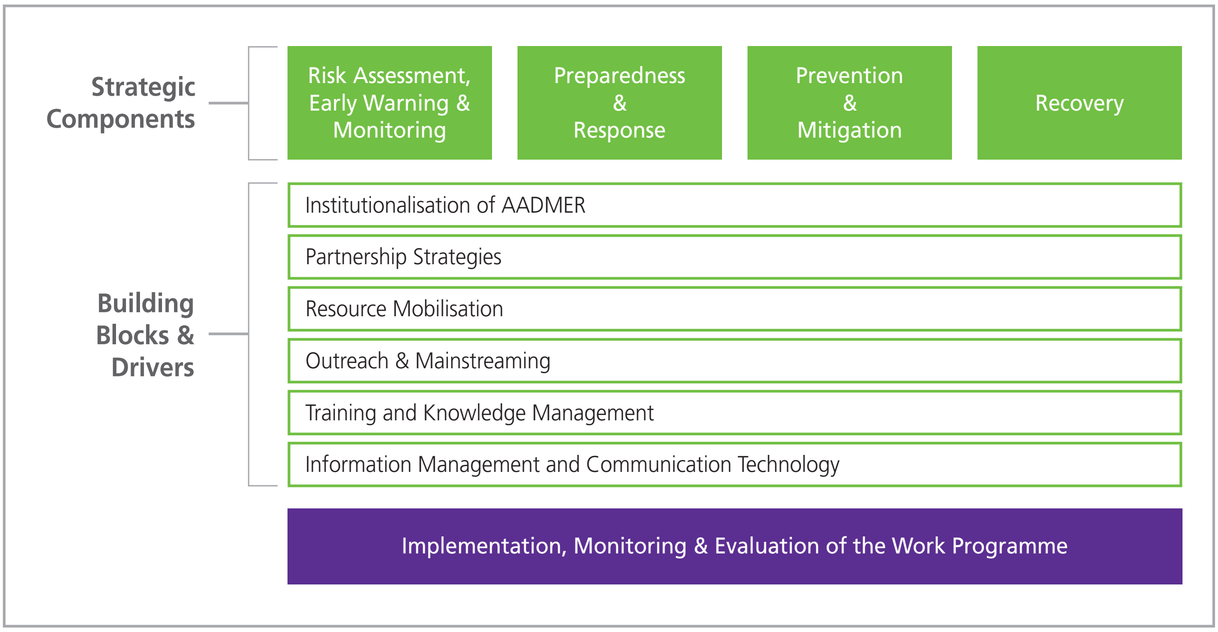
The AADMER has 36 articles, divided into 11 parts that deal with the whole cycle of disaster management starting with risk identification, assessment and monitoring, and continuing with disaster prevention and mitigation, disaster preparedness, emergency response, rehabilitation, technical cooperation, and scientific research and institutional arrangements and procedures. As a first step, Dr. Surin Pitsuwan, Secretary General of ASEAN, was appointed as ASEAN's Humanitarian Assistance Coordinator.

Table VI-1 ASEAN Regional Programme on Disaster Management (2004-2010)

Objectives	Sub-components
Component 1– Establishing the ASEAN Regional Disaster Management Framework	
Promote cooperation and collaboration among Member Countries in all areas of disaster management including joint projects, collaborative research and networking.	Establishing the ASEAN Response Action Plan (RAP) Enhancing Quick Response Capacities of Member Countries ASEAN Joint Simulation Exercises for Disaster Relief Technical Cooperation Projects • Earthquake Vulnerability Reduction • Flash Flood, Landslide, Sea/ River Erosion Preparedness and Mitigation • Dissemination of Flood Early Warning • Safety of Children in Flood-Prone Areas • Typhoon and Cyclone Preparedness and Mitigation • Early Warning System for Land and Forest Fire Management and Haze Preparedness
Component 2: Capacity Building	
Strengthen capacity building in areas of priority concern of Member Countries, and promote human resources development in disaster management in accordance with the needs of Member Countries	ASEAN Disaster Management Training Institutes Network • Specialised Disaster Management Training • Specialised Training in Risk, Damage and Needs Assessment • Specialised Training in Collapsed Structure Search and Rescue • Specialised Training in Forest Fire Fighting • Refresher Courses/ Expertise Development • Training on the Management of Disaster Stress and Behaviour
Component 3: Sharing information and resources	
Promote sharing of information, expertise, best practices, and resources.	ASEAN Disaster Information Sharing and Communication Network (ASEAN DISCNet) • Development of ACDM Website and NDMO Websites • Establishing Effective Communication Systems • Publication of ADMIN Newsletter • ASEAN Inventory of Disaster Management Experts (Brain Bank) and Resources • ASEAN Hazard and Vulnerability Mapping Project Research and Development and Dissemination of Good Practices Improved Use of Climate and Weather Forecasting
Component 4: Promoting collaboration and strengthening partnerships	
Promote partnerships among various stakeholders (GOs, NGOs, and community based international organizations)	Supporting Community-Based Management Programmes Partnerships with Relevant Organizations and NGOs Mobilising Financial Support and Resources
Component 5: Public Education, Awareness and Advocacy	
Promote advocacy, public education and awareness programme related to disaster management	ASEAN Day for Disaster Management Integration of Disaster Management in School Curricula Enhancing Disaster Management Public Education and Awareness Programmes Mainstreaming Disaster Management into Development Plans of ASEAN Member Countries

Source: www.aseansec.org/18455.htm

Figure VI-2 Overview of AADMER work programme (2010-2015)



Source: www.aseansec.org/18455.htm

Earlier, in anticipation of the coming into force of the Agreement, the AADMER work programme (2010-2015) had been developed through a consultative process. The programme has four strategic components and six building blocks, each covering a number of activities, with timelines and clearly defined milestones. The programme is intended to be a dynamic rolling plan that will be updated and revised through a continuous system of feedback, monitoring and evaluation. The programme was formally launched in May 2010 and will be implemented in two three-year phases.

The growing maturity and confidence of the ASEAN system is evident from a comparison between its two work programmes – ARPDM and AADMER. ARPDM took six years to develop, with external technical and financial support. But consensus on the second programme was reached within a year with little assistance from outside agencies. This was largely because the first programme had established the capacities, needs, strengths and constraints of the system and its stakeholders. The AADMER Work Programme, promises to be a dynamic and participatory system with the responsibilities for each component vested with working groups of the member states, with a "lead shepherd" for each activity.

Another distinguishing feature of the ASEAN programme is that various international organizations and multilateral institutions have been engaged in an open, transparent and proactive fashion at every stage of planning and implementation. The system also benefits from a common understanding on the basic framework and from a clear delegation of powers and authorities in the ASEAN Secretariat – which has eliminated most of the bureaucratic and time-consuming processes of approval.

The Agreement provides for the establishment of the ASEAN Co-ordinating Centre for Humanitarian Assistance for the purpose of facilitating co-operation and co-ordination among the Parties and with relevant United Nations and international organizations. The Centre will have four divisions: (a) Preparedness, Response and Recovery, (b) Risk Assessment, Early Warning and Monitoring and Knowledge Management, (c) Prevention and Mitigation, and (d) Partnership and Resource Mobilization. The Centre will work under an Executive Director with the oversight of a Governing Board and an Advisory Group.

