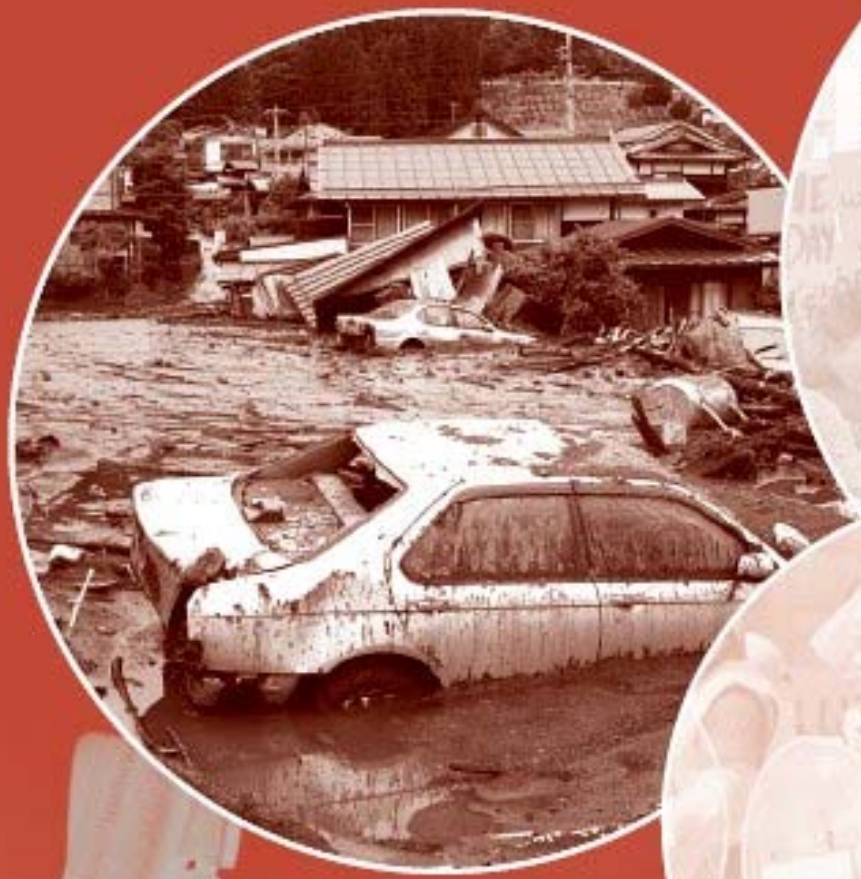


PART IV

NATURAL AND HUMAN-MADE DISASTERS

Over the last three decades, natural and human-made disasters have claimed millions of lives and caused huge economic losses globally. Cities, where half of humanity currently resides and much of the world's assets are concentrated, are fast becoming the locus for much of this destruction and loss from disasters. Rapid urbanization, coupled with global environmental change, is turning an increasing number of human settlements into potential hotspots for disaster risk. The 2005 South Asian earthquake, in which 18,000 children died when their schools collapsed, and the Indian Ocean Tsunami in 2004 that wiped out many coastal settlements in Sri Lanka, India and Indonesia, are testament to the risk that has accumulated in towns and cities and that is released when disaster strikes. Numerous other cases illustrate the suffering and losses experienced by urban dwellers due to natural and human-made disasters (see Box IV.1).

Part IV of this Global Report examines the consequences of natural and human-made disasters for safety and security in cities, and the policy options for preventing and reducing damage caused by these events. Disasters are defined as those events where human capacity to withstand and cope with a natural or human-made hazard is overwhelmed. The majority of the report focuses on large disasters that register direct impacts at the community level and above. However, the impacts of small-scale hazards, where direct impacts are limited to the individual or household levels, are illustrated through an examination of traffic accidents that result in over 1 million deaths worldwide each year, more than any large natural or human-made disaster type.

As highlighted in this part of the report, cities are particularly vulnerable to the effects of natural and human-made disasters due to a complex set of interrelated processes, including a concentration of assets, wealth and people; the location and rapid growth of major urban centres in coastal locations; the modification of the urban built and natural environment through human actions; the expansion of settlements within cities into hazard-prone locations; and the failure of urban authorities to regulate building standards and land-use planning strategies. As cities grow, disaster risk often increases through the rising complexity and interdependence of urban infrastructure and services, greater population density and concentration of resources. Yet, urban growth need not necessarily result in increased disaster risk.

Inequalities in the distribution of disaster risk and loss in urban areas are evident at the global, national and city levels: poorer citizens in cities of poorer countries are most at risk. Disaster impacts are also varied, depending upon what is considered to be at risk. In terms of absolute mortality and economic loss as a proportion of gross domestic product (GDP), regions dominated by low- and middle-income countries record high losses. Indeed, Africa and Asia have experienced the fastest rate of increase in the incidence of natural and human-made disasters over the last three decades. These are also among the world regions with the highest rates of urban growth, indicating that risk will increase in the future as populations grow. Absolute economic loss from natural and human-made disasters is highest in high-income regions such as North America and Europe, although Asia also records high loss in this respect. Indeed, high levels of economic development and political stability help to shift the impact of disasters from human to physical assets, as is evident in the case of Europe. This illustrates that disaster risk reduction planning, investment and management capacity are critical in shaping vulnerability in human settlements.

Disaster loss is also differentiated at the city level. A city's vulnerability to disaster impacts is shaped by its levels of economic development and disaster preparedness. The structure of the urban economy determines which actors bear the brunt of disasters, while its connectivity influences the global spread of impacts from one economy to another. At the individual level, disaster impacts vary according to social differentiation, with women, children, the elderly and the disabled being most vulnerable. The greatest vulnerability to disaster is, however, experienced by the 1 billion people forced to live in urban slums worldwide. People here are excluded from living and working in places protected by construction and land-use planning regulations and have the least assets to cope with disaster shocks. But the speed of urbanization can spread vulnerability to other social groups. For example, where building codes are not followed because of a lack of enforcement, disaster has claimed the lives of those living in the formal housing sector.

The aggregate impact of small hazards and disasters on urban dwellers can be considerable, as shown in this part of the report. Traffic accidents are the best documented of the small-scale hazards, killing over 1.2 million people annually worldwide. The World Health Organization (WHO) calculates the economic costs of traffic accidents to be 1 per cent of gross national product (GNP) in low-income countries, 1.5 per cent in middle-income countries and 2 per cent in high-income countries. Most deaths and injuries are

Box IV.1 Living through disaster in New Orleans, US

Long before Hurricane Katrina washed ashore, New Orleans was inundated with abject poverty, high crime rates, an inadequate education system and governance failures – or, in other words, high vulnerability. Situated as the city is – below sea level, nestled between Lake Pontchatrain, the Mississippi River and Lake Borgne – New Orleans is one of the most hazard-prone and vulnerable areas in the US. The events stemming from 29 August 2005 only re-emphasized the folklore that defines the character of New Orleans as the 'city that care forgot'. For more than two weeks after Katrina struck, 80 per cent of the city remained under water. In addition to 1300 deaths, 350,000 displaced victims were scattered throughout the US. One citizen described her experience:

> *I knew the world was coming to an end… It was me, my husband and daughter. Water was up to my neck. My husband had my [little] girl on his shoulders and we were just holding on to a tree. The water was flowing so hard, it was gushing and gushing. I just prayed for it all to happen quickly if we were going to die.*

As problems of saving victims or restoring order came to characterize the unfolding events of Hurricane Katrina, government and public agencies ceased addressing and meeting the basic human needs of residents in the Superdome and Convention Center to employ tactical response to civil unrest, further thwarting and prolonging safety and security measures designed to protect and assist citizens. As one citizen (a white male, aged 62) explained:

> *Of this whole frightening catastrophe, the police and the military soldiers had me more afraid than anything. I was in a boat trying to help people to the foot of the bridge, when someone said: 'Don't move!' They pointed their rifles at me and asked what was I doing in New Orleans and told me I had to immediately leave the city. I just went home and sat by the door with my wife and my guns. I never would have stayed if I knew that water would get that high all over the city.*

Whether trying to remember or forget, the New Orleans community persists in seeking innovative tactics to return home and find home elsewhere. Seeing that residents remain plagued with no definitive plan from city and state government, nor direct consistent assistance from the federal government, they have assembled and created networks and communities committed to returning home and rebuilding. An African–American female waiting for the possibility to return commented:

> *I know the city will never be the same. But this [is] all I know. I can't wait to get out of Dallas. Those people are tired of helping us. I was able to gut out my house in the east; but who knows when they're going to put on electricity. All my clothes were destroyed. The only thing I am bringing back is plenty of red beans. I got two suitcases full. Everybody told me: bring back red beans! Bring back red beans!*

Is it smart and safe to rebuild the city considering it is 2 metres below sea level and surrounded by water on three sides? Without adequate technological intervention and government funding, the wetlands continue to erode, levee structures remain weak and the city remains vulnerable to more disasters. Nonetheless, since the onset of this catastrophe, community groups and neighbourhoods are participating in rebuilding and reconstruction efforts, determining their own immediate and longstanding opportunities. For example, residents of the Ninth Ward took the initiative and collectively orchestrated a demonstration that halted demolition and bulldozing of their property. One Ninth Ward resident said:

> *I don't care if the government don't give me a dime to help me rebuild: I got this property from my parents; I lived here my whole life, raised six kids here and I am going to die right here. They can bury me right by mama and daddy in the graveyard five blocks away. I'm staying in a hotel in Metarie now, just waiting for the city to get the electricity on in this area (the Ninth Ward). I'm on the list for my FEMA trailer, so I'll be in good shape with or without help; but I ain't waiting on nobody to ask if I can live on my property. I know this looks real bad; but we gonna make them do right by us. We can't let them destroy a whole city.*

Source: Washington, 2007

caused by motorized vehicles, with other road users – pedestrians and cyclists, in particular – being mostly victims. In cities where vehicle ownership is high, car drivers are also among those suffering high levels of loss.

Despite their destructive powers, disasters in urban areas are yet to receive the attention they merit within the field of urban development planning. Indeed, disasters are neither pure natural events nor acts of God, but, rather, products of inappropriate and failed development. Thus, this report takes a risk reduction approach that calls for both small- and large-scale disasters to be seen as problems of development, requiring not only investments in response and reconstruction, but also changes in development paths to reduce or minimize the occurrence and impacts of disaster *ex-ante*. Building on this understanding, a growing number of community groups, non-governmental organizations (NGOs), urban authorities and governments are active in findings ways of reducing the disaster risk that has accumulated in cities.

Mapping disaster risk and its constituent elements of hazard, vulnerability and resilience, or capacity to cope, is a fundamental element of any strategy to reduce risk. This is the case at local as well as urban and national levels. Risk mapping in urban contexts is complicated by the many overlapping hazard types and the dynamism of the social and economic landscape. Great advances in mapping have been made by the application of remote sensing and geographic information systems (GIS), and by the development of participatory mapping methods. However, great inequalities in hazard assessment capacity are also evident. Poorer countries and urban authorities lack the necessary skills and resources to undertake risk assessments. A lack of data to complement assessment techniques, such as census data, poses an additional challenge to risk assessment. Participatory approaches present opportunities for overcoming some of these challenges by enabling communities to have greater control over information and interventions, thereby enhancing their resilience.

One of the key trends observed in this part of the report is that strengthening local resilience or the capacity of local actors to avoid, absorb or recover from the shock of disasters through targeted interventions is now recognized as a vital component of risk reduction. Resilience is closely linked with access to economic, social, political and physical assets, and is constrained by the institutional environment of the city and its wider political–administrative context. Enhancing social networks of support and reciprocity is one way of improving local resilience. Legal frameworks can also be used to invoke the rights of communities to protection and access to resources during and after disasters. Also important is the strengthening of household economies through finance provision and support of livelihood activities. Challenges to the building of local resilience remain; yet, innovative strategies, such as piggybacking risk reduction onto existing local activities, present opportunities.

The availability of information on hazards and vulnerability enables effective early warning (and its four components of knowledge, monitoring and warning, communication and response capacity) in the face of disaster risk. Although significant gains have been made in collating scientific information on approaching risks and hazards, communicating this information to risk managers in a timely and appropriate manner has not been easy. It is also important that information flows are transparent and clear and help to build trust between those communicating and receiving the information. Where information on imminent hazards has not been available or failed to be communicated, potentially avoidable losses have been magnified unnecessarily. Evidence suggests that the more localized early warning and response knowledge can be, the more resilient these systems are in times of disaster. Successful examples of people-centred early warning systems that build communication systems on top of existing networks used in everyday activities exist and are highlighted in this part of the report.

The concentration of infrastructure and buildings in cities, including their spatial layout, is a key source of vulnerability in the face of disasters. However, with adequate planning and design, capacity for regulation, and commitment to compliance or enforcement, potential risks in the built environment of cities may be reduced. For instance, a fundamental tool for integrating disaster risk reduction within urban development initiatives is land-use planning. Likewise, building codes are essential for ensuring safety standards in components of the urban built environment. Yet, enforcement and implementation of these guidelines and regulations remain problematic. Particularly challenging is planning in small urban centres where resources are limited, but population growth (often into new areas of risk) is rapid, and in informal or slum districts of large cities where there is limited power to enforce land use. In both cases, greater inclusion of those at risk in land-use and planning decision-making offers a way forward. Imaginative thinking to overcome the challenge of land-use planning implementation has included suggestions that, as well as being enforced by law, building codes should operate on a system of incentives and support for training of informal-sector builders.

Protecting critical infrastructure and services will influence response and reconstruction capacity in the period after a disaster has struck a city. The potential for cascading events to affect multiple infrastructure systems makes it paramount that critical infrastructure and services are protected and, where possible, managed independently of each other to prevent contagion effects. However, networks of communication and exchange between such services are vital in ensuring a certain minimum level of functioning during and after a disaster.

In the post-disaster period, municipal authorities and local governments are best placed to coordinate relief and reconstruction efforts. Partnerships with community groups and international development and humanitarian agencies are necessary in pre-disaster planning, which is needed in allocating responsibilities and developing operating guidelines for relief and reconstruction. Reconstruction should also be seen as an opportunity to build risk reduction into development. However, reconstruction programmes may even fail to return survivors to pre-disaster conditions. Useful lessons on integrating long-term development goals within reconstruction work are emerging from recent disasters, such as the 2004 Indian Ocean Tsunami. Where development and humanitarian agencies have worked together, as in the involvement of UN-Habitat in the reconstruction of parts of Pakistan following the 2005 earthquake, there are more grounds for optimism.

The difficulties faced by national and city governments in obtaining funding for risk reduction or reconstruction can (and do) preclude the development of relevant policies in these areas. Moreover, national budgets tend to prioritize relief and reconstruction activities. Likewise, much of the funding provided by international organizations and governments for disasters through bilateral and multilateral channels is mostly for recovery and reconstruction activities. Some governments do not set aside budgets for relief and reconstruction activities, but rather draw on contingency funds in the aftermath of a disaster. During recent years, however, the value of investing in risk reduction is being recognized and reflected in international and national funding for disaster-related interventions. This is partly due to evidence illustrating significant cuts in the economic, social and environmental costs of disaster where a risk reduction approach is adopted.

As in the case of natural and human-made disasters, risks arising from traffic accidents can be prevented and/or minimized through targeted policies and interventions. Transport and urban planning, promotion of safe road-user behaviour and traffic management are some of the key strategies for improving road safety. Without building the necessary institutions and awareness for road safety, however, vulnerability to road traffic accidents cannot be reduced. It is equally important to collect and disseminate traffic accident data in order to formulate relevant policies, legislation and interventions. An important trend in recent years is that road safety has gained prominence globally, as is evidenced by extensive international cooperation in this area.