Complementing ASEAN's disaster management efforts is the work of the ASEAN Regional Forum (ARF). This draws together 27 countries that have a bearing on the security of the Asia-Pacific region. In addition to the ASEAN member states this includes the 10 ASEAN dialogue partners (Australia, Canada, China, the European Union, India, Japan, New Zealand, Republic of Korea, the Russian Federation and the United States of America), one ASEAN observer (Papua New Guinea), as well as the Democratic People's Republic of Korea, Mongolia, Pakistan, Timor-Leste, Bangladesh and Sri Lanka. The ARF was established in 1994 to foster dialogue and consultation on political and security issues of common concern, one of which was disaster management. In May 2009, for example, an ARF "Voluntary Demonstration of Response " was conducted in the Philippines as a civilian-led, military-supported exercise designed to demonstrate ARF national capabilities in responding to requests for assistance, and in building regional assistance capacity for major, multinational relief operations.

Subregional cooperation has also been evident in other areas such as the management of water resources, notably in the Mekong River Commission. This is an organization formed in 1995 by the governments of Cambodia, Lao PDR, Thailand and Viet Nam which have significantly reduced the risks of flood in the sub-region by agreeing on joint management of shared water resources.

South Asia – promising road maps

South Asia is the Asia-Pacific sub-region most vulnerable to disaster caused by natural hazards. Subregional cooperation on disaster management started in 1985 with the adoption of the Charter of the SAARC by Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. Afghanistan joined in 2007. The Charter does not mention disaster management but covers this under generic objectives to: (a) promote the welfare of the peoples and to improve their quality of life, (b) accelerate economic growth, social progress and cultural development and to (c) promote active collaboration and mutual assistance.

Disaster management figured for the first time when the third SAARC Summit in Kathmandu in 1987, deeply concerned at the rapid environmental degradation that was leading to disaster caused by natural hazards, commissioned from a group of experts a study for the protection and preservation of the environment and on the causes and consequences of disaster caused by natural hazards. The study report, finalized in 1991, recommended various measures for protecting and managing the environment, and strengthening the disaster management capabilities of state and non-state actors. The recommendations were endorsed by Heads of State or Government at their Sixth Summit (Colombo 1991) and, as follow-up measures, the SAARC Meteorological Research Centre was established in Dhaka in 1995 and a SAARC Coastal Zone Management Centre was established in Male in 2004.

Following the Indian Ocean Tsunami, a special session of the SAARC environment ministers in Male in 2005 decided that an expert group should formulate a Comprehensive Framework on Early Warning, Disaster Management and Disaster Prevention. The expert group met in February 2006 in Dhaka and developed a SAARC Comprehensive

Framework on Disaster Management for South Asia. The framework, which is aligned with the Hyogo Framework of Action, was approved by the SAARC environment ministers in July 2006 and endorsed by the fourteenth SAARC Summit in New Delhi 2007.

In 2005, the thirteenth SAARC Summit adopted the Dhaka Declaration which agreed to set up a "permanent regional response mechanism on disaster preparedness, emergency relief and rehabilitation". The SAARC Disaster Management Centre (SDMC) was therefore established in New Delhi in the premises of the National Institute of Disaster Management as a "vibrant centre of excellence" to assist countries in formulating policies, strategies, and disaster management frameworks, in conducting research, studies, training programmes, and in disseminating information and good practices. The Centre comprises four divisions to look after: (a) water and climate related disasters, (b) geologically related disasters, (c) biological and other man-made disasters and (d) policy planning and related issues. The professionals of the Centre are recruited from all the countries of the region. As the host country, India provides the entire capital costs while all the members share the programme and administrative costs.

The SDMC has developed a perspective plan for the period 2007-2015 to synchronize its activities with the SAARC Comprehensive Framework for Disaster Management. Through a broad consultative process, it has also developed Regional Road Maps on six key areas of disaster management – outlining the tasks ahead in the short, medium and long term to be addressed by local authorities, national governments and subregional organizations. Based on these road maps a number of projects have been taken up at the subregional level.

SDMC compiles disaster events in the sub-region and publishes a weekly update on its website every Monday, as well as a printed quarterly, SDMC Informs, and an annual South Asia Disaster Report. It also publishes a bi-annual Journal of South Asian Disaster Studies which has scientific and technical papers by reputed scholars, scientists and practitioners on various aspects of disaster risk reduction and management.

The SDMC's two flagship projects are the South Asia Disaster Knowledge Network and the Digital Vulnerability Map of South Asia. The South Asia Disaster Knowledge Network is a virtual network of networks involving eight member countries of SAARC and hundreds of organizations and institutions within and beyond the sub-region. When fully operational, it will connect the governments, research institutions, universities, community-based organizations and individuals, enabling them to share information on natural and manmade hazards, risks and disasters.

The Digital Vulnerability Atlas of South Asia will integrate spatial data on the physical, demographic and socio-economic features of each country. This will use a WebGIS platform showing geo-physical and climatic hazard zone classifications, and include data on, for example, demography, socioeconomic conditions and housing types. The first version was due to be launched in July 2010.

In 2008, the fifteenth SAARC Summit in Colombo called for the creation, under the aegis of the SDMC, of a disaster caused by natural hazards Rapid Response Mechanism. In February 2009, an expert group comprising representatives from the Ministries of Foreign Affairs, Ministries of Defence and National Focal Points on disaster management met in New Delhi and concluded that the best option would be a Voluntary Response Model. An agreement is likely to be signed in the near future. The SDMC would then have a Disaster Response Division and a serve as Regional Emergency Operation Centre. Within three years, SDMC has thus been able to create a strong foundation for supporting SAARC members, helping them cope with disaster caused by natural hazards that might create problems beyond the capacity of any single country.

Central Asia – cooperation in the making

The Central Asia sub-region – comprising Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan – has yet to find a solid subregional mechanism for disaster risk reduction. These states have diverse political, security and economic interests that have encouraged them to seek cooperation through various groupings – looking north to the Commonwealth of Independent States (CIS), east to the Shanghai Cooperation Organization, and South to Economic Cooperation Organization (ECO).

Of these, only ECO has any significant programme or agenda on disaster management. Established in 1985 by Iran, Pakistan and Turkey, ECO now includes Afghanistan and Azerbaijan as well as all five Central Asian States. In 2006, at their Ninth Summit in Baku, ECO leaders called for regional programmes for early warning, and practical steps for disaster preparedness. Since then ECO has organized annual International Conferences on DRM. Although ECO leaders have emphasized the need for cooperation on disaster management they have yet to place the issue on the organization's active agenda.

One ad hoc initiative, affiliated to ECO, is the Regional Centre for Risk Management of disaster caused by natural hazards. This was established in Mashhad in 2007 by the Government of Iran to develop early warning mechanisms, to monitor disaster caused by natural hazards, weather and environmental conditions and to help member states in capacity building. But it has yet to report any significant progress, particularly for Central Asia.

The five core Central Asian States have nevertheless also been trying to improve cooperation among themselves. In 1998, they signed a Cooperation Agreement for Prevention and Liquidation of Emergencies. This was to include "a range of activities carried out well in advance, aimed at reducing to the maximum possible extent the risk of an emergency as well as preserving human health, reducing extent of environmental damage and material losses in case an emergency occurs". However such cooperation did not significantly extend to reducing disaster caused by natural hazards risks.

In addition, three states, Kyrgyzstan, Tajikistan and Uzbekistan, met in Osh in Kyrgyzstan in 2008 and 2009 to reach a common understanding and cooperate on a number of disaster concerns. They agreed to:

- *Establish early warning systems;*
- *Make or revise inter-state agreements between the customs offices, ministries of internal affairs, and border-security forces;*
- *Train professional search-and-rescue teams;*
- *Exchange information, including hydro-meteorological data;*
- *Establish a working group for disaster risk management for the Ferghana Valley.*

Meanwhile, efforts are underway for developing full-scale regional cooperation among all the five Central Asian states. Representatives have met on the sidelines of various conferences: the Asian Ministerial Conferences in Delhi in 2007 and Kuala Lumpur in 2008, and more recently in the regional meetings in Almaty and Geneva in 2009. Here they arrived at broad agreements on the legal and institutional arrangements, principles and objectives and a framework of activities for the first eighteen months. It was expected that the much-awaited Central Asian Centre for Disaster Response and Risk Reduction would be set up in 2010.

West Asia – looking for models

West Asia has seen hardly any significant progress in subregional cooperation on disaster risk management. Indeed, discouraged by prolonged conflicts the countries of the sub-region have yet to develop a single subregional organization. Instead, for addressing disaster risk management they have looked to organizations beyond their neighbourhood.

One is the League of Arab States. Set up in Cairo in 1945 this now has 22 member states of which 12 are from West Asia. The League does not yet have a proposal to set up a specialized disaster risk agency. However, in 2009 in Riyadh it held a workshop on Disaster Reduction and Sustainable Development which articulated the need for an Arab strategy for disaster risk reduction and an executive programme, including technical and financial mechanisms at national and regional levels. At this workshop, the Islamic Development Bank in Jeddah also offered to support capacity building for implementing the Hyogo Framework of Action. In addition, the Arab Academy for Science and Technology and Maritime Transport in Alexandria agreed to explore the possibility of developing regional capacity for disaster risk reduction through training and other programmes.

A second organization to which the countries of the sub-region have turned is the Gulf Cooperation Council (GCC). The Foreign Affairs Ministers of GCC have appointed a Technical Committee to draft a proposal for setting up a GCC Disaster Centre (GCC-DC). The committee is visiting various regional and national initiatives across the globe before finalizing its recommendations. It is envisioned that the GCC-DC will be managed by a board of governors comprising ministers of foreign affairs and will have a steering board with one representative from each member state. As currently conceived, the Centre will focus on all risks including natural and technological threats. Given this grouping's economic potential, the GCC-DC should be a strong and vibrant centre for disaster risk reduction.

Pacific Island countries – partnerships and networks

The main vehicle for cooperation on disaster risk reduction and management is SOPAC. Established by the UN in 1972, SOPAC became an autonomous intergovernmental organization in 1984, initially among 12 island countries along with Australia and New Zealand. Since then, seven other island countries have joined and SOPAC has broadened its focus from marine mapping and geosciences to include hazard assessment and risk management.

The Pacific island countries, confronted by the geographical settings of "big ocean, small islands" are exposed to multiple hazards and risks – environmental, economic and social. Conscious that they face common risks, they have been keen to address these at the subregional level. Following the adoption of the Hyogo Framework of Action they have therefore adopted a subregional framework – "An Investment for Sustainable Development in the Pacific Island Countries – Disaster Risk Reduction and Disaster Management A Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters." This was endorsed by leaders at the Thirty-Sixth Pacific Islands Forum in October 2005. The framework envisions building "safer, more resilient Pacific island nations and communities to disasters, so that Pacific peoples achieve sustainable livelihoods and lead free and worthwhile lives". Its mission is to accelerate policies, planning and programmes for disaster risk reduction and management for all hazards, taking a "whole of government" approach.

The framework has six themes, closely aligned with the five themes of the Hyogo Framework of Action. Each theme lists key national and regional activities along with outcome expected by 2015. The themes are:

1. Organizational, institutional, policy and decision-making frameworks
2. Knowledge, information, public awareness and education
3. Analysis and evaluation of hazards, vulnerabilities and risks
4. Planning for effective preparedness, response and recovery
5. Effective, integrated and people-focused early-warning systems
6. Reduction of underlying risk factors

In February 2006, at the behest of Pacific leaders, and to support the subregional framework, SOPAC facilitated the establishment of the Pacific Disaster Risk Management Partnership Network. The membership is open ended and voluntary and comprises international, regional and national governments as well as non-governmental organizations, all of which have comparative advantages and interests and can contribute resources and technical expertise to develop joint programmes and projects that respond to the evolving needs of member countries. Funding will be on a shared basis and consistent with the mandate of the individual partners. To assist in the implementation of the framework SOPAC has worked with partners to develop a set of tools. These include:

- *Pacific Disaster Net – www.pacificdisaster.net*
- *A Partnership Capability Matrix, outlining the projects and areas of expertise and interests of each partner*
- *Online Monitoring of the Regional Framework for Action*
- *A reporting system for progress on the Regional Framework for Action which feeds into the HFA.*

Pacific Disaster Net is a virtual centre of excellence for disaster risk management and is designed to be the most comprehensive information resource to support national action planning, and decision making. It provides in-country information for distribution within the sub-region. The web portal and database system were developed with assistance from UNDP, IFRC and UNOCHA.

SOPAC has also developed various tools and guidelines for the regional framework. One is Mainstreaming DRR Conceptual Framework. Another is Guidelines for Development of DRM National Action Plans, which is an eight-step process from initial planning, to advocacy, situation analysis, development, costing, implementation, monitoring and evaluation. Various regional and international agencies have also provided expert technical guidance for preparing national action plans and mainstreaming DRM into development plans.

SOPAC is also working on local-level risk assessment and early warning systems. In this sub-region it will be particularly important to understand the implications of global warming and climate change and the precise impacts of sea level rise in different islands. A number of studies have been commissioned to study the local-level impacts and the required measures for mitigation and adaptation.

Other regional organizations

Disaster reduction in Asia and the Pacific is also supported by a number of other regional organizations, including intergovernmental groups, academia, the media, the private sector and NGOs.

The Asian Disaster Preparedness Center (ADPC)

ADPC was established on the recommendation of UN Disaster Relief Organization in 1986 to strengthen national disaster risk management systems. Initially it was an outreach activity of the Asian Institute of Technology in Bangkok, supported by the government of Thailand, but in 1999 it became independent. ADPC is now governed by a board of trustees, with 21 members representing 15 countries, and is advised by a regional consultative committee, with 32 members from 26 countries, as well as an advisory council, with 55 members from a wide range of agencies. The regional consultative committee holds annual meetings on specific themes. Since 2000 there have been eight such meetings, each contributing to better understandings of the current and future disaster risk management challenges and issues.

Over the years, ADPC has also shifted its focus from disaster response and preparedness to risk reduction and mitigation and has made a strong contribution in developing capacities, systems and processes across Asia and the Pacific but particularly in South-East Asia and South Asia. Its vision, which is in tandem with the Hyogo Framework of Action, is "Safer communities and sustainable development through disaster risk reduction". Its mission is to mainstream disaster reduction in development, build and strengthen capacity, and facilitate partnerships and exchange of experiences. For this purpose, ADPC has implemented cross-sectoral programmes and projects in a number of thematic areas: climate risk management; community-based disaster risk management; disaster risk management systems; public health in emergencies; training resources; and urban disaster risk management.