This part of the report considers the multiple aspects of risk in urban areas today associated with natural and human-made disasters. In doing so, Chapter 7 provides an overview of global trends in the incidence and impacts of natural and human-made disasters, as well as those urban processes that contribute to the generation of risk. Subsequently, Chapter 8 reviews existing policy approaches for reducing disaster risk and incorporating risk reduction within urban management and disaster response and reconstruction. Chapter 9 then examines the trends – including policy trends – and impacts of road traffic accidents as an example of hazards threatening the safety and security of urban dwellers on a day-to-day basis.

CHAPTER 7

DISASTER RISK: CONDITIONS, TRENDS AND IMPACTS

Disasters in urban areas are experienced when life support systems fail in the face of pressure from external stress, resulting in loss of life, damage to property and the undermining of livelihoods. However, they are not natural events or 'acts of God', but products of failed development. For the majority of people at risk, loss to disaster is determined more by processes and experiences of urban development and governance than by the physical processes that shape natural or human-made hazards.

This chapter presents an overview of global trends in the incidence and impacts on cities of disasters associated with natural and human-made hazards. In this context, natural hazards include earthquakes, hurricanes, tsunamis, tornadoes, landslides, floods, volcanic eruptions and windstorms, while human-made hazards encompass explosions and chemical releases. However, the conceptual distinction between disasters associated with natural and human-made hazards is increasingly becoming blurred, as many human actions and practices, such as the construction of human settlements in flood-prone areas or on the slopes of active volcanoes, exacerbate human-made hazards. While the focus here is primarily on large-scale disasters that register direct impacts at the community level and above, the characteristics of small-scale disasters whose impacts are largely felt at the individual or household levels are reviewed.

Epidemic diseases and environmental health are not discussed herewith, nor are acts of war. This is because while these forms of stress impact upon the built environment, human health and political systems, the balance of impact is different in each case. It is natural and human-made hazards that most frequently threaten urban sustainability through damage to buildings and critical infrastructure. The focus on natural and human-made disasters also responds to global trends in increasing numbers of such events, in people affected and made homeless by disaster, and in the economic impacts of disaster, especially on the poor and marginalized.

An overview of the relationships between urbanization and disaster risk, human vulnerability and loss (or outcome) is presented below, once key disaster terms are defined. This is followed by a detailed discussion of the distribution of disaster loss associated with natural and human-made hazards worldwide and across cities. The economic and social outcomes, or impacts, of disasters, including the disproportionate impacts on the poor and marginalized, the aged, the very young and women, are then reviewed. Subsequently, factors generating urban disaster risk and contributing to human vulnerability, including modification of the urban environment, planning and construction techniques, urban finance and poverty, are examined. Finally, a regional comparison illustrates variation in conditions, trends and impacts of urban disaster risk globally.

DISASTER TERMINOLOGY

In addition to the terms introduced in Chapters 1 and 2, terminology specific to disaster risk is first presented here to identify what a disaster is and its component parts, and then to identify elements of disaster risk management (see Box 7.1). It is important not to confuse the definition of terms here with meanings attributed to these terms in sister disciplines. For example, in the international development community, 'vulnerability' is commonly used in reference to economic poverty, whereas here vulnerability refers to exposure and susceptibility to harm from natural or human-made hazards, also referred to as 'risky events' in the conceptual framework presented in Chapter 2.

A disaster is understood here to be the outcome of a vulnerable individual or society being hit by a human-made or natural hazard. The vulnerability of an individual or society is reduced through short-term coping and longer-term adaptation that adjust human actions to minimize risk impacts or outcomes.

Disaster management is seen as best undertaken through a disaster risk reduction approach. Here, disaster risk is addressed at a number of stages. Before hazards occur, underlying physical and technological processes can be contained through mitigation. Unfortunately, in most societies, mitigation is not sufficient and residual hazard remains. Reducing risk from residual hazard requires preparedness, including education, risk assessment and early warning and evacuation planning. Disaster response takes place in the first hours and days after a disaster and

Box 7.1 Key terminology

Disasters and their component parts

Disaster: a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses that exceed the ability of the affected community or society to cope using its own resources. A disaster is a function of risk processes. It results from a combination of hazards, human vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.

Natural disaster: a serious disruption to human systems triggered by a natural hazard causing human, material, economic or environmental losses that exceed the ability of those affected to cope.

Human-made disaster: a serious disruption to human systems triggered by a technological or industrial hazard causing human, material, economic or environmental losses that exceed the ability of those affected to cope.

Natural hazards: natural processes or phenomena occurring in the biosphere that may constitute a damaging event. Natural hazards can be classified by origin (geophysical or hydro-meteorological), and they can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.

Human-made hazards: danger originating from technological or industrial accidents, dangerous procedures, infrastructure failures or certain human activities that may cause the loss of life or injury, property damage, social and economic disruption, or environmental degradation. Examples of human-made hazard include industrial pollution, nuclear activities/accidents and radioactivity, toxic wastes, dam failures, and industrial or technological accidents (explosions, fires and spills).

Human vulnerability: the conditions determined by physical, social, economic and environmental factors or processes that increase the exposure and susceptibility of people to the impact, or outcomes, of hazards.

Coping capacity: the means by which people or organizations use available resources and abilities to face identified adverse consequences that could lead to a disaster. In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities builds resilience to withstand the effects of natural and human-induced hazards.

Adaptation: adaptation refers to human action taken to reduce exposure or sensitivity to hazard over the long term.

Managing disaster risk

Disaster risk reduction: an overarching term used to describe policy aimed at minimizing human vulnerability and disaster risk to help avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards within the broad context of sustainable development.

Mitigation: structural (e.g. engineering) and non-structural (e.g. land-use planning) measures undertaken to limit the severity or frequency of natural and technological phenomena that have the potential to become hazardous.

Preparedness: activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations.

Response: the provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term or protracted duration.

Recovery: decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk. Recovery affords an opportunity to develop and apply disaster risk reduction through rehabilitation and reconstruction measures.

Resilience: the capacity of a system, community or society potentially exposed to hazards to change by coping or adapting in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction.

Source: adapted from ISDR, 2004a

… cities experience both large and small disasters, but the latter are seldom systematically recorded and often ignored…

addresses the basic needs of survivors. As soon as possible, and often with some overlap, disaster response is followed by the more developmental agenda of recovery.

At all stages, from pre-disaster to relief and recovery, there are opportunities to address the root causes of human vulnerability, such as (among others) unsafe housing, inadequate infrastructure, poverty and marginalization. Bringing these elements of risk reduction together can help to make individuals, groups and cities more resilient.

THE SCALE OF DISASTERS

Most cities experience both large and small disasters, but the latter are seldom systematically recorded and are often ignored, even by the local news media. More often than not, there is no mention of 'small disasters' in the policy statements of government or non-governmental organizations (NGOs).[1] Yet, for those involved, small events can be as destructive as large events causing injury and death and undermining livelihoods. The impact of small disasters is particularly worrying because, while there is no systematic data, many commentators argue that the aggregate impact of small events in cities exceeds losses to the low-frequency, high-impact hazards that capture news headlines.

There is no agreed upon definition, such as the scale of human or economic loss, for what makes a disaster small or large. In practice, the scale ascribed to a disaster is context dependent. Ten people being killed by a landslide in

Rio de Janeiro might be considered a small event by urban authorities; but the same event in the much smaller city of Castries, Saint Lucia, may well be considered of national significance. Table 7.1 outlines those characteristics that can be used more objectively to identify similarities and differences between small and large disasters.

Human vulnerability also plays a large role in determining the scale of disaster. Small hazard events can be turned into large disasters where high vulnerability means many people are at risk, emergency response is inadequate and critical infrastructure is fragile. Where vulnerability is low, emergency services are adequate and critical infrastructure is resilient, large disasters can be avoided even from large hazards.

Successive disasters can reduce the resilience of people or households to subsequent shocks and stresses. Small disasters can pave the way for large events by eroding people's assets and the integrity of critical infrastructure, progressively lowering society's thresholds of resilience.[2] Large events that damage critical infrastructure or urban economies will similarly undermine the capacity of individuals or emergency services to resist even everyday hazards, potentially making small disasters more frequent.

Everyday hazards may be hard to avoid for those at risk and, indeed, become an intrinsic part of livelihood and survival strategies. In this way, everyday hazards and small disaster losses can mistakenly become accepted as an expected part of life. In turn, this can have the perverse effect of lowering the willingness of individuals at risk or development agencies to invest in risk reduction,[3] thus creating a vicious circle where poverty and marginalization coincide with disaster risk.

Everyday hazards and small disasters differ from large disasters in that they are often seen as a problem of technological efficiency and infrastructure management – in other words, as problems of development. This has two consequences. First, everyday hazards tend to be managed by specialists from diverse fields, including engineering, medicine, land-use planning and chemistry, making integrated risk reduction more difficult. Secondly, social dimensions are easily overlooked by technological professions and planning agencies that dominate these areas of work.

Episodic hazards and large disasters pose an even greater challenge to sustainable urbanization. This is because they are too often seen not as problems of development, but as problems for development. Predominant strategies for dealing with risk and loss from large disasters focus on emergency response and reconstruction – not in addressing underlying failures in development that lead to human vulnerability. The risk reduction approach taken by this Global Report calls for small and large disasters to be seen as problems of development, requiring changes in development paths as well as in disaster response and reconstruction to build resilient human settlements.

	Small disasters	Large disasters
Scale of risk	Individuals and small groups	Communities, city regions, cities, global
Systems at risk	Individual health and livelihoods, subcomponents of critical infrastructure, local economic or ecological systems	Social stability, critical infrastructure, urban economies, ecosystem services
Examples of associated trigger hazard	Localized hazard events such as tidal flooding or irresponsible driving	Widespread hazard events such as a severe earthquake or major release of toxic chemicals
Frequency of hazard event	High ('every day')	Low ('episodic')
Strategic importance to development planning	Aggregate loss high	Huge loss from individual events
Data sources	Emergency services, local news media	National and international emergency relief agencies and news media
Dominant actors in response	Family, neighbours, emergency services	Family, neighbours, emergency services, military or civil defence, national and international humanitarian actors

Table 7.1

Small and large disasters

URBANIZATION AND DISASTER RISK

The last decade has seen an unprecedented number of disaster events unfold worldwide. The global incidence and impacts of disasters from 1996 onwards illustrates extensive damage both in terms of mortality and economic losses (see Table 7.2).[4] Transport accidents[5] and floods were the most frequently reported disasters. Impacts were highest for natural disasters, with earthquakes and tsunamis being the deadliest. Floods and windstorms accounted for the greatest number of disaster events and also affected the greatest number of people. Windstorms were most costly compared to other disaster types. Even with a time span of ten years, comparing the frequency and impacts of disaster types can be problematic. Large infrequent events, such as the Indian Ocean Tsunami, or individual flood or earthquake events can distort aggregate measurements of impacts associated with each hazard and disaster type. Far longer time spans would be needed to capture infrequent disaster types. However, longer time spans would subject disaster impact data to the effects of changing underlying human development contexts, including urbanization.

In the new urban millennium, natural and human-made disasters are likely to have their greatest impact in cities...

In the new urban millennium, natural and human-made disasters are likely to have their greatest impact in cities where half of humanity is expected to reside. The world will become predominantly urban, with the total urban population expected to reach 5 billion by 2030, while rural populations will begin to contract from 2015 onwards.[6] The location of major urban centres in coastal areas exposed to hydro-meteorological hazards and in geologically active zones is an additional risk factor. The concentration of

Table 7.2

Global extent and impacts of disasters by hazard type (total 1996–2005)

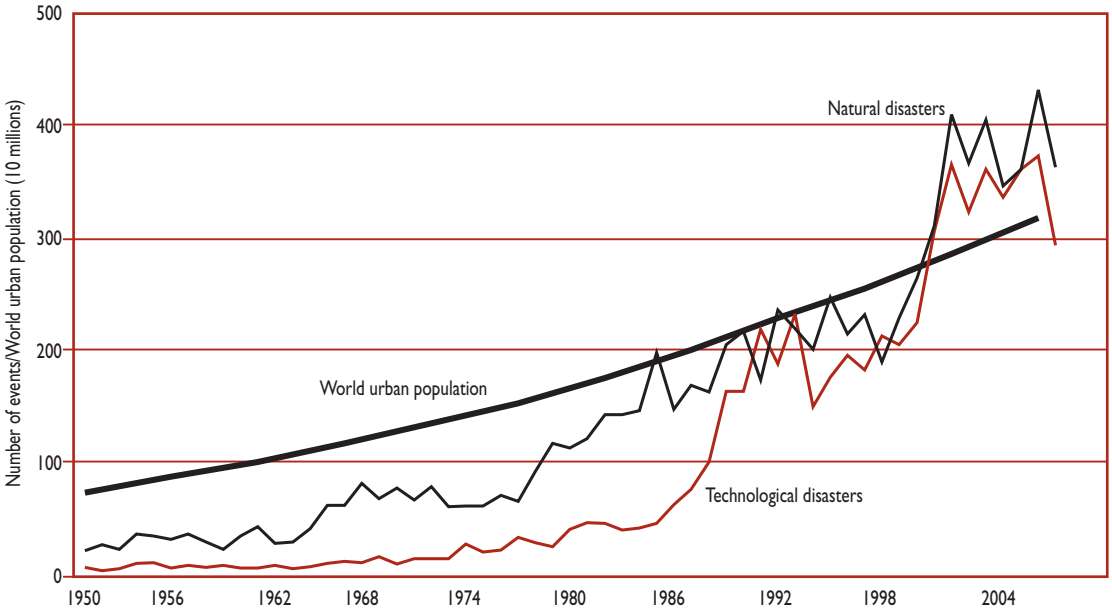
Source: EM-DAT, CRED database, University of Louvain, Belgium, www.em-dat.net

	Number of events	Mortality	People affected	Economic damage (US$ millions, 2005 prices)
Avalanches/landslides	191	7864	1801	1382
Earthquakes, tsunamis	297	391,610	41,562	113,181
Extreme temperatures	168	60,249	5703	16,197
Floods	1310	90,237	1,292,989	208,434
Volcanic eruptions	50	262	940	59
Windstorms	917	62,410	326,252	319,208
Industrial accidents	505	13,962	1372	13,879
Miscellaneous accidents	461	15,757	400	2541
Transport accidents	2035	69,636	89	960

Figure 7.1

Recorded disaster events and world urban population (1950–2006)

Data Sources: EM-DAT, CRED database, University of Louvain, Belgium, www.em-dat.net; United Nations, 2005



...the 1 billion slum dwellers worldwide, who reside in hazardous locations within cities... are perhaps most vulnerable to the impacts of disasters

economic assets, cultural heritage, infrastructure, services and basic life-support systems, industries and other potentially hazardous establishments in cities further exacerbates disaster risk and impacts. The growing numbers of the urban poor, especially the 1 billion slum dwellers worldwide, who reside in hazardous locations within cities such as industrial waste sites, floodplains, riverbanks and steep slopes, are perhaps most vulnerable to the impacts of disasters. As indicated earlier in Chapter 2, increasing urban poverty and exclusion also worsen the vulnerability of some urban inhab-

Box 7.2 The urban impacts of Mozambique's great flood

In February 2000, floods in Mozambique killed at least 700 people, displaced 650,000 and affected 4.5 million. Arguably, it was Mozambique's small but growing urban populations who were hardest hit, with more than 70 per cent of all flood-related deaths occurring in urban areas.

Extensive deforestation contributed to flood risk in Mozambique, where between 1990 and 2000, an average of 50,000 hectares of forested area were depleted annually. Urban land-use plans and codes in existence prior to the 2000 flood were not adhered to, often resulting in the spontaneous occupation of plots and building of roads in unsuitable areas and, in the long term, a cumulative process of soil erosion. Mozambique's experience during the 2000 floods must also be situated in both its circumstances of significant poverty, debt and post-conflict recovery from the 16-year civil war. The war internally displaced 3 million people and destroyed vital infrastructure, while pushing people towards urban centres.