The Asian Disaster Reduction Center (ADRC)

ADRC was set up in 1998 in Kobe by the Government of Japan. Its mission is to enable Asian countries and communities to be more disaster resilient and to establish networks among countries through various programmes including exchange of personnel. So far the network involves 28 countries: nine from South- East Asia, six from South Asia, four from East Asia, seven from Central Asia and one each from West Asia and the Pacific.

ADRC's most significant contribution is the Sentinel Asia project, which uses data from EO satellites as the basis of a disaster management support system (see Chapter VI). ADRC maintains a repository of data and good practices on disaster management, conducts studies on disaster reduction, develops education and training materials and organizes various conferences and workshops. Each January, on the anniversary of the Kobe Earthquake, ADRC convenes the annual Asian Conference on Disaster Reduction, bringing together disaster management officials from member countries and experts from international organizations sharing information and opinions and enhancing partnerships.

The International Centre for Integrated Mountain Development (ICIMOD)

ICIMOD was established in 1983 in Kathmandu, Nepal. ICIMOD studies the dynamics of mountain ecosystems and livelihoods in the Hindu Kush-Himalaya region in the contexts of climate change and globalization. It has eight member countries – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. Between 1995 and 2002, ICIMOD implemented, in two phases, a Regional Collaborative Programme in three strategic areas – water, environmental services, and livelihoods – which significantly enhanced the knowledge and capacity of the mountain people to understand the changes they were facing, adapt to them, and make the most of new opportunities.

From 2002 onwards, ICIMOD started working on a new programme aligned with the Hindu Kush-Himalaya region's physical, social, and economic vulnerabilities. This involved six integrated programmes: natural resources management; agriculture and rural income diversification; water, hazards and environmental management; culture, equity, gender and governance; policy and partnership development; and information and knowledge management.

ICIMOD mobilizes its resources from donor countries and organizations. Initially there was some apprehension that the organization might be used to influence policy decisions on strategic issues. But over four decades of research and programmes, the Centre has established its credibility and value as a knowledge-based organization that can supplement the efforts of government and other agencies in improving people's living conditions. ICIMOD has however been constrained by the reluctance of member countries to share with their neighbours critical information on such issues as rainfall and water.

Asia-Pacific Economic Cooperation (APEC)

Another intergovernmental organization that has shown considerable interest in disaster management is APEC. APEC was set up in 1989 to enhance cooperation among 21 Pacific Rim countries, mostly covering East Asia, South-East Asia and the Pacific countries, as well as the United States of America, Mexico and Peru. APEC has identified disaster management as critical for sustainable economic growth and has adopted an APEC Strategy for Disaster Risk Reduction and Emergency Preparedness and Response: 2009-2015. The strategy aims to promote risk management, business resilience and public-private sector partnerships, and has initiated long-term capacity building projects for accelerating recovery in disaster-affected areas. The APEC countries have endorsed an Australia-Indonesia proposal for a Disaster Risk Reduction Facility linked to the APEC Task Force on Emergency Preparedness.

Academia, the private sector and the media

The Asia-Pacific region has a large number of scientific, technical, academic and professional organizations that are concerned with the causes and consequences of disaster caused by natural hazards and the tools and techniques of their remediation. Much of their collaboration has taken place under government patronage, but they also have a momentum and potential of their own. Many universities in Asia and the Pacific have set up regional studies centres which conduct research on a range of regional issues and often advise national and regional organizations. The Graduate School of Global Environment Studies of Kyoto University, Japan, for example, is involved with various initiatives on cooperation on disaster reduction in the Asia-Pacific region.

There is also collaboration among the electronic and print media. A number of media groups are aiming to increase awareness about disasters and are developing appropriate standards and codes of ethics for reporting disaster events. The South Asia Free Media Association, for example, has organised various programmes and events to create awareness among journalists.

Federations of chambers of commerce and industries have also been exchanging information and good practices on corporate social responsibility, public-private partnerships and business continuity planning for reducing the risks of disasters.

Non-governmental organizations

Many international non-governmental organizations (NGOs) have been working with vulnerable communities for many years and have implemented innovative community-based disaster risk management programmes, not just highlighting weaknesses and vulnerabilities, but also showing how community strength can be harnessed for better preparedness and response. Among the most prominent is the International Federation of Red Cross and Red Crescent Societies; most countries also have national societies with branches in their provinces and districts. After catastrophic disasters, the Federation's Asia-Pacific Zonal Office, based in Kuala Lumpur, works with the national societies in issuing flash appeals for humanitarian assistance. It has also forged partnerships with the ADB and ASEAN. The regional office also provides national societies with guidance and technical assistance on disaster preparedness programmes and has produced excellent knowledge sharing materials highlighting experiences and lessons learned.

In addition, many local NGOs and civil society organizations have supplemented government efforts and also pushed for greater transparency and accountability in government-driven programmes and initiatives. Some now have a presence in several countries in the region and beyond. They have also developed significant coalitions and partnerships which have become significant stakeholders in regional cooperation on disaster risk reduction, notably the Asian Disaster Reduction and Response Network and Duryog Nivaran.

The Asian Disaster Reduction and Response Network (ADRRN) is a network of 34 national NGOs from 16 countries across Asia and the Pacific, with its secretariat in Kuala Lumpur. ADRRN promotes coordination and collaboration among NGOs and other stakeholder. It has four principal objectives: first, to develop an interactive network of NGOs committed to achieving excellence in the field of disaster reduction and response; second, to raise the relevant concerns of NGOs in the Asia-Pacific region to the larger community of NGOs globally, through various international forums and platforms; third, to promote best practices and standards; and fourth to provide a mechanism for sharing reliable information and facilitating capacity building among network members and other stakeholders. ADRRN has been active in various regional and global conferences, workshops and platforms on humanitarian response and disaster risk reduction.

Another network is Duryog Nivaran, meaning "disaster mitigation". With its secretariat in Colombo, this was established in 1995 as a South Asian network of individuals and organizations committed to an "alternative perspective" on disasters and vulnerability. The network has undertaken a number of studies on disaster preparedness and mitigation, regional cooperation, gender and livelihoods. It has also organized several policy discussions and debates on institutionalizing and mainstreaming disaster risk reduction in development in South Asia. The most important, organized in collaboration with the National Institute of Disaster Management India and Practical Action Sri Lanka, was in New Delhi in 2006 – the South Asia Policy Dialogue. Here, policy makers, scientific and technical organizations, media, and civil society organizations adopted the Delhi Declaration which provided a vision and blueprint for disaster management in South Asia, particularly for SDMC which was established in New Delhi soon after. Duryog Nivaran took another pioneering initiative of bringing out the South Asia Disaster Report. The two editions of this report, released in 2006 and 2009, have added considerably to the understanding of disaster risk and vulnerabilities in South Asia.

United Nations organizations

Regional cooperation on disaster reduction has also been a priority of the United Nations and its various agencies, particularly following the Indian Ocean Tsunami. Their collaboration has been facilitated by UNISDR and ESCAP.

UNISDR, created in 1999, is the focal point in the UN System for disaster reduction activities. Following the Indian Ocean Tsunami in 2004 and the World Conference on Disaster Reduction in January 2005, in June 2005 UNISDR established an Asia-Pacific regional unit in Bangkok hosted by ESCAP. This has three areas of focus: (a) promoting the HFA and forging regional partnerships to facilitate its implementation; (b) following up and strengthening projects carried out under the

United Nations Flash Appeal for the Indian Ocean Tsunami Early Warning System; and (c) developing an effective regional information management system with comprehensive databases. UNISDR has also been supporting other regional organizations through a range of activities, including developing tools, methodologies and good practices for projects such as safety in schools and hospitals, and policy advocacy, knowledge management and networking. In addition, the agency has been supporting a number of campaigns, workshops and conferences on disaster risk reduction and enabling the participation of regional stakeholders.

The Asia-Pacific regional unit has also established the UNISDR Asian Partnership on disaster reduction (IAP). Through the IAP, national governments, regional intergovernmental and other organizations and the international organizations meet periodically to review the progress of implementation of HFA. The IAP also provides technical, operational and secretarial support for the implementation of decisions taken at the Asian Ministerial Conferences on Disaster Reduction.

The second principal source of regional coordination on disaster reduction is ESCAP. Set up in 1947, ESCAP has 53 member states and nine associate members and is charged with supporting inclusive and sustainable economic and social development. ESCAP focuses particularly on issues that are addressed most effectively through regional cooperation – which includes natural hazards and the management of disasters. To fulfil this objective the Commission has helped create a number of important regional institutions. These include: in 1957, the Mekong Committee which eventually grew into the Mekong River Commission; in 1968, the ESCAP/WMO Typhoon Committee whose 14 members work to minimize loss of life and property by typhoons; in 1971, the ESCAP/WMO Panel on Tropical Cyclones whose eight members have helped to improve tropical Cyclone warning systems in the Bay of Bengal and the Arabian Sea; and, in 1994, the Regional Space Applications Programme which enables countries to benefit from advances in space technology for disaster risk reduction.

ESCAP's most recent initiative has been the Tsunami Regional Trust Fund for developing a tsunami early-warning system in the Indian Ocean. By the end of 2009, the Fund had mobilized $12.7 million in contributions from the governments of Thailand, Sweden, Turkey and Nepal. The Fund has supported a number of projects, for disseminating and communicating warnings, for example, and for improving sub-national and community-level responses. Among other things, the Fund is supporting a Regional Integrated Multi-Hazard Early Warning System (RIMES) in the Indian Ocean and South-East Asia (Box VI-1).

In 2008, ESCAP established a Committee on DRR. At its first session in March 2009, this recommended, inter alia, that the ESCAP secretariat should: (a) continue to promote regional cooperative mechanisms and knowledge-sharing arrangements, including those on information, communications and space technologies; (b) establish an Asia-Pacific gateway on disaster risk reduction and development for information sharing and analysis (c) launch a publication focusing on best practices and lessons learned in various aspects of disaster risk reduction and management in the Asia-Pacific region; (d) further enhance partnerships and collaboration with UNISDR and other United Nations entities as well as regional and subregional organizations and (e) build regional consensuses to serve as inputs to major regional and global events.

In May 2008, following Cyclone Nargis, ASEAN, the Government of Myanmar and the United Nations established a working-level mechanism to facilitate collective efforts in urgent post-Cyclone Nargis humanitarian relief and recovery work. The Tripartite Core Group (TCG) of the ASEAN Humanitarian Task Force, which was formed immediately after the disaster, proved to be an effective model for cooperation between the three parties. One of the first TCG activities was to conduct a Post-Nargis Joint Assessment (PONJA), to determine the scale of the damage and provide the basis for humanitarian and recovery programmes. The results of PONJA were taken into account by UNOCHA when it launched a revised flash appeal for $482 million on 10 July 2008. ESCAP and ASEAN jointly assisted the TCG activates by organizing the 'Regional High-level Expert Group Meeting on Post-Nargis Recovery and Livelihood Opportunities' in October 2008 and the 'Post-Nargis Lesson Learning Conference' in August 2010 when the TCG mandate came to the end.

Various UN agencies also have significant regional programmes to support country offices and national governments. The UNDP Regional Centre in Bangkok, for example, focuses mainly on Crisis Prevention and Recovery and supports UNDP country offices in a number of cross-cutting areas of prevention and mitigation of disasters. The United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) also has a regional office for Asia and the Pacific to support regional organizations, governments, UN agencies, NGOs and other humanitarian actors in their responses to major disaster caused by natural hazards and can deploy staff with a range of technical expertise. The UNOCHA regional office also works to build response capacity by strengthening emergency preparedness. The UNESCO regional office in Bangkok has worked closely with UNISDR in promoting school safety and integrating disaster caused by natural hazards concepts in school curricula. WFP has recently established its first Humanitarian Response Depot in Asia, based in Subang, Malaysia. This is the fifth such hub in WFP's global emergency response arsenal and will provide storage and logistics support and services to UN and other humanitarian agencies in Asia, and possibly beyond. UNHCR also has considerable experience on relief management and has supported other agencies in the region.

Countries in the region can also rely on support from the multilateral development banks. The World Bank, for example, in 2006 created GFDRR – a trust fund through which it extends technical and financial support to UNISDR and other organizations for transborder risk reduction. In 2008, this facility also provided crucial assistance to ASEAN for coordinating international assistance to Myanmar following Cyclone Nargis.

Another major source of support is the ADB. In June 2004, ADB approved a comprehensive Disaster and Emergency Assistance Policy, with three main objectives: (a) strengthening support for reducing disaster risk; (b) providing rehabilitation and reconstruction assistance following disasters, and (c) leveraging ADB's activities by developing partnerships. In April 2008 this was complemented with an Action Plan that will embed disaster risk management within ADB's operational practices. Following the India Ocean Tsunami, for example, ADB reacted swiftly, creating the Asian Tsunami Fund with an initial $600-million contribution for financing rehabilitation, reconstruction, and associated development activities in the most severely affected countries – India, Indonesia, Maldives, Sri Lanka, and Thailand.

In April 2009, ADB established the Asia and the Pacific Disaster Response Fund to help countries offer life-preserving services to disaster-affected communities. This should bridge the gap between existing ADB loans and grants for hazard mitigation and longer-term loans for post-disaster reconstruction. ADB is further negotiating with regional organizations like SAARC and ASEAN to offer assistance for various regional programmes.

Pan-Asia-Pacific Cooperation

The Asia-Pacific region has always taken the lead in promoting disaster risk reduction globally. It was the Asian city of Yokohama, for example, that in 1994 hosted the first World Conference on Disaster Reduction which adopted the "Yokohama Strategy and Plan of Action for a Safer World: Guidelines for disaster caused by natural hazards Prevention, Preparedness and Mitigation". It was the Asian city of Kobe that in 2005 hosted the second World Conference on Disaster Reduction which adopted the HFA 2005-2015 – the world's only international legal instrument for disaster reduction. Asian leaders have also been meeting periodically to review implementation of the HFA and to discuss measures to enhance cooperation.