The urban poor within Maputo, Matola, Xai-Xai and Chokwe suffered the most from the 2000 flood. Exorbitant pricing and highly politicized land distribution force many poor urban residents to live in informal settlements and unregulated slums, known as *barrios*, constructed in undesirable and hazardous locations such as in ravines, slopes susceptible to landslides and low-lying areas prone to flooding. In addition, the majority of *barrios* are constructed with locally accessible materials, such as bamboo and straw, that easily collapse easily beneath torrential rains and get washed away in flooding. The lack of drainage infrastructure in Maputo has also meant that seasonal one-day rain events can result in flooding that lasts for days, and rain over the course of several days can cause flooding that will not subside for a month.

The 2000 flood reached disastrous proportions when torrential rainfall brought on flooding in the Incomati, Umbeluzi and Limpopo rivers that flow within the Maputo and Gaza provinces. Accumulated rainfall, as well as Cyclone Eline, which hit Inhambane and Sofala provinces during the month of February, caused flooding in the cities of Maputo, Matola, Chokwe and Xai-Xai. The flooding of the latter two cities within the Limpopo River basin was responsible for the majority of the fatalities. Post-flood evaluations revealed that within the urban areas affected, flooding and rains had damaged the physical infrastructure and production capabilities of over 1000 shops and wholesalers in the river basins.

The 2000 flood also caused extensive damages to productive sectors in Maputo, the hub of Mozambique's industrial production, and Matola, a major industrial centre and the country's primary port. Destruction in Xai-Xai, the capital of Gaza Province and a coastal city, dealt a blow to fishing and tourism industries. The destruction of roads linking Maputo to neighbouring countries not only halted trade, but prevented the distribution of relief supplies. Across Mozambique's urban economy, food prices rose rapidly in response to losses in the countryside. Yet, by incapacitating Mozambique's transportation infrastructure, the floods had wiped out critical linkages to less affected Mozambican areas, impeding or preventing delivery of available foodstuff to urban areas that had few other options to secure food sources.

Source: Chege et al, 2007

Table 7.3

Selected recent natural disasters affecting human settlements (1972–2005)

Year	Location/area	Country	Hazard	Mortality	Economic losses (US$ billion)	Comment
2005	Northwest Frontier and Pakistan-controlled Kashmir	Pakistan (also affected: India-controlled Jammu and Kashmir and Afghanistan)	South Asian earthquake	73,000 (in Pakistan)	5.2	Collapsed schools killed 18,000 children; 2.8 million made homeless
2005	New Orleans	US	Flood and Hurricane Katrina	1863	81.2	The costliest natural disaster in US history
2004	Banda Aceh	Indonesia	Indian Ocean Tsunami	70,000	–	Complete destruction of coastal settlements
2004	Bam	Iran	Earthquake	31,000	–	World Heritage historic city destroyed
2003	European cities	Europe	Heat wave	35,000 to 50,000	–	Impacts worst in cities; the elderly were most vulnerable
2002	Dresden (and other cities on the Elbe River, as well as the Danube)	Germany (also Hungary, Slovakia and the Czech Republic)	Flood	90	–	30,000 evacuated in Dresden; cultural assets damaged
2002	Goma	Democratic Republic of Congo	Volcanic eruption	47	–	>100,000 made homeless; 25% of city destroyed
2001	Gujarat	India	Earthquake	20,000	5.5	1.2 million made homeless
2000	Maputo, Chokwe, Xai-Xai and Matola	Mozambique	Flooding	700	–	4.5 million affected
1999	Caracas and coastal Venzuela	Venezuela	Flooding and landslides	Up to 30,000	1.9	5500 homes destroyed; rains in 2000 left another 2000 homeless
1999	Orissa and coastal settlements	India	Cyclone	>10,000	2.5	130,000 people evacuated
1999	Izmit	Turkey	Marmara earthquake	15,000	12	Failure to enforce building codes a significant cause
1998	Tegucigalpa, Honduras and many smaller settlements in Honduras and Nicaragua	Honduras and Nicaragua	Hurricane Mitch	11,000–20,000	5.4	Flooding and landslides caused most loss
1998	Dhaka	Bangladesh	Flood	1050	4.3	
1998	Gujarat and coastal settlements	India	Cyclone	Up to 3000		2938 villages affected
1992	South of Miami	US	Hurricane Andrew	65	26	
1991	Coastal settlements	Bangladesh	Cyclone	138,000	–	Three times as many women as men were killed
1988	Spitak and surrounding towns	Armenia	Earthquake	25,000	–	500,000 homeless; Spitak, a city of 25,000, was completely destroyed
1985	Mexico City	Mexico	Earthquake	At least 9000	4	100,000 made homeless
1985	Santiago	Chile	Earthquake	180	1.8	45,000 dwellings destroyed
1976	Tangshan	China	Great Tangshan earthquake	Around 300,000	–	180,000 buildings destroyed
1972	Managua	Nicaragua	Earthquake	>10,000	–	Core of city completely destroyed

…the number of recorded disasters is increasing as the number of people living in cities increases

itants to disaster risk. Such processes underlying the vulnerability of urban areas to disaster are examined in greater detail later in this chapter.

Despite such risk factors, vulnerability to disaster remains largely underestimated in urban development.[7] There is no dedicated global database with which to analyse urban disaster events or losses. Indeed, few countries or cities systematically record disasters. Existing evidence does, however, indicate an upward trend in the annual number of natural and human-made disaster events reported worldwide, and a similar upward trend for global urban population since 1950 (see Figure 7.1).

No simple causal link between urban growth and reported worldwide disaster occurrence can be made from such data; but it is clear that the number of recorded disasters is increasing as the number of people living in cities increases. Given these trends, it is not unreasonable to conclude that, without major changes in the management of disaster risks and of urbanization processes, the number of urban disasters will also increase in the future.

An account of the urban costs of flooding in Mozambique illustrates the complexity of factors exacerbating urban disaster risks (see Box 7.2). The high levels of risk that have already accumulated in urban societies due to a complexity of factors means that, even with risk reduction activity being undertaken today, disaster risk is set to increase in the foreseeable future. Furthermore, recent events continue to show weaknesses in the ability of governments and of the international community to protect their citizens from, and to respond to, disaster. Experience from recent disasters also points to a central role for sustainable human settlements planning and management in risk reduction.

Experience from recent disasters … points to a central role for sustainable human settlements planning and management in risk reduction

Table 7.4

Selected recent human-made disasters affecting human settlements (1984–2006)

Note: Transport disasters and traffic accidents are included.

Year	Location/area	Country	Hazard	Mortality	Comment
2006	Lagos	Nigeria	Explosion in an oil pipeline	200	
2005	Jilin	China	Explosion in a chemical plant		>10,000 people evacuated; an 80km long toxic slick resulted
2001	Toulouse	France	Explosion in a fertilizer factory	31	650 seriously injured
1999	New Jalpaiguri	India	Two trains collide	>200	
1995	Seoul	South Korea	Department store collapsed	421	>900 injured
1994	Baltic Sea	Estonia	Sinking of ferry	859	Worst post-war European maritime disaster
1993	Bangkok	Thailand	Fire	188	500 seriously injured; most casualties were women
1986	Chernobyl	Russia	Nuclear power plant explosion	56	Evacuation and resettlement of 336,000 people; continental radiation impact
1984	Bhopal	India	Accidental release of toxic gases	>15,000	Up to 60,000 injuries

Since 1975, there has been a fourfold increase in the number of recorded natural disasters globally

INCIDENCE OF NATURAL AND HUMAN-MADE DISASTERS

This section reviews available data in order to assess the distribution of disaster risk, which unfolds at a range of scales, from the global to the local. The lack of data on vulnerability, hazard and disaster loss at the city level means some inference from national data is required. The first level of analysis is at the global scale, followed by a comparison of disaster loss by levels of national development. Differences in city-level risk profiles are then analysed.

The global incidence of disaster risk and loss

Since 1975, there has been a fourfold increase in the number of recorded natural disasters globally. Each of the three years with the highest number of recorded disasters has been during the current decade, with 801 disasters in 2000, 786 in 2002 and 744 in 2005.[8] While all continents now report more natural disaster events, on average, the rate of increase has been highest for Africa, where a threefold increase in natural disaster events has been experienced in the last decade alone.[9] Human-made disasters have seen a tenfold increase from 1975 to 2006, with the greatest rates of increase in Asia and Africa.

An outline of recent natural and human-made disaster incidents that have affected human settlements globally goes some way to indicate their destructive powers (see Tables 7.3 and 7.4). This is by no means a complete list; but, rather, attempts to indicate the scale of loss and diversity in hazard and settlement types that will be examined in detail throughout this Global Report. The best documented are large-scale natural disasters. The great diversity in types of hazards and disaster impacts across various human settlements is evident.

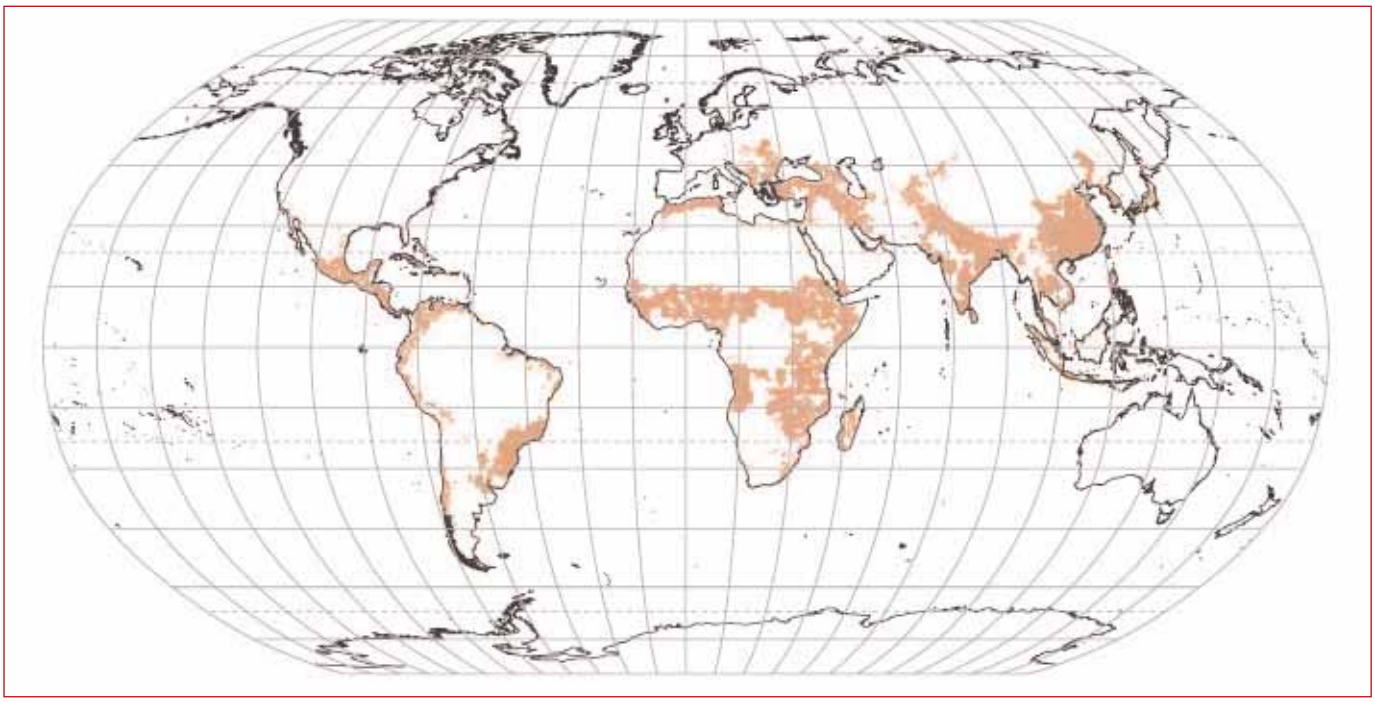
Natural disasters

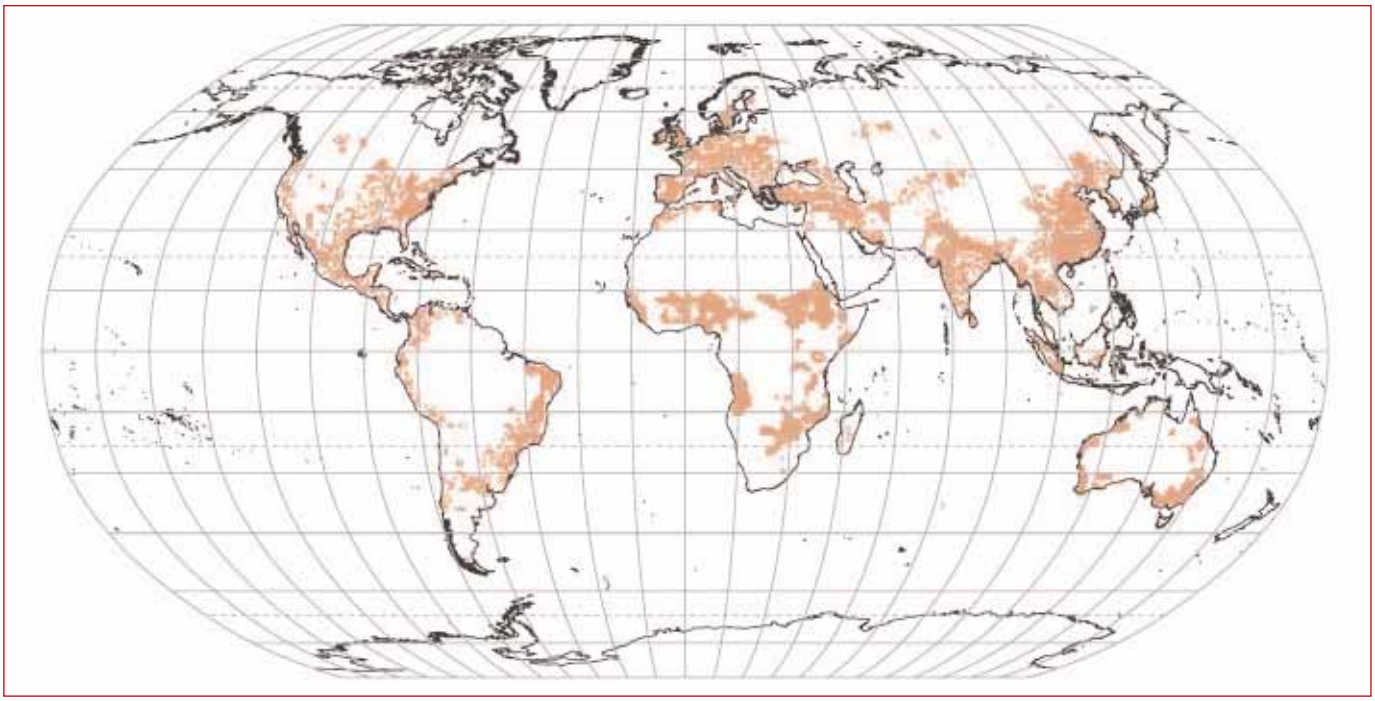
A global geography of natural disaster risk based on exposed populations and past losses (1980 to 2001) illustrates that both predominantly rural and urban world regions are at risk

Figure 7.2

Global distribution of highest risk disaster hotspots indicated by mortality (1980–2001)[10]

Source: Dilley et al, 2005





(see Figures 7.2 to 7.4). Loss to hydrological (floods, landslides and hurricanes) hazard is most widespread, affecting human settlements in China, Southeast Asia and Central America, and in a band from Eastern Europe through Central and Eastern Asia. Loss to geological hazard (earthquakes and volcano eruptions) is most concentrated in Central Asia and the Mediterranean and Pacific Rim states (e.g. Japan, the US and Central America). The Americas show variable loss, with low levels of loss in North America.