At the same time, governments of the region have been promoting cooperation across Asia through a series of biennial conferences. In 2005, China took the lead in convening the First Asian Conference on Disaster Reduction in Beijing, with delegations from 42 Asian and South Pacific countries, of which 33 were represented at ministerial level. The Conference adopted a framework of strategies and objectives, the Beijing Action for Disaster Reduction. The second conference was hosted by India in 2007, as what would be known henceforth as the Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR). The conference adopted the Delhi Declaration on Disaster Reduction in Asia which affirmed that the biennial conference would be expanded as the Regional Platform for DRR, with the participation of national governments, regional and subregional organizations, the UN agencies, IFIs and other stakeholders including civil society, scientific and technical organizations, the private sector and the media. Political leadership for the regional platform would come from the ministers in charge of disaster reduction, while technical, operational and secretarial support would be provided by the Asia-Pacific regional office of UNISDR. The declaration added that there would also be conferences at the subregional level. The Delhi Declaration thus ensured that decisions of the AMCDRR would be followed up on a continuing basis, with regular stakeholder consultations for implementing the HFA.

The same model was followed in the third conference in Kuala Lumpur, Malaysia in December 2008 and will be followed in the forthcoming fourth conference in Inchon, Republic of Korea in October 2010.

The Third AMCDRR was held in Kuala Lumpur in 2008. The Declaration here took the process further by highlighting six important issues: (a) public-private partnerships; (b) high technology and scientific applications including climate change adaptation; (c) involvement and empowerment of local governments and civil society; (d) mobilization of resources; (d) engaging the media; and (e) creating public awareness and education for disaster risk reduction. The Declaration invited the Asia-Pacific regional office of UNISDR, in collaboration with members of the IAP, to follow up on the Beijing, Delhi and Kuala Lumpur declarations by preparing a Kuala Lumpur Regional Action Plan (KLAP). The task of preparing the plan was entrusted to the ADPC, which has submitted a draft with seven components:

1. Accelerating HFA implementation through national action plans;
2. Empowering local government and civil society in DRR;
3. Mobilizing resources and promoting public private partnerships for DRR;
4. Linking climate change adaptation to DRR;
5. Protecting critical infrastructure
6. Public education, awareness and engaging the media in DRR; and
7. High technology and scientific application for DRR

For each component, there would be an implementation cluster, with a further cluster charged with steering the overall plan. Each cluster would comprise one or more lead mentor countries, one or more lead support agencies and several partner support agencies. The lead mentor countries would guide and direct the support agencies and help mobilize inputs and resources. Resources would be mobilized from five sources: national governments; ongoing DRR programmes being implemented in partnership with UN Agencies, bilateral donors, regional organizations and NGOs; new national DRR programmes implemented in relation to these components; synergistic implementation with ongoing regional programmes; and new regional programmes.

The draft KLAP, with such modification as may be decided by the IAP, is likely to be submitted to the fourth AMCDRR in Inchon in October 2010 for consideration and approval.

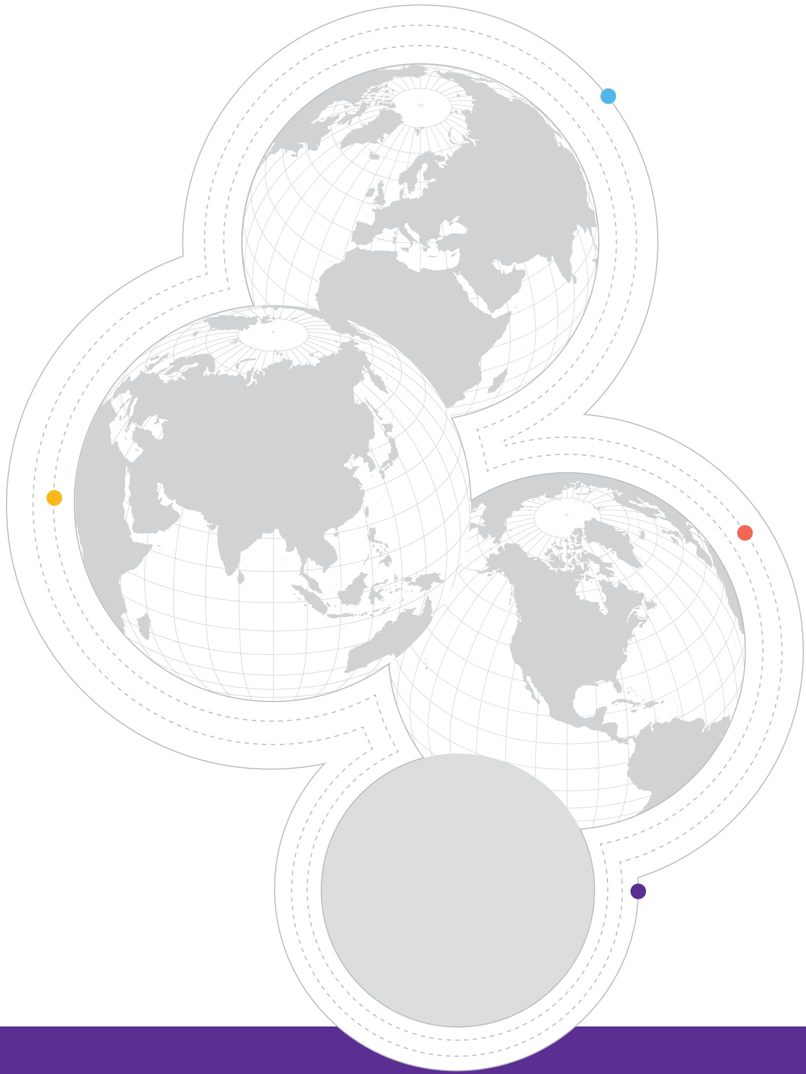
Looking forward

The Asia-Pacific region is the most vulnerable to disaster caused by natural hazards. But it has also resolved to reduce the risks of disasters through various initiatives taken at the local, national, subregional and regional levels. Progress has, however, varied between subregions. Some have created the legal-institutional framework for cooperation and for developing regional programmes and action plan, while other regions are still seeking viable models that would work in their prevailing political, security and economic situations.

Regional cooperation for implementing global framework for disaster reduction has also benefitted from the support of international organizations and multi-lateral funding institutions and various regional non-governmental stakeholders. This has created the necessary climate for more concerted action. There is now huge scope for sharing experiences across regions both within and outside the Asia-Pacific. The coming years will offer many more opportunities to make Asia and the Pacific safer from the risks of disaster caused by natural hazards.

Box VI-1 - Regional Integrated Multi-hazard Early Warning System

Regional Integrated Multi-hazard Early Warning System (RIMES) has evolved from the efforts of 26 countries to establish a regional tsunami early warning system within a multi-hazard framework, in the aftermath of the 2004 Indian Ocean Tsunami. ESCAP supported these efforts through the Tsunami Regional Trust Fund, which was established in 2005 with an aim to build and enhance tsunami early warning capabilities in accordance with the needs of Indian Ocean and Southeast Asian countries. The Fund has been a resource mechanism to narrow the capacity gaps in the region, through building institutional, technical, system-wide and other types of capacity for the development of early warning systems for tsunamis in a multi-hazard context. In addition to Cambodia, Comoros, Lao PDR, Maldives, and Seychelles, three more countries, namely, Bangladesh, Philippines, and Timor-Leste signed the RIMES Cooperation Agreement during the 66th Commission session of ESCAP in May 2010. The services provided by RIMES include the provision of regional tsunami watch information, capacity building and technology transfer in support of localized hydrometeorological disaster risk information, capacity building to respond to early warning information at the national and local levels. The RIMES products are viewed in a multi-hazard framework with regional, national and local elements of an end-to-end early warning system. In fact, RIMES works in conjunction with the national and regional tsunami watch providers in Australia, India, Indonesia, Malaysia, and share information with the Pacific Tsunami Warning Centre (PTWC) based in Hawaii and the Japan Meteorological Agency (JMA) in Tokyo.