Central Asia is exposed to losses from the greatest number of hazard types. Likewise, the Black Sea region, Central America and Japan face multiple hazards. Disaster risk is, however, distributed differently across specific regions, depending upon what is considered to be at risk. In terms of mortality caused by natural disasters, hotspots include Central America, the Himalaya, South and Southeast Asia, Central Asia and sub-Saharan Africa (see Figure 7.2). Risk of absolute economic loss shows quite a different distribution (see Figure 7.3). Wealthier countries lose the highest value of economic assets in natural disasters. Consequently, hotspots for absolute economic loss include North America, Europe and Central, South and Southeast Asia, with sub-Saharan Africa being less prominent. A third measure – economic loss as a proportion of gross domestic product (GDP) – resembles losses recorded for mortality (see Figure 7.4).

Figure 7.3

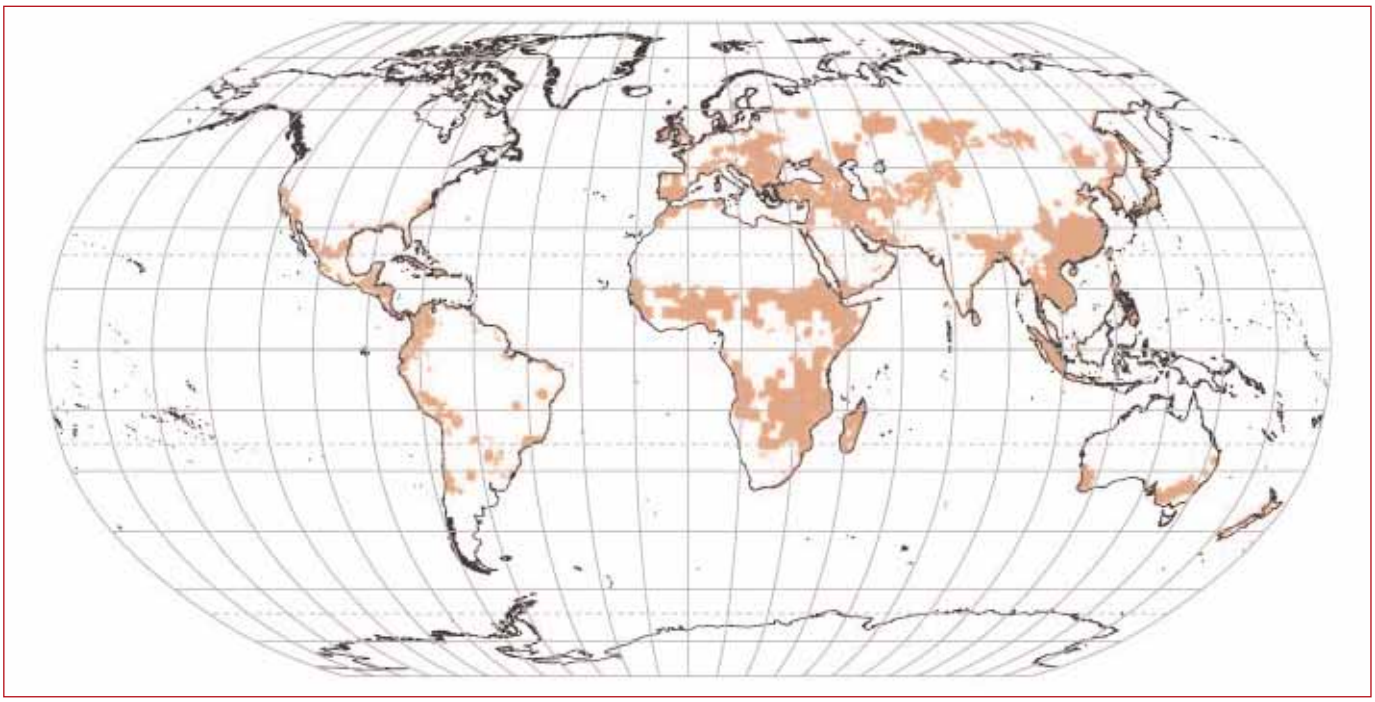
Global distribution of highest risk disaster hotspots indicated by total economic loss (1980–2001)[11]

Source: Dilley et al, 2005

Figure 7.4

Global distribution of highest risk disaster hotspots indicated by economic loss as a proportion of GDP per unit area (1980–2001)[12]

Source: Dilley et al, 2005



Box 7.3 Bhopal: A deadly human-made disaster

The accident at Union Carbide's pesticide plant in Bhopal, Madhya Pradesh (India), in 1984, exposed 500,000 people, the majority living in low-income settlements close to the plant, to toxic gas. To date, assessments of the death toll vary from 4000 to 20,000. The majority of deaths have been in the years since the disaster, as its chronic health effects unfold. Even by conservative estimates, it remains the worst industrial disaster on record, and the victims are still dying. The company paid US$470 million compensation to a trust in 1989. The survivors say they received around US$500 each and claim the cleanup efforts were inadequate.

The disaster was initiated when a faulty valve let nearly 1 tonne of water being used to clean pipes pour into a tank holding 40 tonnes of methyl isocyanate. The resulting runaway reaction produced a deadly cloud of toxic gas.

The runaway reaction should have been contained but was not, largely because Bhopal had far more limited emergency equipment than was available, for example, in Carbide's sister US plant. Gasses can be contained by being burned off by flare towers or filtered by a scrubber. At the time of the incident, the Bhopal plant had only one flare, shut for repairs. Bhopal's sole scrubber was overwhelmed by the mass of liquids and gases that boiled up at a rate over 100 times for which it was designed.

Bhopal's liquid waste was also poured into open lagoons to evaporate. Recent analyses of groundwater, soil and people near the plant have found high levels of heavy metals, such as mercury and toxic organo-chlorine chemicals.

Responsibility for the Bhopal incident is contested, with Dow Chemical, which took over Union Carbide, insisting that Carbide's Indian subsidiary was wholly responsible for the design and running of the plant. In 1999, Bhopal survivors launched a class action in New York State, which led to the court forcing the company to release internal documents, some of which contradicted its claims.

In the wake of the disaster, almost two dozen voluntary groups formed to cope with medical relief, supporting the families of victims and organizing a political and legal response to the disaster. This is, in part, a reflection on the lack of preparedness and response capacity that served to heighten the vulnerability of those living near the plant.

Sources: Jasanoff, 1994; New Scientist, 2002

Human-made disasters typically cause less direct loss of life than natural disasters

Human-made disasters

Most human-made disasters and the highest numbers of people killed are found in Asia and Africa. Data from the Emergency Events Database, Centre for Research on the Epidemiology of Disasters (EM-DAT, CRED) for 1997 to 2006 shows that 1493 human-made disasters were recorded in Asia and 952 in Africa, compared with only 392 events in the Americas, 284 in Europe and 11 in Oceania. The mean number of deaths during this period per event is highest in Oceania (46 deaths). Asia (34 deaths) and Africa (32 deaths) also have high average deaths per event, and this is especially significant given the high numbers of human-made disasters in these two world regions. The Americas (28 deaths) and Europe (24 deaths) recorded the lowest mean number of deaths per event and also the lowest absolute mortality for this time period. Europe is most affected by economic loss, which at over US$10 billion is greater than the economic loss suffered by any other world region. This demonstrates well both the high level of capital investment in Europe and the knock-on effect this has for loss profiled with low mortality and high economic loss. A similar profile is found for natural disasters where high-income countries and regions shift loss from mortality to economic damage. Outside Europe, economic loss is higher for Asia (US$883 million) and Africa (US$830 million), with lower economic loss in the Americas (US$83 million). No economic loss was recorded for events in Oceania.[13]

Human-made disasters typically cause less direct loss of life than natural disasters. Worldwide, the mean number of deaths per human-made event (2000 to 2005) is 30, while for natural disasters (excluding drought and forest fire, which are predominantly rural events) this is 225.[14] While direct human loss is lower for human-made disasters, impacts can be felt in the ecosystem and in human health many years after an event, and this loss is seldom recorded in official statistics. One of the most notorious examples of the long-term health consequences of human-made disaster has been the 1984 Bhopal disaster in Madhya Pradesh (India) (see Box 7.3). Here, the accidental release of 40 tonnes of methyl isocyanate from a factory owned by Union Carbide India caused thousands of deaths and injuries. The effects are still being recorded in babies whose parents were exposed to the released gas, so that impacts have crossed generations.

…national economic development …can both reduce and generate risk … for society

National development and disaster loss

The relationship between national economic development and natural disaster risk and loss is complicated. It is, however, clear that development can both reduce and generate risk for society and determine who in society carries the greatest burden of risk from natural and human-made hazard.

According to an analysis of the influence of development on natural disasters by the United Nations Development Programme (UNDP), countries with a high Human Development Index (HDI) experience low absolute and proportional disaster mortality rates (see Figure 7.5). Small island states such as Vanuatu and St Kitts and Nevis show relatively low absolute mortality, but high mortality as a proportion of population, reflecting the low total populations of these small states. Countries that had experienced a catastrophic disaster during the period for which data were collected (1980 to 2000), such as Armenia and Honduras, also show high losses as a proportion of population.

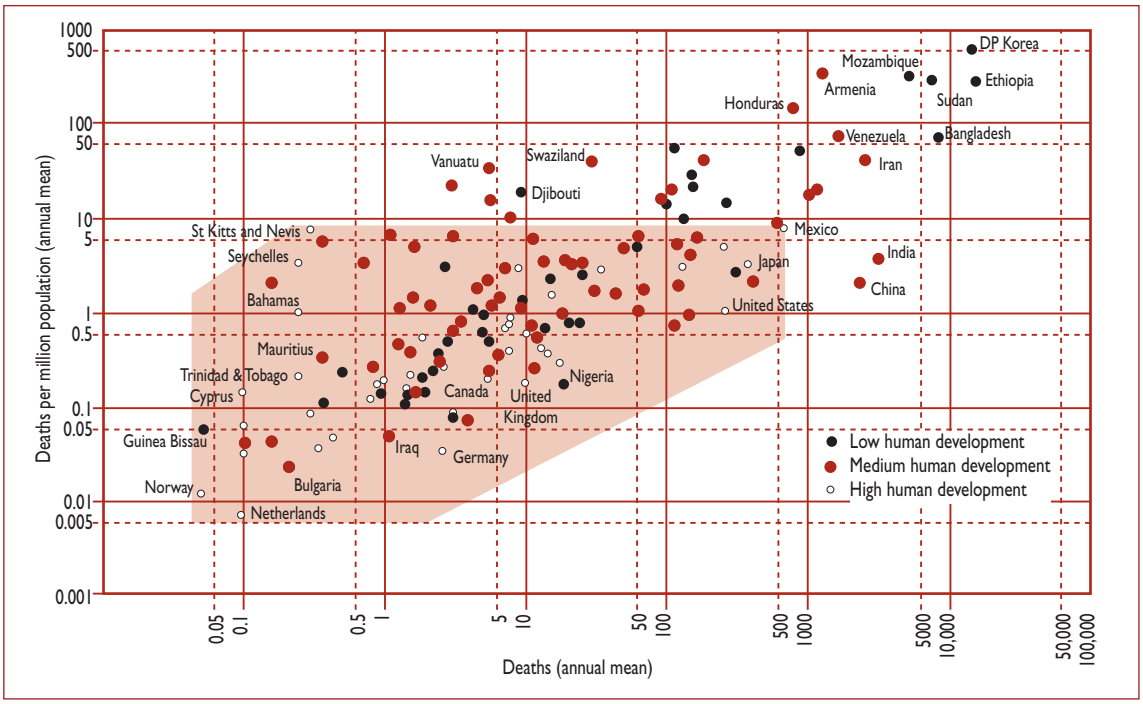


Figure 7.5

National development status and natural disaster mortality (1980–2000)

Source: UNDP, 2004

Note: HDI ranking for Afghanistan, Democratic People's Republic of Korea, Iraq, Liberia and Yugoslavia are from UNDP Human Development report 1996, all others from UNDP Human Development Report 2002.

The UNDP also developed the Disaster Risk Index, a pioneer tool for assessing variations in disaster vulnerability according to levels of development. The index tests 24 socio-economic variables against disaster mortality for earthquakes, flooding and windstorm at the national level to identify those variables that most explained patterns of loss. For all hazard types, exposure of human populations to hazard-prone places was found to be statistically associated with mortality. Urban growth was also found to be statistically associated with risk of death from earthquakes. This work provides statistical support for the large amount of observational data that connects rapid urban growth with disaster risk, and, in particular, with losses associated with earthquakes. Disaster risks and impacts are also differentiated by levels of development and investments in risk reduction at the city level.

City-level comparisons of disaster risk

There have been few studies of the global distribution of disaster risk for individual cities. Munich Re's Natural Hazards Risk Index for Megacities is a rare example (see Table 7.5).[15] The Natural Hazards Risk Index includes 50 participating cities and is primarily designed to compare insurance risk potential. With this caveat in mind, the index database is applied here to build up a picture of disaster risk at the city level.

One achievement of the Natural Hazards Risk Index is its multi-hazard approach, covering earthquake, windstorm, flood, volcanic eruption, bush fires and winter damage (frost). Reflecting Munich Re's business focus, the conceptualization and measurement of vulnerability is restricted to built assets, with an additional measure of financial exposure. The multi-hazard approach is enabled through individual assessments of vulnerability for each hazard type (for building structures and construction and planning regulations), which are then combined with an overall assessment of the general quality of construction and building density in the city to arrive at a risk index. There is some concern over the quality of vulnerability data available for cities; but Munich Re considers the results to be plausible and reflective of expert opinion on city vulnerability and risk.

Using Munich Re's methodology, results show that greatest risk has accumulated in the cities of richer countries. Only one megacity from a non-industrial country, Manila, is in the top ten when cities are ordered by the risk index.[16] With a view to supporting decision-making within the insurance sector, the Natural Hazards Risk Index understandably identifies high exposure in cities with large physical assets and commercial interests. Hence, Tokyo, San Francisco and Los Angeles have the highest Natural Hazards Risk Index values.

From a human settlements perspective, Munich Re's Natural Hazards Risk Index is less instructive than the base data held in Table 7.5. When considering the vulnerability of cities in terms of the sum of different types of natural hazard exposure, high risk becomes associated with Manila, Tokyo, Kolkata, Osaka–Kobe–Kyoto, Jakarta and Dhaka, all cities in excess of 10 million inhabitants and with high exposure to at least two different kinds of natural hazard. There are some counterintuitive results. For example, San Francisco appears low on the list, despite high earthquake exposure, because of low exposure to other hazard types.

Munich Re's data is also useful for identifying those cities where a large natural disaster is most likely to impact negatively upon the national economy. Dhaka, with 60 per cent of national GDP produced within the city, and with high exposure to earthquakes, tropical storms and storm surges, is a strong candidate for a city whose risk has national consequences.

The impact of disaster is further differentiated according to the development paths and levels of disaster

The impact of disaster is … differentiated according to the development paths and levels of disaster preparedness of individual cities

Table 7.5

Comparative exposure to large natural hazards for 50 cities

Source: Munich Re, 2004

Megacity	Country	Sum of natural hazard exposure	Population (million, 2003)	Area (km^2)	City GDP as percentage of national GDP	Individual natural hazard exposure assessment							Munich Re Natural Hazards Risk Index
						E	V	St	So	F	T	SS	
Manila	Philippines	15	13.9	2200	30	3	2	3	2	2	2	1	31.0
Tokyo	Japan	12	35	13,100	40	3	1	2	2	1	1	2	710.0
Kolkata	India	12	13.8	1400	< 10	2	0	3	2	3	0	2	4.2
Osaka–Kobe–Kyoto	Japan	12	13.0	2850	20	3	0	2	2	2	1	2	92.0
Jakarta	Indonesia	12	12.3	1600	30	2	2	1	2	2	2	1	3.6
Dhaka	Bangladesh	12	11.6	1500	60	3	0	3	2	3	0	1	7.3
Hong Kong	China	11	7.0	1100	10	2	0	3	2	2	0	2	41.0
Shanghai	China	10	12.8	1600	< 10	1	0	3	1	2	0	3	13.0
Karachi	Pakistan	10	11.1	1200	20	3	0	1	1	2	1	2	3.1
Mexico City	Mexico	9	18.7	4600	40	3	3	0	2	1	0	0	19.0
Istanbul	Turkey	9	9.4	2650	25	3	0	0	2	2	1	1	4.8
Miami	US	9	3.9	2900	< 5	0	0	3	2	1	0	3	45.0
Lima	Peru	8	7.9	550	50	3	0	0	1	1	3	0	3.7
Los Angeles	US	7	16.4	14,000	< 10	3	0	0	2	2	0	0	100.0
Buenos Aires	Argentina	7	13.0	3900	45	1	0	0	2	2	0	2	4.2
London	UK	7	7.6	1600	15	0	0	0	3	2	0	2	30.0
Randstad	Netherlands	7	7.0	4000	50	0	0	0	3	2	0	2	12.0
Singapore	Singapore	7	4.3	300	100	1	0	1	2	1	1	1	3.5
Alexandria	Egypt	7	3.7	100	Unknown	2	0	0	1	1	2	1	1.4
New York	US	6	21.2	10,768	< 10	1	0	1	2	1	0	1	42.0
Seoul	Korea, Rep. of	6	20.3	4400	50	1	0	2	1	2	0	0	15.0
Mumbai	India	6	17.4	4350	15	2	0	1	1	1	0	1	5.1
Delhi	India	6	14.1	1500	< 5	2	0	0	2	2	0	0	1.5
Tehran	Iran	6	7.2	500	40	3	0	0	2	1	0	0	4.7
Bangkok	Thailand	6	6.5	500	35	1	0	1	2	2	0	0	5.0
Baghdad	Iraq	6	5.6	500	Unknown	2	0	0	2	2	0	0	1.3
St Petersburg	Russia	6	5.3	600	< 5	0	0	0	2	2	0	2	0.7
Athens	Greece	6	3.2	450	30	2	0	0	2	1	0	1	3.7
Medellín	Colombia	6	3.1	250	Unknown	3	0	0	2	1	0	0	4.8
Rio de Janeiro	Brazil	5	11.2	2400	15	0	0	1	2	2	0	0	1.8
Ruhr area	Germany	5	11.1	9800	15	1	0	0	2	2	0	0	14.0
Paris	France	5	9.8	2600	30	0	0	0	3	2	0	0	25.0
Chicago	US	5	9.2	8000	< 5	1	0	0	2	1	0	1	20.0
Washington, DC	US	5	7.6	9000	< 5	0	0	1	2	1	0	1	16.0
Bogotá	Colombia	5	7.3	500	20	3	0	0	1	1	0	0	8.8
San Francisco	US	5	7.0	8000	< 5	3	0	0	1	1	0	0	167.0
Sydney	Australia	5	4.3	2100	30	1	0	0	2	1	0	1	6.0
Cairo	Egypt	4	10.8	1400	50	2	0	0	0	2	0	0	1.8
Beijing	China	4	10.8	1400	< 5	2	0	0	2	0	0	0	15.0
Johannesburg	South Africa	4	7.1	17,000	30	1	0	0	2	1	0	0	3.9
Bangalore	India	4	6.1	300	Unknown	1	0	1	1	1	0	0	4.5
Santiago	Chile	4	5.5	950	15	2	0	0	1	1	0	0	4.9
Milan	Italy	4	4.1	1900	15	1	0	0	2	1	0	0	8.9
São Paulo	Brazil	3	17.9	4800	25	0	0	0	2	1	0	0	2.5
Lagos	Nigeria	3	10.7	1100	30	0	0	0	2	1	0	0	0.7
Moscow	Russia	3	10.5	1100	20	0	0	0	2	1	0	0	11.0
Madrid	Spain	3	5.1	950	20	0	0	0	2	1	0	0	1.5
Berlin	Germany	3	3.3	900	< 5	0	0	0	2	1	0	0	1.8
Abidjan	Côte d'Ivoire	2	3.3	500	50	0	0	0	1	1	0	0	0.3

Notes: Natural hazards key is defined as follows (3 = high; 2 = medium; 1 = low; 0 = none):
E = earthquake;
V = volcanic eruption;
St = tropical storm;
So = other storms (winter storms, hailstorms, tornado);
F = flood;
T = tsunami;
SS = storm surge.

preparedness of individual cities. This is evident when comparing the contrasting cases of Kobe (Japan) (hit by a 7.2 Richter magnitude earthquake in 1995) and Marmara (Turkey) (hit by a 7.4 Richter magnitude earthquake in 1999). The Kobe (or Great Hanshin) earthquake was among the worst disasters to have befallen modern Japan since it claimed 6433 lives. The Marmara earthquake was similarly catastrophic; but with 18,000 lives lost, was three times as deadly as the Kobe earthquake.[17] In Kobe, strong engineering standards reduced losses; but a lack of planning for social systems to identify vulnerable groups and help in response, relief and reconstruction compounded losses. In Marmara, decades of ineffective building and planning regulation meant many modern buildings were not adequately resistant to earthquakes, and accumulated risk translated into high human loss. As in Kobe, failure in social planning also undermined response and reconstruction. The Tangshan earthquake in China in 1976 similarly illustrates how differential vulnerability shapes loss in different human settlements (see Box 7.4).

DISASTER IMPACTS

This section differentiates between and discusses the main impacts of disasters. The capacity for disaster impacts to cause knock-on consequences and additional risks through secondary human-made disasters and the ecological impacts in the city is also examined.

Although the review of natural and human-made disasters goes some way in indicating their destructive power, it can only show tip-of-the-iceberg losses. Gaps in data and contradictory statements make comprehensive assessment of disaster impacts difficult. Even assessments of disaster incidence, although made easier by global media, are not easily undertaken at the global scale, where there is no standard system for verifying local reports.

Systematic gaps in disaster data collection and presentation mean that loss is underestimated in three different ways:

- Psychological and livelihood impacts are seldom recorded, with the majority of disaster impact data focusing on mortality and economic loss.[18]
- Macro-economic loss estimates cannot easily capture the secondary and knock-on consequences of disaster for economic production and trade.
- Disasters affecting small urban settlements and small-scale disasters in large cities are often overlooked, despite evidence suggesting that, in aggregate, small-scale disasters may be associated with at least as much suffering and loss as the large-scale disasters in cities that make front page news.[19]

At a minimum, psychological trauma, livelihood losses and losses to productive infrastructure should be included in measuring the full impact of disasters.

Box 7.4 The Great Tangshan earthquake, China

The most destructive earthquake of the past 400 years occurred in Tangshan (China) in 1976. The magnitude 7.8 earthquake occurred in the early morning while the majority of the over 1 million residents slept and lasted 14 to 16 seconds. Later in the day, the city was further paralysed by an aftershock with a magnitude of 7.1. The official death toll published by the Chinese government was about 240,000. More recent estimates place the total for casualties at over 0.5 million.

While nearly 50 per cent of the population of the city of Tangshan died during the earthquake, the neighbouring County of Qinglong had only one death out of 470,000 residents. Scientists from the State Seismological Bureau identified six main factors that contributed to the unprecedented destructiveness of the Tangshan earthquake, including high population density, existence of few earthquake-resistant buildings, occurrence of shock while people were sleeping followed by a strong aftershock later, paralysis of critical infrastructures and the geological conditions under the city.[20] Yet, the disparity between the death toll in Tangshan and Qinglong cannot be accounted for by these factors alone since both counties experienced similar vulnerabilities. The divergence in the death toll between Qinglong and Tangshan comes from an additional seventh factor: the difference in earthquake preparedness in the two areas.

Tanghsan's over-reliance on scientific monitoring of seismic activity for national preparedness partly contributed to the massive loss of life during the 1976 earthquake. Two years earlier, a report by the Chinese Academy of Science had advised greater preparedness and monitoring in North China. During the following two years, Qinglong County increased the number of earthquake monitoring stations and intensified public education using pamphlets, films, posters, drills and community discussions, far beyond those reported to have been undertaken in Tangshan. Qinglong's successful disaster mitigation was a best-case outcome of the coordination between public administrators, scientists and the public.

Source: Pottier et al, 2007

Direct and systemic impacts of disaster

Disaster impacts can be classified as either direct or systemic. Direct impacts include damages directly attributable to the disaster, including lives lost and injuries and physical damage to infrastructure and buildings. Direct (and other) losses can also be caused by knock-on human-made or natural disasters. For example, an earthquake can trigger chemical fires or liquefaction. If uncontained, direct impacts can be magnified through failures in critical infrastructure and services in the city, leading to systemic impacts such as outbreaks of disease, social violence and lack of access to electricity, potable water or food. For instance, a review of health service infrastructure in Latin America and the Caribbean found that around half of all hospitals are sited in high-risk areas. Perhaps not surprisingly, this report also found that over the 1980s and 1990s, 100 hospitals and 650 health centres have been destroyed in disasters. This is a little over 5 per cent of all hospitals in this region.[21] In turn, such disruptions can lead to instabilities in the political economy of the city and undermine economic development.

Gaps in data … make comprehensive assessment of disaster impacts difficult

Systemic loss can further be differentiated into indirect losses and secondary effects. Indirect losses (sometimes called flow losses) are the costs of goods that will not be produced and services that will not be provided because of a disaster. Secondary effects are generated by macro-economic distortions.[22]

Urban areas are characterized by great diversity in land use as well as environmental variability (e.g. in slope angle and direction, soil properties and land altitude). This

Natural hazard	Primary hazard	Secondary hazard
Cyclone	Strong winds, heavy seas	Flood and sea surge, landslide, water pollution, chemical release
Flood	Flooding	Water pollution, landslide, erosion, chemical release
Tsunami	Flooding	Water pollution, landslide, erosion, deposition, chemical release
Earthquake	Ground motion, fault rupture	Soil liquefaction, fire, flood, landslide, tsunami, water pollution, explosion, chemical release
Landslide	Ground failure	Flooding following river damming, water pollution, debris flow
Volcano	Lava flow, pyroclastic flow, ash fall, gas release	Fire, air pollution, tsunami, water pollution, ground subsidence, explosion, chemical release

Table 7.6

Primary and secondary hazards

Source: Institute of Civil Engineers, 1999

diversity can lead to initial 'primary' natural hazards triggering 'secondary' hazards (see Table 7.6). In many cases, secondary hazards can be as devastating as the primary hazard (or even more). Warnings of this potential include Kobe (Japan) in 1995 and San Francisco (US) in 1906, where earthquakes were followed by urban fires.

Human-made hazards triggered by the impacts of natural disasters are called Natech events. There is little systematically held data on the vulnerability of industrial facilities to natural hazards since assessments are undertaken privately and often considered too sensitive for public access. There is also little recording of Natech incidents, and even less data on near misses. Again, this information is often held privately and is not easily accessible for analysis. The seriousness of the threat posed by Natech events in urban contexts can be seen by the following list of events triggered by the 1999 Marmara earthquake in Turkey:[23]

The potential for feedback between natural and human-made hazards in large cities presents the scenario for a disaster on an unprecedented scale

- leakage of 6.5 million kilograms of toxic acrylonitrile – as a result, contaminating air, soil, water and threatening residential areas;
- the intentional air release of 200,000 kilograms of ammonia gas to avoid explosion;
- the release of 1.2 million kilograms of cryogenic liquid oxygen caused by a structural failure;
- three large fires in Turkey's largest oil refinery, consuming more than 180,000 cubic metres of fuel;
- a release of liquefied petroleum gas, killing two truck drivers.

Powerful players can move indirect economic losses around the urban economy

Human-made hazards can also lead to unexpected secondary hazards, potentially turning minor incidents into major events. On 10 August 1983, a 30 centimetre diameter water main ruptured in New York's Garment District. Water flooded an underground electricity sub-station, causing a fire. The fire was too intense for fire fighters to approach it directly. The blaze ignited the roof of a 25-storey building and took 16 hours to extinguish. Power was not restored for five days. The resulting blackouts hit 1.9 square kilometres of the Garment District, disrupting telephones and an international market week being hosted in the Garment District at the time. The cascading events started by this minor incident caused disruption and loss in increasingly complex systems. Estimated losses were in the tens of millions of dollars.[24]

The potential for feedback between natural and human-made hazards in large cities presents the scenario for a disaster on an unprecedented scale. The economic impacts of such a disaster in a city of regional or global importance could resonate around the world's financial system, with catastrophic consequences worldwide.

Ecological damage and the impacts of recovery

Urban disaster impacts can be significantly compounded by environmental damage, resulting in the loss of ecosystem stability. Perhaps most important is the potential for disaster to result in the pollution of groundwater. Salt water intrusion following storm surges, tsunami and coastal flooding, or the pollution of groundwater from sewerage, petrol and hazardous chemicals, can render aquifers unsafe for prolonged periods. This was the case in Banda Aceh following the Indian Ocean Tsunami.[25]

Disaster impact assessments seldom include damages caused in the process of disaster response and recovery. This is a serious omission. A recent evaluation has suggested that the ecological costs of cleanup and reconstruction following the Indian Ocean Tsunami will compete with or even exceed environmental losses caused by the wave.[26] In the wake of typhoon Tokage, which hit Japan from 19 to 21 September 2004, 44,780 tonnes of waste were produced by the city of Toyooka, composed mainly of forest debris and household goods. Waste treatment took over four months, at an estimated cost of US$20 million – a significant financial burden on the budget of a small city.[27] The use of debris as recycled material in reconstruction is commonplace in local reconstruction efforts, but rare in large contracted reconstruction work.

An account of the Great Hanshin earthquake that hit Kobe City in 1995 concludes that the volume of dioxins released into the atmosphere through the incineration of 2 million tonnes of waste equalled the amount generated by the 1976 industrial disaster in Seveso (Italy), effectively causing a human-made disaster. Other environmental impacts included the scattering of asbestos and concrete particles during demolitions, improper lining of landfills used for hazardous waste, use of tetrachloroethylene, which caused pollution of soil and groundwater, and a missed opportunity to recycle waste.[28]

Economic effects of disasters

The following discussion focuses on the economic effects of disasters. The economic sectors exposed to individual disaster types and the role of land markets are discussed in turn.

Economic production and infrastructure

The economic costs of natural and human-made disasters over the past few decades have been phenomenal. Economic losses from natural disasters, for instance, have increased 15-fold since the 1950s.[29] In a matter of two decades between 1974 and 2003, economic damages worth US$1.38 trillion were caused worldwide by natural disasters. In 2006, economic losses from natural disasters amounted to US$48 billion, while human-made disasters triggered economic

Impact	Hazard type							
	Flood	Wind	Wave/tsunami	Earthquake	Volcano	Fire	Drought	Human made
Direct: loss of housing	✗	✗	✗	✗	✗	✗		
Direct: damage to infrastructure	✗	✗	✗	✗	✗	✗		
Systemic: short-term migration	✗				✗		✗	
Systemic: loss of business production	✗	✗	✗	✗		✗	✗	✗
Systemic: loss of industrial production	✗	✗	✗	✗		✗	✗	✗
Systemic: disruption of transport	✗	✗		✗				✗
Systemic: disruption of communication	✗	✗	✗	✗				✗

Table 7.7

Economic impacts of disasters by hazard type

Source: adapted from UNDRCO, 1991

losses worth US$5 billion.[30] Economic losses are regionally differentiated, with the Americas and Asia incurring highest losses from natural disasters[31] and Europe experiencing greatest loss from human-made disasters.