Way forward

Way forward

Asia and the Pacific is a region vulnerable to natural hazards of almost every kind – from earthquakes to droughts, from floods to tsunamis. And with the prospect of climate change, the situation could become even more hazardous. The risks depend, however, not just on natural phenomena but also on the political, economic and social environment in which disaster events occur. This report considers ways of reducing vulnerability to disasters, building resilience and protecting hard-won development gains.

Over the period 1980-2009, Asia and the Pacific suffered 45 per cent of global disasters, 42 per cent of the economic losses and around 60 per cent of disaster-related deaths. Eighty-six per cent of the total population was affected by disasters. As might be expected, in terms of absolute numbers the countries worst affected tend to be the largest and most populous. In relative terms, however, the smaller countries can be the hardest hit. In 2008, Samoa, American Samoa and Tonga were among the world's top 10 countries and territories in terms of number of deaths per 100,000 inhabitants.

The most common form of disaster in the region is flooding, followed by cyclones, though the greatest loss of life has been from earthquakes. The Asia-Pacific region also experiences many frequent but low-level disasters that inflict serious damage for highly vulnerable populations.

Overall disaster risk depends on three factors: the natural "hazard"; the "exposure", which is the number of people and assets exposed; and the "vulnerability" which represents the capacity to cope and recover. For flooding, for example, the Asia-Pacific region has the world's top 10 most exposed countries and for cyclones six Asia-Pacific countries are in the top 10 – reflecting the high concentration of people living in river flood plains and deltas. Despite the efforts to improve multi-hazard warning systems, between the periods 2000-2004 and 2005-2009 the risks from these disasters do not appear to have been reduced.

Nowadays, disasters have increasingly been linked to climate change. While it is not possible to establish this relationship conclusively, there is evidence suggesting that climate change could affect GLOFs, droughts, extreme precipitation events, and forest fires.

Socio-economic impacts of disasters – threats to development

Disasters not only cause immediate economic damage and loss of life, but they also have a deep and lasting impact on development. People who are constantly exposed to natural hazards are more likely to stay poor, perpetuating a vicious cycle that can be extremely difficult to break.

Many disaster losses are direct – in terms of injuries and loss of life as well as physical damage. But they can also be indirect – through disruptions in the flow of goods and services that cause additional losses in earnings and jobs. There can also be secondary effects on economic factors such as GDP growth rates, indebtedness levels and fiscal deficits.

Almost everywhere the people most vulnerable are the poor. They often live in substandard housing in dangerous locations – on flood plains, riverbanks or steep slopes. Without secure land ownership rights, they also have less incentive to invest in risk reduction. And with limited livelihood opportunities they may be forced to over-exploit the environment, making both the environment and their situations even more vulnerable. As well as causing hardship and distress, disasters can also tip those on the brink of poverty into poverty.

Of even more concern is that typically most post-disaster efforts go into rebuilding the economy, even though the damage and loss can be even greater in the social sectors – a divergence that risks widening levels of inequity. There are concerns for health, for example, through contamination of water supplies, or for education, as schools are destroyed. Disasters also have profound psychosocial impacts, which frequently go underreported but in the long run can be even more insidious and destructive. Children may be especially vulnerable as they react differently to adults and may therefore not be recognized as experiencing psychosocial disorders. The elderly who are already susceptible to health problems and malnutrition deficiencies, may experience further vulnerabilities, especially if income support previously provided by children is no longer available or if the state has no social protection programmes in place. It is therefore incumbent upon state organs to anticipate these impacts by setting up social provisions of cash and in kind support for vulnerable groups prior to the occurrence of a disaster. Furthermore, social protection systems for the elderly should be seen in terms of compensation for the contributions that a long life brings to society – providing social protection for the elderly is therefore an issue of social justice.

The poor also have fewer opportunities to recover so in many cases the effects are permanent. When it comes to humanitarian assistance and reconstruction once again, some groups, such as women, children, the elderly and the disabled are often more vulnerable as humanitarian assistance and support for reconstruction tends to mirror existing societal inequities. For example, in 2008 in Cyclone Nargis in Myanmar women accounted for 61 per cent of deaths. Women are also affected differently during the recovery as caretakers; they have to take most responsibility for sick and injured family members while having less access to formal recovery assistance. Furthermore, the death or disability of a spouse may result in women becoming a family's sole source of income. Under these circumstances, children may also become vulnerable as they are forced to take on responsibilities that are not appropriate for their ages.

Overall, in the period 1980 to 2009 all Asia-Pacific subregions have shown some reduction in vulnerability. Progress has been fastest in South-East Asia though slower among the Pacific developing countries. There is thus nothing inevitable about a country's level of vulnerability to natural hazards: governments can help make their countries more disaster resilient.

Improving risk reduction further – scaling up vulnerability reduction

In the past, most governments typically considered disaster risk reduction within the framework of environmental assessments. Now, through the HFA and other initiatives at regional and national levels, the need for broader and more comprehensive socio-economic perspectives is moving up policy agendas. Since the poor are the most vulnerable, one of the key strategies for minimizing the impact of natural hazards should be the reduction of poverty. But this is unlikely to reduce disaster losses on its own. Indeed, even well intended development initiatives can unwittingly exacerbate existing forms of vulnerability or create new ones. Development action needs to centre on broader and more comprehensive strategies that address the complex and multifaceted nature of people's vulnerability to hazards. Disaster risk reduction will thus have to be considered within development frameworks with budgetary processes that address economic inequities, and social and environmental imbalances resulting from past development strategies.

Making adaptation more inclusive

As climate change adaptation action is mostly local, there is a need to link organized and autonomous (or independent) adaptation strategies and approaches. This will not only provide the necessary understanding of how to improve coping and adaptation strategies by communities already impacted by climate change, it will also support an enabling environment to make such practices sustainable and more effective by fostering better participation, incorporating indigenous knowledge and empowering those who are actually taking action.

Improving further vulnerability reduction along the lines of the HFA

The overall international strategy for reducing disaster risks is the HFA, 2005-2015. In response to this, a number of Asia-Pacific countries have produced comprehensive disaster risk management programmes or action plans along the lines of the HFA. They have also been making disaster risk reduction a more significant part of PRSPs. But there is still a long way to go. Governments have been slow to integrate disaster risk reduction and climate change fully into development planning and practice and for many programmes and projects, disaster risk concerns are generally limited to environmental assessments.

Disaster risk reduction and preparedness requires strong, capable institutions. Ideally, national disaster management offices should be located into ministries of planning. Here progress has been mediocre and there has been little political support for building coherent administrations. Disaster risk management policies also need to be supported by strong legislation, backed by enforcement in other areas including building codes, land use planning and environmental assessment.

Losses from disasters can be reduced substantially by making adequate preparations and establishing early-warning systems. These activities should be based on an understanding of local capacities and knowledge. Communities can work with governments on participatory risk assessment and integrate local knowledge and stakeholder perspectives into more technical assessments. This kind of participation can also be encouraged by introducing disaster risk reduction into school curricula.