Various hazards have differentiated effects on urban economic systems (see Table 7.7). The scale of economic impact varies according to the spread, intensity and form of the energy released by each hazard type. For example, natural disasters that tend to produce spatially concentrated impacts, such as flows of hot ash and rock fragments from volcanoes, will not usually overwhelm urban transport systems, compared to the more widespread impacts of earthquakes, hurricanes or catastrophic flooding. Drought is more likely to undermine economic activity indirectly rather than lead to property damage and therefore may cause a loss of industrial productivity, but with little impact on productive infrastructure. Human-made disasters tend to have systemic impacts on cities through damage to, or isolation of, critical infrastructure such as transport and communication systems, but are less destructive of housing.

Powerful players can move indirect economic losses around the urban economy. This was the case in Kobe (Japan) following the 1995 earthquake. Here, major producers, such as Toyota Motor Corporation and Kawasaki Heavy Industries Ltd, used a 'just-in-time' stocking approach. Following the earthquake, damage to subcontractors threatened to hold back production. The major producers were able to protect themselves by shifting to new subcontractors within a few days. This strategy passed risk on from the major producers to the subcontractors who had to cope with a double burden of disaster impacts and lost contracts. Many faced bankruptcy as a result.[32]

Larger developed urban/national economies with sizeable foreign currency reserves, high proportions of insured assets, comprehensive social services and diversified production are more likely to absorb and spread the economic burden of disaster impacts. An example of large economic losses in an urban region that were contained comes from the 1999 Marmara earthquake in Turkey. Direct losses were estimated at US$2 billion for industrial facilities, US$5 billion for buildings and US$1.4 billion for infrastructure, including a similar figure for losses generated through lost production during the many months required for factories and industrial facilities to return to their pre-disaster production levels.[33] However, only seven months after the disaster, a downturn in the rate of inflation and declining interest rates for government borrowing indicated that the Turkish economy had made a fast recovery.[34]

There is also growing potential for cities connected to regional or global financial systems (e.g. Mexico City, Rio de Janeiro, Johannesburg, Bangkok, Manila, Seoul and Singapore) to spread the negative consequences of disaster across the global economy, with huge systemic loss effects. Evidence for what has become known as the 'contagion effect' can be seen from the losses incurred following the Kobe earthquake in 1995. While world stock markets were unaffected, the Japanese stock market lost over 10 per cent of its value in the medium term. The duration of negative effects on stock markets depends upon wider consumer confidence. Munich Re considers human-made disasters to be worse than natural disasters for the international market. More catastrophic might be a disaster (or series of disasters) that damages the global trading infrastructure. It is for this reason that financial institutions and businesses invest heavily in back-up systems.[35]

Larger developed urban/national economies … are more likely to absorb and spread the economic burden of disaster impacts

For urban residents, systemic economic effects may not be felt for some time as businesses restructure, although in the short term, unemployment or livelihood disruption is to be expected and may be prolonged. Shelter and labour power are the two most important assets for low-income urban households. When either is damaged or destroyed in disaster, households are forced to expend savings or borrow to survive and re-establish livelihoods. Relief aid itself can distort local livelihoods and markets as goods and services that can be provided locally are undercut and replaced by externally sourced aid. The result is that local livelihoods and the local economy can be eroded. For households with strong familial or social ties, access to remittances or borrowing money without interest payments is a possibility. Increasingly, access to remittances from overseas is a key indicator of resilience to economic shocks caused by natural and human-made disasters in urban Latin America.

Urban land markets

Disaster impacts, risk of disaster impacts and actions taken to protect areas from disaster risk … have an impact on urban land values

Disaster impacts, risk of disaster impacts and actions taken to protect areas from disaster risk all have an impact on urban land values. As in any urban regeneration or upgrading scheme, urban planning and engineering projects aiming to mitigate disaster exposure can lead to changes in the social geography of communities or city regions.

Investing in mitigation to protect those at risk can result in increases in the value of land and housing, which, in turn, can lead to lower-income households selling to higher-income households. This cycle is a major challenge to the poverty reduction potential of investments in structural mitigation. Informal, illegal and formal/legal land and

Box 7.5 Urban land markets and flooding in Argentina

In Argentina, land market agents have tended to oppose any legislation that might constrain their actions on areas prone to flooding. The consequence has been that across Argentina, in Buenos Aires, Santa Fe and Greater Resistencia, the state has allowed the division of land in flood-prone areas into lots for sale. In Greater Resistencia, despite existing legal instruments, the Resistencia City Council has consistently voted for exceptions to regulations if they hinder construction plans. Development in areas prone to flooding has not only generated new hazard, but has also caused changes to land drainage, placing previously safe developed areas at risk.

Flood risk has had a detrimental effect on land values in Buenos Aires. A study in the Arroyo Maldonado area found that land values in this middle- and low-income community fell by 30 per cent following two years of consecutive flooding. Land at risk from flooding is cheaper and can be purchased by low-income households, as has happened in parts of Buenos Aires such as Matanza-Richuelo and Reconquista, and in Resistencia along the course of the Rio Negro. In Resistencia, middle-income households are also at risk from flooding, but can often evacuate to family or friends in higher (more expensive) neighbourhoods. This option is less available to the poor, who rely on state or non-governmental organization (NGO) shelters.

In middle- to high-income areas, real estate agents have been found to mask flood risk. In housing developments at Colastiné and Rincón, Greater Santa Fe, land was purchased in the belief that it was flood secure. Unfortunately, this was not the case, with purchasers feeling cheated. The state was implicated in this, having failed to regulate against granting development in flood-prone locations. In already built-up areas in Buenos Aires (e.g. Belgrano on Avenida Cabildo), flooding is also effectively masked, with no discernable change in the market price of flats except for temporary decreases following severe flooding.

On the whole, middle- and high-income populations, as well as estate agents and land developers, have successfully masked flooding to avoid possible land and property value losses. This also reflects the higher resilience of areas occupied by middle- and high-income households and associated commercial activities that are able to cope better with flooding than low-income households and marginalized commercial activities.

Source: Clichevsky, 2003

housing market values are equally sensitive to disaster risk (see Part III of this Global Report on security of tenure).

Box 7.5 examines the history of urban land development and the impact of flooding in Argentina. It illustrates the negative spiral of flood-prone land having a reduced value and therefore being affordable to low-income households, but also increasing exposure to flood hazard among this group, who has the least resources to cope with or respond to flood hazard.

Especially in poorer countries, women and children tend to be most affected by disasters

Social and political impacts of disaster

The social and political impacts of disaster are less easy to pin down than the direct economic impacts of disaster. The social impacts of disaster are determined by those institutions and processes in society that shape differential access to resources. These include cultural, ethnic, religious, social, and age- and disability-related causes that lead to segregation and exclusion. Every urban community is structured by a myriad of social relationships, obligations, competitions and divisions that shape the particular social characteristics associated most with vulnerability and loss.[36] Despite checklists of vulnerability routinely including social characteristics, rigorous research is relatively limited, with most of the resulting knowledge focusing on gender inequalities. A common theme is that where inequality has generated disproportionate vulnerability for a specific social group, higher losses during disaster and reconstruction serve to deepen inequality, thus creating vicious cycles of loss and vulnerability.

Political impacts of disaster are often determined by the pre-disaster political context. Post-disaster, political leaders have a remarkable ability to deflect criticisms and survive, or even benefit from disaster notwithstanding any role their decisions might have played in generating disaster risk.

This section examines the ways in which vulnerability to disaster impacts is shaped by gender, age, disability and political systems. On the ground, the many social and economic roots of vulnerability interact. For simplicity, social characteristics are discussed in turn; but any individual may experience more than one form of social exclusion and this, in turn, may be compounded or relieved through economic status. Economic poverty – for example, experienced through homelessness – is not discussed here as a separate social pressure, but is a theme that runs throughout the analysis of disaster risk in this and subsequent chapters.

Gender and disaster

Gender is a social variable that shapes vulnerability and is reflected in disaster impact statistics worldwide. Especially in poorer countries, women and children tend to be most affected by disasters.[37] The 1991 cyclone in Bangladesh killed 138,000 people and mortality among females over ten years of age was over three times that of males over ten years old.[38] Following the Maharashtra earthquake in India, in 1993, while less women than men were affected (48 per cent), more women than men were killed (55 per cent).[39]

In addition to differential death and injury rates from the direct impacts of natural and human-made hazards, women are at risk from indirect impacts. Four pathways for this inequality have been identified:[40]

- *Economic losses* disproportionately impact upon economically insecure women (e.g. when livelihoods traditionally undertaken by poor women rely on assets at risk, such as peri-urban agriculture, or the destruc-

tion of women's home-based businesses, or when women and girls are granted only limited access to post-disaster economic aid).
- *Work load changes* suggest that disasters increase women's responsibilities in the domestic sphere, paid workplace and community.
- *Post-disaster stress* symptoms are often (but not universally) reported more frequently by women.
- *Increased rates of sexual and domestic violence* against girls and women are reported in disaster contexts.

One global study has found that in 42 out of 45 disaster events, women or girls were more adversely affected. The study focused on post-traumatic stress disorder and found that psychological effects were not only stronger among females, but more lasting, as well.[41] Box 7.6 elaborates upon the disproportionate impact on women of the Indian Ocean Tsunami in 2004.

Social and legal systems can discriminate against women during reconstruction. The lack of rights or the ability to exercise such rights can push women closer to vulnerability, particularly in the post-disaster period, and especially if male household heads have been killed. The disproportionate vulnerability of women (and children) to hazards, but also to exploitation during the social disruption that follows disaster, has not been adequately factored into disaster planning. For example, disaster impact assessments are not routinely disaggregated by gender. There are some notable exceptions; but more needs to be done to systematically record gendered vulnerabilities.

Box 7.6 More women than men lost in the Indian Ocean Tsunami

Evidence from Indonesia, India and Sri Lanka illustrates that many more women and children than men died due to the Indian Ocean Tsunami. In four villages in the Aceh Besar district in Indonesia, male survivors outnumbered female survivors by a ratio of almost 3:1. In another four villages in North Aceh district, females accounted for 77 per cent (more than three-quarters) of deaths. In the worst affected village of Kuala Cangkoy, there were four female deaths for every male death.

In Cuddalore in India, almost three times as many women as men were killed, while the only people to die in Pachaankuppam village were women. In Sri Lanka, too, partial information such as camp surveys and press reports suggest a serious imbalance in the number of men and women who survived.

Some of the causes of these patterns are similar across the region: many women died because they stayed behind to look for their children and other relatives; men more often than women can swim; and men more often than women can climb trees. But differences, too, are important. Women in Aceh, for example, traditionally have a high level of participation in the labour force; but the wave struck on a Sunday morning when they were at home and the men were out on errands away from the seafront. Women in India play a major role in fishing and were waiting on the shore for the fishermen to bring in the catch, which they would then process and sell in the local market. In Sri Lanka, in Batticoloa district, the tsunami hit at the hour women on the east coast usually took their baths in the sea.

Source: Oxfam International, 2005a

Age, disability and disaster

The young, the elderly and those with disabilities are often among the most vulnerable to natural and human-made hazards. For example, in the Bangladesh cyclone in 1991, mortality rates for those under 14 and over 50 years of age were more than three times that for the 15 to 49 age group.[42] Since data on age and disability is not routinely collected post-disaster, evidence is limited to accounts of individual events.

Children's lack of physical strength and immature immune systems make them vulnerable to injury and illness following disaster. Where children are separated from parents or carers, their safety is jeopardized during relief and reconstruction. Property rights and personal security of children, as well as women survivors, are not easy to protect during reconstruction. Children and young people may be placed in positions of increased responsibility for household maintenance or at greater risk through lack of familial support. For instance, studies from Cape Town show that children from low-income households face a much higher risk of sustaining fire-related injuries. This is linked to being left alone for long periods.[43]

For the elderly, vulnerability is more ambiguous. In some circumstances, the elderly can acquire resilience through their knowledge and more developed social networks of support. Where this is not the case, the elderly can become a high-risk social group. The heat waves that hit Chicago in 1995 and Paris in 2003 both disproportionately impacted upon the elderly. However, in both cities, it was the socially isolated and unsupported elderly who were most at risk. This underlines the social construction of vulnerability. The physical fragility of senior years itself was not a cause of increased mortality. In Chicago, high death rates were found among the elderly who lived alone and were isolated from the community around them. This has been described as a social process during which some individuals remain living in a transitional urban neighbourhood while the community changes around them, thus making it more and more difficult to sustain supportive social networks.[44]

The young, the elderly and those with disabilities are often amongst the most vulnerable to natural and human-made hazards

Data on the additional vulnerability faced by the disabled is very limited. Occasional anecdotal accounts are available, and these suggest, in some cases, that the disabled might be purposely abandoned during disaster. A news report in 2004 claimed that disabled people were left behind during evacuation in the 2000 floods in Zimbabwe and Mozambique.[45]

The political consequences of disaster

The social and political repercussions of disaster can extend well beyond forcing change in disaster management policy and practice. In extreme cases, disasters can serve as catalysts for political change. That political systems affect disaster risk is also clear. A survey of 89 natural disasters between 1972 and 1976 found that political interference was a regular consequence. The most common problems concerned lack of acknowledgement of the disaster by the government of the affected country, the government's political interference with the response process, and corruption in the distribution of relief.[46] Despite such evidence, there has been little analysis of the impacts of disasters affecting urban areas upon political systems.

A common metric for measuring the impact of disasters upon political systems might be described as political

Table 7.8

Natural disasters and socio-political change

Source: Pelling, 2003; except *: Dill and Pelling, 2006

City (country)	Date of disaster	Disaster trigger	Socio-political reaction
Lice (Turkey)	1972	Earthquake	Discrimination against the minority Kurdish population was blamed for inadequate preparedness before, and relief aid after, the earthquake. Complaints were made by a Kurdish member of parliament to the Turkish Parliament.
Managua (Nicaragua)	1972	Earthquake	The scale of corruption by the Somoza dictatorship united workers, intellectuals, the business community and international popular opinion fuelling a popular revolution that eventually led to a change in regime.
Guatemala City (Guatemala)	1976	Earthquake	Described as a 'classquake' because of its high impact among slum dwellers, this event stimulated popular mobilization and land invasions, which reshaped the geography of the city.
(Chile, nationwide)	1985	Earthquake	A traditional civilian response threatened to undermine a weak dictatorship. The response was demobilized through repression and the state took over.
Mexico City (Mexico)	1985	Earthquake	Inadequate state response. A highly organized civil society-led reconstruction programme emerged, unique in Mexico's modern history of authoritarian state control.
Miami (US)	1992	Hurricane	Broad interest coalitions formed, assisting in the rebuilding of the city. These coalitions have not persisted but have created the potential for cooperation in local politics.
Marmara* (Turkey)	1999	Earthquake	A conspicuous failure in state oversight of the construction industry led to riots and political lobbying for policy change.

space. It may be possible to assess how disaster risk reduction, the hazard events themselves and their aftermath open or close political space. In other words, do the activities conducted during these periods of disaster management provide an opportunity for inclusive governance? Disasters can act as catalysts highlighting underlying inequality, corruption and incompetence that fuels popular unrest; but they can also close political space. More authoritarian political regimes whose legitimacy is built on the control of political power in a national state are likely to feel threatened by any opening of political space through disaster, and so may be expected to act to restrain emerging civil society voices. Entrenched political systems are difficult to change and single disaster events rarely achieve significant political movement, unless this was already entrained before the event.

…political relations at the local level will be tested by disaster events …

Table 7.8 presents information from studies of disasters that have had a mainly urban impact and were triggered by a natural hazard. In many cases, it was the capital city that was hit, with political consequences for the nation as a whole. In cases where the formal state response has been politically biased (Turkey in 1972) or inadequate (Mexico City in 1985; Turkey in 1999), civil society responses have emerged or even come to dominate disaster relief, recovery (Chile in 1985; Mexico City in 1985) and reconstruction (Guatemala City in 1976). In many cases, civil society efforts can become formalized when interest groups have created coalitions with the state (Miami in 1992; Mexico City in 1985; Turkey in 1999) or protested through formal political or legislative channels (Turkey in 1972). Where political differences between the cooperating groups are too large, collaboration may not last long beyond the disaster reconstruction period (Miami in 1992); but even here the experience is likely to have built up new trust between civil society groups within the city.

State elites can benefit from disaster when, for example, the political function of party networks is adapted for relief distribution or institutional weaknesses allow corruption (Managua in 1972), thus strengthening 'clientalism' in society. This suggests that it can be in the interest of parasitic governing elites to allow degeneration in the institutions overseeing disaster response (providing a space for corruption), while investing in state control over local disaster response strategies (to prevent the emergence of potentially critical civil society organizations). Where states do not benefit from disaster, astute politicians can control potential damage. In 1966, despite having made decisions that directly led to increased vulnerability to flooding in New Orleans, the incumbent mayor was successfully re-elected, having demonstrated leadership in reconstruction.[47]

Beyond the national level, political relations at the local level will be tested by disaster events and also by risk reduction and reconstruction interventions. If disaster risk reduction is to be effective in changing the root causes of risk, then change in local social and political relations – between gender, economic class, cast, and ethnic and religious groups – is a legitimate target for action. Even where change is not intended, this may often be an unplanned outcome of interventions, with positive and negative consequences for those affected. For all disaster types at the local level, periods of disaster and emergency response – especially if these are prolonged – can result in dislocations in the authority of the state and the emergence of, if only temporarily, alternative forms of social organization. Disasters can also lead to more positive social bonding and the building of trust between people forced together by adversity.

Cultural impacts of disaster

Urban areas concentrate cultural assets, including architecturally significant buildings and urban landscapes, but also artworks housed in urban centres. The Jahrhundertflut flood of August 2002 that affected the Czech Republic, Germany and Hungary, is one recent example where cultural assets were at risk. The World Heritage towns of Cesky Krumlov and Prague were damaged and large galleries in Dresden and Prague were flooded. In Prague, flooding in the National Museum and Prague University of Technology caused damage to books, including an archive on Czech architecture. The vulnerability of the historic city of Genoa (Italy) further illustrates the cultural impacts of disasters (see Box 7.7).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage List includes 644 cultural and 24 mixed cultural and natural properties (including an additional 162 natural properties, such as nature parks). Many of these sites are located in earthquake-risk hotspots in Central America and Central Asia

and flood-risk areas in Central Europe. In Africa, sea-level rise has been identified as a cause of heritage loss in coastal Ghana, where Fort Peasantine in the Volta region has been lost. In Mali, drought has caused the abandonment of areas with significant architectural heritage, placing these buildings at risk from lack of maintenance.[48] The ancient citadel and surrounding cultural landscape of the Iranian city of Bam, where 26,000 people lost their lives in the earthquake of December 2003, was simultaneously inscribed on UNESCO's World Heritage List and on the List of World Heritage in Danger in 2004. World Heritage List status has enabled UNESCO to lead international efforts to salvage the cultural heritage of this devastated city. The potential for protecting global architectural heritage through the inclusion of World Heritage sites in urban disaster management plans has also been realized – for example, in Central Quito (Peru) and Havana (Cuba).[49]

When places of cultural importance are damaged or destroyed by disaster, the impacts go far beyond economic value.[50] Cultural heritage can provide disaster-affected communities with a much needed sense of continuity and identity during reconstruction, as well as a future resource for economic development. Cultural heritage is particularly at risk in the period following a disaster, when the urgency to address the basic needs of the population, combined with the interests of developers and entrepreneurs, often leads to emergency response activities and planning and rehabilitation schemes for recovery that are insensitive to the cultural heritage of the affected areas or the social traditions of their inhabitants. With this in mind, many have called for cultural heritage to be integrated within the general framework of development and planning, as well as within existing disaster management policies and mechanisms.[51]

Box 7.7 Flood hazard threat to cultural heritage in Genoa, Italy

The city of Genoa is located in the Liguria region, in northwest Italy, where earthquakes, landslides and floods represent the major natural hazards being historically experienced. These natural hazards pose a serious threat to the cultural heritage of Genoa, which hosts one of the largest medieval centres in Europe, with about 150 noble palaces and many valuable architectonic evidences. The historic city centre is particularly subject to floods that are produced by the many streams crossing the area and partially conveyed by hydraulic structures built during the last two centuries. Failures in the artificial drainage system are, therefore, the main reason of flooding for the ancient neighbourhoods of the town.

The vulnerability of local monumental heritage against flooded waters was first brought to attention following the 1970 flooding, which caused 19 casualties, 500 homeless and losses of about US$60 million in the productive sector.

An extensive survey of the available records of flooding episodes during the last 100 years was completed in order to derive a map of historically flooded areas. The study concludes that the vulnerability to flooding of cultural monuments can hardly be addressed at the scale of a single monument or art piece. Thus, projects involving the whole area of the historic centre are recommended. Results from the study also illustrate that the problem is mainly of a hydrologic/hydraulic nature; therefore, hydraulic solutions must be at the base of the intervention.

Source: Lanza, 2003

URBAN PROCESSES GENERATING DISASTER RISK

This section presents an examination of the root causes of vulnerability in cities exposed to natural and human-made disaster risk. First, the impact of patterns of growth of mega and large cities and of the many intermediate and smaller human settlements on disaster risk is reviewed. Second, the ways in which urban processes generate risk through modifying the physical environment and through the extent and impact of poverty in urban slums is examined. Third, the role of urban management and, in particular, of building construction, urban planning and the influence of international action on urban development is reviewed. These topics are returned to in Chapters 8 and 11, where experience of, and future potential for, disaster risk reduction is reviewed.

Growth and diversity of urban areas

Rapid urban growth, coupled with geomorphology, hydrology, politics, demography and economics, can create and exacerbate landscapes of disaster risk in a variety of ways (see Box 7.8). Global statistics on urban growth are as impressive as those on disaster loss.[52] UN-Habitat's *State of the World's Cities 2006/2007* shows that during 2000 to 2015, 65 million new urban dwellers will be added annually, 93 per cent of these in developing countries. Asia and Africa are the most rapidly urbanizing regions. In 2005, urban populations were 39.9 per cent in Asia and 39.7 per cent in Africa, increasing to 54.5 per cent and 53.5 per cent, respectively, in 2030.[53] By this time, over 80 per cent of Latin America's population will be urban based.

Rapid urban growth … can create and exacerbate landscapes of risk in a variety of ways

Urban settlements are becoming larger and more numerous through a combination of natural population growth and in-migration. Political stability and economic opportunity can lead to small rural settlements expanding into towns, as is happening in Central America, and taking on new social and environmental challenges and opportunities in which urban managers might not be experienced. At a larger scale, rapid expansion of urban corridors, such as that along China's seaboard, can reconfigure risk profiles at the regional level.

For cities, there is a constant pressure to keep pace with, if not lead, change in regional and global economic development. This, in turn, can be a force contributing to uncontrollable urban expansion and the generation of more vulnerability to disasters. Mumbai, for instance, shifted its industrial base from import substituting to export orientation in response to changes in the global political economy. This led to industrial relocation from the central city to highways extending beyond the city limits, catalysing massive population growth in the urban periphery. Some settlements reportedly grew to six times their original population, outstripping the capacity of urban planning and infrastructure provision.[54]

Foreign investment can bring new prosperity to a city and its residents and be a resource for risk management. However, competing for foreign capital investment can also

Box 7.8 Rapid urbanization and environmental hazard in Dhaka, Bangladesh

Dhaka has a population of 11.6 million, and this is rising fast. The city is built on alluvial terraces and is exposed to flooding from rivers, direct rainfall, coastal flooding and earthquakes. With so many sources of natural hazard, one might ask how a city came to thrive in such a location.

The city's growth has been tied to its political importance. The city was established as the capital of Bengal in 1610. In 1905, Dhaka became the capital of East Bengal and in 1947 it was designated the capital of East Pakistan, with the greatest growth after independence when Dhaka became the capital of Bangladesh. In 1971, there were between 1 million and 2 million residents. Throughout the modern period, expansion has seen the conversion of marshes and farmland into urban land use. High-rise commercial and residential buildings have become increasingly used to cater for growth and are predominantly located in the higher areas of the city.

Despite its long history, 90 per cent of population growth and associated urban expansion into areas at risk has occurred since 1971. Initial expansion to the north of the city captured higher ground above flood levels or on earth-filled lower-lying sites. More recent expansion has continued northwards over low-lying land. Inequality is extreme in the city, with the richest 2 per cent of the residents occupying 20 per cent of the city's land. Some 30 per cent of the city's population fall below the poverty line and live in increasingly marginalized and hazardous slums and squatter settlements.

The multiple relationships between urbanization and hazard are well exemplified in Dhaka. Rapid population growth is partly fuelled by rural migrants who have been made homeless by flooding, cyclones or shifting river beds in rural districts. The neglect of small towns also increases the pull of Dhaka as a place of economic opportunities. Urban expansion in Dhaka is swallowing adjacent agricultural land, reducing opportunities for sustainable local food production.

Industrial risk has increased as industrial zones that were originally on the outskirts of the city have been swallowed by sprawling residential areas. These residential zones fall outside of land-use planning and regulations. Fire is a problem in these areas and in densely populated slum districts.

Source: Huq, 1999

Increasingly, urban planners are looking for ways in which … disaster risk-reduction … can scale down … to semiautonomous local planning and action zones

be a pressure leading to an increase in vulnerability through the lowering of employment rights or environmental protection legislation. The 3500 deaths from a toxic gas leak in Union Carbide's plant in Bhopal (India) in 1984 can be explained by just such a cocktail of pressures.[55]

Urban populations follow industrial investment, so that large cities also contribute substantially to their country's GDP. For instance, Mexico City is responsible for around one third of Mexico's GDP. Large cities and megacities,[56] in particular, create huge concentrations of people and physical and financial assets, and are frequently also cultural and political centres. They generate the potential for substantial losses from single large disaster events, creating new challenges for risk management. Increasingly, not only the balance of urban populations, but also the world's largest cities, will be found in Africa, Asia and Latin America and the Caribbean.[57]

Not all large urban centres have similar vulnerability profiles. At a broad level, differences exist between those cities that form part of the core global economy (London, Paris, New York and Tokyo) and are globally connected (Mexico City, Johannesburg, Alexandria and Mumbai), on the one hand, and, on the other, those that are large but only loosely connected globally (Lagos, Nairobi and Khartoum). While this division is simplistic, it serves well to illustrate the different economic base, political institutions and management capacity that is found in large cities and megacities worldwide.

Small cities of less than 500,000 are home to the large majority of the world's urban dwellers, with the total population of small urban areas exposed to environmental risk exceeding the total at-risk population resident in megacities.[58] Small cities may be especially susceptible to complete destruction in a single event – for example, a volcanic eruption and mudflow in Amero (Colombia) in 1985 killed most of the city's 25,000 inhabitants.[59] Despite this, the majority of research and investment have, to date, focused on large cities and megacities.

While smaller settlements might, as a last resort, be relocated to avoid hazard risk, this becomes increasingly problematic with large cities. There has been some talk of moving major cities away from zones of earthquake risk, as in the case of Tehran, where a large earthquake could claim 720,000 lives and bring the country to a standstill.[60] Simply scaling up risk management procedures developed for relatively smaller cities might not be the best option for building security into megacities. Increasingly, urban planners are looking for ways in which infrastructure, land-use and disaster risk reduction and response planning can scale down from master plans at the city level to semi-autonomous local planning and action zones. However, experiences of managing disaster risk in larger cities should not be uncritically applied in small urban areas where political, economic, social and environmental contexts and capacities will differ (see Box 7.9).

Even where urban expansion is planned, disaster risk can be generated. In El Salvador, free trade zones in San Bartolo, El Pedregal, Olocuilta and San Marcos were promoted by the government without adequate concern for earthquake hazard. During the 2001 earthquake, large losses were reported from among migrant workers who supplied labour to foreign-owned enterprises in these new towns.[61] Thus, to understand the motors shaping trends in urbanization and disaster risk, it is necessary to look beyond population statistics to changes in the form, composition and governance of human settlements.

Box 7.9 Disaster risk in a small city: Shimla, India

Shimla is a small settlement in India, with a population of 140,000. The city is located in the north Indian Himalayas in an area of high seismic activity. On 4 April 1905, an earthquake of 7.8 on the Richter scale damaged much of the city. While the city was designed for 25,000 occupants, it now houses up to 140,000 as permanent residents and another 100,000 transitory population. Urban development has proceeded apace and without due regard for hazard management. Risk has accumulated as the city has developed.

Capacity for urban planning has not been able to keep pace with development, although recent initiatives have built disaster management capacity. The non-governmental organization (NGO) Sustainable Environment and Ecological Development Society has worked with the municipal corporation of Shimla to build resilience. An earthquake risk assessment has been conducted that has flagged several urban processes as contributing to risk:

- Rapid unplanned growth has occurred so that residential districts – but also critical infrastructure (e.g. hospitals, power stations, telecommunication installations and water supply stations) are located in hazard zones.
- Most buildings are residential (over 75 per cent) and the city is high density. Both of these factors limit the amount of spare capacity space that could be used for public shelter in the event of a large disaster.
- Many of the buildings are not accessible from roads (72 per cent) and many are on steep hill slopes, making evacuation and relief difficult.
- Emergency services are under-funded. Only 100 fire fighters with six fire engines serve the city and its surrounding region.
- The building stock is predominantly of a poor condition. Existing building stock is poorly maintained, particularly in the rental sector, coupled with a preference for building with unsafe material, such as brick or concrete with minimal reinforcement. Some 36 per cent of the city's building stock has been classified by the Sustainable Environment and Ecological Development Society as being of very poor quality.
- Many buildings are inappropriately high for an earthquake region. At least 24 per cent of buildings have three or more stories, 40 per cent of which are built on steep slopes on top of un-compacted soil.
- Around 15 per cent of Shimla's building stock was constructed before 1925 and is built of wood. This is a concern for half of these structures, which have not been properly maintained, leading to decay. In the old districts of the town, the high density of building means that adjoining buildings are put at risk.
- Seismic building codes were introduced in 1971. About 30 per cent of the buildings were constructed before this ordinance was passed; but a lack of regulation enforcement means that some 80 per cent of buildings do not meet standards.

Source: Gupta et al, 2006

Environmental change and poverty in cities

The economic imperatives that drive urbanization also play a large role in determining the status of the urban environment and ecosystems, as well as the extent and depth of poverty, wealth and inequality in the city. This sub-section reviews the ways in which urbanization processes generate risk by shaping the environment of the city and the growth of slums. The role of global environmental change on disaster risk in cities is also considered.

Modifying the hazard environment

Consumption of natural assets (trees for fuel, groundwater, sand and gravel) and the overexploitation of natural services (water systems and air as sinks for sewerage or industrial waste) modify the environment and generate new hazards. These include deforestation and slope instability within and surrounding cities, encouraging landslides and flash flooding. Such changes to the urban environment do not impact upon citizens equally.