In the past many countries lacked data on disaster-related losses, and did not have guidelines for systematic damage assessment. Now, however, more countries employ comprehensive disaster damage and loss and needs assessments, which they have been using to design appropriate relief and reconstruction programmes as well as to highlight the links between disasters, socio-economic development and growth.

The importance of community engagement to resilience building cannot be overemphasised.

Often such participation is limited to consultation. This is better than not engaging with communities at all, but does not contribute fully towards local empowerment and decision-making. It is also important to ensure that such consultations reflect the needs and priorities of vulnerable groups.

Cost-benefit analyses show that it pays to invest in risk reduction. Yet governments seem reluctant to do so, perhaps fearing that this will be expensive – and that the benefits may only be reaped many years ahead under the watch of succeeding administrations. But the costs may not be as high as feared. Disaster risk reduction can be less about expenditure than about a different attitude to development. It may, for example, only entail altering the design of a building, re-siting a road or altering an agricultural development project, with minimal cost implications.

For disaster preparedness and response, there are a number of budgeting options. Countries that experience frequent disaster losses every year could spread the budget over several years while making plans for catastrophic events to ensure that some funds are immediately available. At the same time, they will need to establish simple, low-technology but practical systems for tracking the use of relief and reconstruction funds that come from diverse sources.

Opportunities after a disaster - making the recovery resilient

Countries afflicted by disasters have to address immediate issues of relief and reconstruction. But they also have the opportunity to improve their arrangements for disaster risk reduction and make a resilient recovery.

One of the most important measures is to allow sufficient time. If the time frame is too short the danger is that the recovery processes may build back vulnerabilities or even increase them, while risk reduction will amount to little more than a series of add-on training programmes. A frequent problem is a conflict between donor time frames and real time frames: donors are under pressure to disburse funds quickly, typically within two or three years, whereas the recovery phase for a major disaster is likely to be three to five years.

The scale of financial resources available for recovery, especially from non-governmental sources, generally depends less on need and more on media attention. Governments can, however, also offer more resources of their own by rearranging their national development priorities. They should also be able to rely on funds from local governments and communities. Another option for financing the recovery is to twin provinces or municipalities. This involves pairing an economically strong local government with a less developed one.

Post-disaster planning should aim to ensure efficiency and public safety and take place swiftly so as to preserve social and economic networks. And, from the outset, authorities should be concerned with equity, since people with the fewest resources generally get less attention from aid organizations, and get it later. Organizations under time pressure also tend to overlook gender-specific needs and capacities. Instead gender concerns should be integral to all reconstruction programmes. Culturally and gender appropriate protection and mitigation strategies will not only promote gender equality and address gender-based vulnerabilities, but also ensure faster, deeper recovery.

Recovery provides an opportunity not just to reconstruct physical infrastructure but also to build on the community's inherent cultural and social resilience. For this to happen, however, local people need to be involved very early in the recovery process. This requires significant investments of time and human resources but results in greater client satisfaction, quicker disbursement, and greater local empowerment. One strategy is to support local networks – which may be as simple as enabling people to contact other members of the network.

Resilient recovery means compressing decades of development into a few years while reducing future risks, including those from climate change. But disasters themselves also offer opportunities to address the underlying risk factors from multiple hazards and to "build back better."

Capitalizing on new technology

Improving the gathering and sharing of hazard and risk information, early warning and awareness raising

The levels of risk and uncertainty arising from natural hazards can also be reduced by making full use of information and communication technologies. The most dramatic recent change has been the spread of cellular mobile handsets, most of which, in addition to telephony, can receive SMS messages; some have embedded GPS functions. Nevertheless, the most popular and depending on the location of the disaster, the most effective media for delivering information before and after disasters remain television and radio.

The starting point is to establish data baselines on hazards, vulnerabilities, exposures and possible disaster risks and impacts. Almost all countries in Asia and the Pacific have conducted risk mapping and assessments. But they can face severe limitations. Most hazard mapping is often at too low a resolution to address complex and dynamic risk patterns. Many countries also lack the appropriate data or capacity needed for complex modelling or for using remote sensing and GIS.

All these forms of communication, however, now depend critically on EO satellites. Almost all public operators of satellites, satellites in Asia and the Pacific, including those of China, India, Japan, the Republic of Korea, Thailand and Turkey, are committed to share their information during major disasters. During emergencies it is also important to ensure or expand local communications capacity. This can involve restoring or establishing wireless telephone and internet services, expanding the capacity of local cellular mobile systems and internet bandwidth to accommodate sudden increases in traffic, and deploying standby communication facilities to service links between field teams and their headquarters.

The uses of technology have benefited from a number of initiatives to share information and products. These include: Sentinel Asia which provides disaster-related satellite information and International Charter Space and Major Disasters which aims at providing a unified system of space data acquisition and their products for disaster response. There is also a UN Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER).

Cooperating across the region

Strengthening the enabling political environment for national level risk reduction

The hazards of nature are embedded deep in geography and geology, so disaster caused by natural hazards and climate change do not respect national boundaries. This means that the response must also be cross-national, but more specifically regional and subregional. Such cooperation can take place in many ways – through sharing knowledge, information and good practices; developing common frameworks and understandings; reaching agreements on common laws, institutions and protocols, and by pooling common resources – human, material and financial.

The principal means of cooperation is through regional intergovernmental organizations. In Asia and the Pacific, the most highly developed cooperation has been in South-East Asia under the aegis of ASEAN, which has a Regional Programme on Disaster Management and runs an annual emergency response simulation exercise. SAARC has also been active. It has developed a SAARC Comprehensive Framework on Disaster Management for South Asia and has established a Disaster Management Centre to assist countries in formulating policies, strategies, and disaster management frameworks. In the Pacific, the main vehicle for cooperation is SOPAC. The countries of the region have also adopted a subregional framework to accelerate policies, planning and programmes for disaster risk reduction taking a "whole of government" approach.

Disaster reduction is also supported by a number of other regional organizations. These include ADPC, which has members from 26 countries and aims to mainstream disaster reduction in development, build and strengthen capacity, and facilitate partnerships and exchange of experiences. In addition, there is the ADRC in Kobe, Japan, which establishes networks among 28 countries and has established the Sentinel Asia project. Another major regional resource is ICIMOD in Nepal. ICIMOD studies the dynamics of mountain ecosystems and livelihoods in the Hindu Kush-Himalaya region. Many local NGOs and civil society organizations have also supplemented government efforts and have developed significant coalitions and partnerships notably the ADRRN and Duryog Nivaran. At the same time, governments of the region have been promoting cooperation across Asia through the biennial Third AMCDRR which was held in Kuala Lumpur in 2008.

Regional cooperation on disaster reduction has also been a priority of ESCAP, for example, has been instrumental in founding a number of regional organizations and has been promoting mechanisms to help its members gain access technical tools and data on space, information and communication technology. One recent ESCAP initiative has been the Tsunami Regional Trust Fund for developing an early-warning system in the Indian Ocean.

Another major resource is UNISDR, which in 2005 established an Asia-Pacific regional unit in Bangkok. Among other activities UNISDR focuses on following up the HFA and on building a regional information management system with comprehensive databases. Other UN agencies also have significant regional programmes, including the UNOCHA, which deploys staff with a wide range of technical expertise.

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Photo Caption: **Young girl at home in Siem Reap, Cambodia**
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