Recent evidence illustrates that with increasing affluence and through the use of technology, those who produce waste and risk can avoid the consequences both in time and space. Thus, the environmental costs of over-consumption by the wealthy become burdens for the poor, who are forced to live not only in unsafe and insecure housing, but also with urban pollution and environmental degradation.[62] Climate change is the most extreme example of this thesis. High consumption by the rich and in aggregate by richer cities has contributed 80 per cent of carbon emissions that cause climate change. Yet, it is the less wealthy and the poor in cities, towns and villages who will least be able to cope with and adapt to the local impacts of climate change, either directly or collectively through government or social actions.[63]

Flooding, perhaps more than any other hazard type, has been exacerbated by the physical processes of urbanization. Flood risk has been made worse in urban areas through the silting of natural water courses and the lowering of water tables, followed by salt intrusion or land subsidence. Building roads and houses makes it harder for rainwater to drain through the soil, leading to more frequent flash flooding in cities. The loss of mangrove ecosystems on urban fringes leads to coastal erosion and exposure to storm wind and waves. Similarly, deforestation on hill slopes within and surrounding settled land can create instability and lead to greater landslide hazard. Many losses to Hurricane Mitch, during 1998, in Central America were in small regional towns smothered by mudslides or flash floods caused by deforestation in adjacent agricultural areas.[64] Increased losses to flooding can also be expected as the number and size of urban settlements in coastal areas increases.[65]

Inadequately built multi-storey construction has been a cause of losses in many urban disasters…

The urban landscape itself is changing the context of natural and human-made disasters. Inadequately built multi-storey construction has been a cause of losses in many urban disasters, and skyscrapers have also been the site for devas-

tating fires. In São Paulo in 1974, 189 people died in a fire in a 25-storey building.[66] The close proximity of residential, commercial and industrial land uses in a city can generate new cocktails of hazard that require multi-risk management. Calcutta and Baroda are just two cities where the close proximity of manufacturing, hazardous materials storage and residential areas has been a cause for concern.[67] The growth of slums whose residents' livelihoods are tied to solid waste dumps is a similarly common cause of hazard in large cities such as Manila, where 300 people were killed by a landslide in the city's Patayas dump.[68]

Climate change has far reaching consequences for the incidence and impacts of disasters in cities

The impact of climate change

Climate change has far reaching consequences for the incidence and impacts of disasters in cities. Cities are particularly vulnerable to the impacts of climate change, as this is where much of the population growth over the next two decades will take place and where a large and growing proportion of those most at risk from climate change reside.[69]

Rising global temperatures and the resultant changes in weather patterns and sea levels have direct impacts on cities. In particular, cities located along the world's coastlines will face an increased number of extreme weather events such as tropical cyclones, flooding and heat waves.[70] There has been a 50 per cent rise in extreme weather events associated with climate change from the 1950s to the 1990s, and the location of major urban centres in coastal areas exposed to hydro-meteorological hazards is a significant risk factor: 21 of the 33 cities which are projected to have a population of 8 million or more by 2015 are located in vulnerable coastal zones and are increasingly vulnerable to sea-level rise.[71] Around 40 per cent of the world's population lives less than 100 kilometres from the coast, within reach of severe coastal storms. In effect, close to 100 million people around the world live less than 1 metre above sea level. Furthermore, recent research shows that 13 per cent of the world's urban population lives in low elevation coastal zones, defined as less than 10 meters above sea level.[72] Thus, if sea levels rise by just 1 metre, many coastal megacities with populations of more than 10 million people, such as Rio de Janeiro, New York, Mumbai, Dhaka, Tokyo, Lagos and Cairo will be under threat. Indeed, several projections have indicated that sea levels are expected to rise by 8 to 88 centimetres during the 21st century due to climate change.[73]

… if sea levels rise by just one metre, many coastal mega cities with populations of more than 10 million people … will be under threat

Climate change also has less dramatic and direct effects on cities. In sub-Saharan Africa, climate change and the consequent extreme climatic variations is a key factor which causes rural populations to migrate to urban areas, thereby fuelling rapid and often uncontrolled urban growth.[74] In turn, this exacerbates other disaster risk factors such as the spread of settlements into easily accessible yet hazardous locations and unsafe building practices.

While cities remain vulnerable to the effects of climate change, they are also key contributors to global warming. Cities are responsible for 80 per cent of the carbon emissions that cause climate change through energy generation, vehicles, industry and the burning of fossil fuels and biomass in household and industrial energy consumption.[75] Levels of greenhouse gas emissions are higher in many cities of developed countries than in developing country cities. For instance, emissions from cities in North America and Australia are often 25 to 30 times higher than those of cities in low-income countries.[76]

Slums are characterized by inadequate and insecure living conditions that generate hazard…

The vulnerability of urban slums

Some 998 million people lived in urban slums in 2006, and if current trends continue, it is predicted that some 1.4 billion will live in slums by 2020.[77] It is not unusual for the majority of urban residents in cities to be excluded from the formal housing market. In Manila, informal settlements at risk to coastal flooding make up 35 per cent of the population; in Bogota, 60 per cent of the population live on steep slopes subject to landslides; and in Calcutta, 66 per cent of the population live in squatter settlements at risk from flooding and cyclones.[78]

Slums are characterized by inadequate and insecure living conditions that generate hazard; but they are also home to many people with few resources and, thus, high vulnerability. At an individual and household level, vulnerability to natural and human-made hazard is shaped by the kinds of physical, economic, social and human capital assets that people can command. Capacity to increase, protect or diversify an asset profile is largely determined by cultural, administrative and legal institutions and opportunities, such as security of tenure, access to markets, customary hospitality or the effectiveness of the rule of law. Many people in slums have fewer assets and supporting institutions than those living in formalized residential areas and are consequently highly vulnerable to harm from natural and human-made hazards, as well as from other risks associated with crime, violence and insecurity of tenure. Box 7.10 describes such risk conditions for those living in one of Rio de Janerio's slums.

The most important physical asset for the urban poor is housing. Housing provides personal security, but can also be a livelihood resource if it is the locus of home-based enterprises. Those with no home at all are perhaps the most vulnerable. During Hurricane Mitch in 1998, a disproportionate number of the victims were street children.[79] For those with homes, lack of secure tenure has many consequences for their quality of life.[80]

Lack of secure tenure, discussed in greater detail in Part III of this Global Report, reduces people's willingness to upgrade and therefore mitigate local environmental hazard. Renters as well as those living in squatter settlements are at risk from eviction, generating uncertainty before disaster and often resulting in homelessness post-disaster due to competing higher-value land uses. It is not unusual for disasters to be followed by the redevelopment of inner-city low-income rental or squatter areas during reconstruction, often (and famously, in the case of Mexico City) with widespread protest.

When people are excluded from the formal housing market through poverty, they are forced to live in places of risk. People often choose to face environmental hazards and increase their chances of earning a living than live in a more

Box 7.10 Living with risk in the *favelas* of Rio de Janeiro, Brazil

Rio de Janeiro is home to over 10 million people, of which nearly one third live in slums known as *favelas*. Many *favela* residents were originally squatters and the vast majority lack legal title to their homes. Rocinha, one of Rio de Janeiro's richest and most developed *favelas*, is home to between 100,000 and 150,000 people. Rocinha's highly prized location in the south zone of Rio (*Zona Sul*) includes famous seafront neighbourhoods such as Copacabana, Ipanema and Leblon. In the absence of state presence, except for frequent police incursions, it is controlled by those involved in organized drug trafficking. Violence caused by frequent intra-gang warfare and police invasions, coupled with densely populated living conditions, make the *favela* an undesirable place to live. Most inhabitants dream of saving enough money to move out of the *favela*; but very few ever do. Yet, living in Rochina is an advantage, given its proximity to some of Rio's richest neighbourhoods and, hence, potential sources of employment.

Rocinha's population is home to various social groups, and certain areas of the *favela* are more expensive to live in than others. The very bottom of the *favela*, across the highway from the wealthy neighbourhood of Sao Conrado, is relatively prosperous and many homes have legal titles. Neighbourhoods located further up the mountain are generally poorer and more prone to disaster because of the difficulty of building on a nearly vertical mountain slope. One of these neighbourhoods is Roupa Suja, the top of which is located right below a vertical wall of rock and considered a *Zona de Risco* – or risk area – by the Rio de Janeiro city government. Technically, residents are prohibited from building and living in this area; but many are so poor that they have no alternative place to build. The majority of the residents living in this area immigrated to Rio attempting to escape even greater poverty in the rural drought-stricken northeast. Others immigrated from different *favelas* in Rio after urban renewal campaigns razed many of these. Some also come from poorer *favelas* on the city's periphery.

Several people die every year in mudslides caused by heavy rains in Rio's *favelas*. Deforestation at the edge of Rochina, as it expands into the national forest of Tijuca, has worsened this risk. Rio's municipal government, as well as residents themselves, have built aqueducts to channel the water away from homes; but these do not protect all areas of the *favela*. The danger of falling rocks is perhaps greater than that of rain. Since the homes at the top of the *favela* are directly beneath a vertical overhang, rocks break off due to erosion and fall on the homes below.

Faced each day with multiple types of risk – from natural hazards, violence and disease – the residents of Roupa Suja's *Zona de Risco* lead a precarious and difficult life. Most stay because they have nowhere else to go.

Source: Carter, 2006

Income generation is a more immediate concern for the poor than disaster risk

environmentally secure location, but one that offers limited livelihood opportunities. Income generation is a more immediate concern for the urban poor than disaster risk. For 25 years, the Yemuna River drainage reserve in central Delhi has served as an informal settlement for just this reason.[81] Regular flooding has not reduced the demand for living space in this high-risk location.

The strong social bonds that exist in many slums can be a resource for building resilience; but slum dwellers can also experience social isolation, particularly when they are new to the city. Recent rural migrants are often identified as among the most vulnerable people in cities. In Dhaka (Bangladesh), for example, the urban poor are mainly rural migrants whose lack of access to secure housing and livelihoods is compounded by the absence of familial support.[82] Work in Los Angeles (US) has shown that legal and illegal migrants from Latin America live in the least well-constructed housing built before earthquake codes were introduced.[83]

Building control and land-use planning

A key determinant of the physical vulnerability of buildings and infrastructure in urban areas is the enforcement of building and land-use planning regulations. In the absence of such controls, or a lack of observance of the same, unsafe construction and land-use practices will flourish, generating greater vulnerability. This section examines the effects of safe building construction and land-use planning on urban disaster risk.

Safe building construction

The rapid supply of housing to meet rising demand without compliance with safe building codes is a principal cause of disaster loss in urban areas. The failure of urban administrations to enforce safe building practices exacerbates urban disaster risk in three ways:

The rapid supply of housing to meet rising demand without compliance with safe building codes is a principal cause of disaster loss in urban areas

- Unsafe housing increases the likelihood of injury and damage to property during a disaster.
- Debris from damaged buildings is a major cause of injury during and after disaster.
- The loss of dwellings through disaster places a major strain on individuals and on the sustainability of communities and cities.

There are few urban settlements that are not covered by building codes. However, in order for building codes to work, they need to be appropriate – that is, to be designed in light of prevailing and likely future hazard risks, and to take into account prevalent building materials and architectural customs. In particular, while some core aspects might be retained, the importation of one country's building codes to another requires careful thought. Jamaica's building codes were based on British templates; but these required revision to provide security in a country exposed to hurricanes.[84] In cities exposed to multiple hazards, careful judgement has to be used to balance risks in building design – for example, offsetting the preferred steep roof pitches for volcanic ash fall against the flatter roof design for properties exposed to hurricane-force winds.

Arguably, the most important reason for unsafe construction is the failure to implement and enforce building codes. Failure to enforce regulation was the principal cause of high losses among poor and middle-class households in the 1999 Marmara earthquake in Turkey,[85] and in the collapse of multi-storey buildings in Spitak in the Armenian earthquake in 1988.[86] Even among public buildings and critical infrastructure such as schools, unsafe construction continues in the face of building codes. The 2005 Pakistan earthquake destroyed 4844 educational buildings, 18,000 children were killed by the collapse of school buildings and 300,000 children were still unable to attend school six months after the event.[87] The collapse of schools was presumed to have resulted from poor-quality construction and construction materials, a lack of monitoring in the building processes, and a general lack of awareness of seismic risk and appropriate standards.[88]

Urban land-use planning has not succeeded in separating people from sources of potential human-made or natural hazard

Municipal authorities are normally charged with overseeing construction standards, but are prevented from fulfilling their duty for several reasons. Lack of resources and human skills are perhaps greatest for smaller cities, where land-use or development planning departments may be absent, and responsibilities for overseeing construction standards become added to those of the city engineer or surveyor. In many cities, even these professionals may be absent and construction regulation is, in effect, non-existent. Resource scarcity can be compounded by institutional cultures that allow corruption to distort regulation and enforcement.

While lack of enforcement fails those who can afford to build safely, poverty and exclusion from the formal housing sector consign many, often the majority of urban residents, to living in unsafe dwellings. Unsafe building in slums is compounded by the burden of natural and human-made hazards found in these communities. The result is a deadly cocktail of human vulnerability, unsafe dwellings and high hazard. It is not surprising, then, that the poor, especially those living in slums, bear the brunt of natural disaster losses.

Land-use planning

Urban land-use planning has not succeeded in separating people from sources of potential human-made or natural hazard. In the UK, around 15 per cent of urban land, containing 1.85 million homes and 185,000 commercial properties, is built on land known to be at risk from flooding. Much of this land has been developed since the 1947 Town and Country Planning Act, which gave local authorities power to prevent floodplain development.[93] In this case, as in many others, pressure for local economic development has been given priority over flood risk management, with increasingly disastrous consequences demonstrated by widespread flooding in 1998 and 2000.

In middle- and low-income countries experiencing rapid urbanization, the capacity of town planning departments to measure, let alone manage, the expansion of urban land use is seriously inhibited. This is a major cause for the accumulation of disaster risk in human settlements. The spread of informal and slum settlements has already been identified as an acute concern. These settlements, at best, are only weakly influenced by land-use planning policy, so that internal structure as well as adjoining land uses and characteristics combine to produce disaster risk. Not only are slum settlements located in risky places, but high density also limits access for emergency vehicles and can in itself be a cause of hazard – for example, in spreading house fires.

Even in cities responsive to formal planning control, inappropriate policy can lead to increased risk. In many cities, widespread concretization and the infilling of natural drainage has increased flood hazard. In Bangkok, the conversion of drainage canals into streets now results in regular flooding.[94] In Georgetown, the capital of Guyana, uncontrolled expansion of the built environment, infilling of drainage canals and concretization has similarly increased the speed of runoff and reduced the water storage capacity and speed of natural drainage in the city, contributing to an increase in flooding.[95]

Box 7.11 takes up this theme with regard to Mumbai and looks in some detail at the ways in which poverty has come together with poor planning decisions and hazard management to generate flood risk.

Urban land-use planning is too often left outside of reconstruction planning. When reconstruction is undertaken

Box 7.11 Poverty and flooding in Mumbai, India

The 2005 monsoon brought disastrous flooding to Mumbai (India). Those worst affected were the most vulnerable – slum dwellers living in flood-prone locations and with little capacity to avoid or cope with flood impacts. Over half of Mumbai's 12 million people live in slums.[89] Because the majority of these slums are located on hill slopes, low-lying areas, coastal locations and pavements along water mains and open drainage systems, they are the most prone to flooding during times of heavy rainfall and high tides.

Typically, slum dwellers occupy land that is close to the streets or main transportation hubs, such as railways. These communities are constantly in danger from passing trains and are denied formalized access to water, sanitation and electricity because they build on land owned by the Indian Railways and other public or private companies.[90] Beyond this, encroachment onto this land is in conflict with the need to maintain transport and drainage networks. The survival strategies of Mumbai's poorest populations directly affect the city's ability to maintain disaster management infrastructure. By not addressing chronic housing and infrastructure problems, the entire city is exposed to flood hazard.

A risk analysis was undertaken as part of Mumbai's Disaster Management Plan (DMP) prior to the July 2005 floods. Subsequently, a mitigation strategy that focuses on public information systems, infrastructure and sanitation improvements, as well as land-use policies and planning, was developed. The strategy also includes a plan for coordination between public service providers, emergency personnel and disaster aid non-governmental organizations (NGOs).[91] Despite the DMP, the severity of the 2005 floods indicated just how much risk had accumulated over time in the city, built into the geography of its land use, the inadequacy of drainage, rapid urban expansion and tensions within the urban and state-level administrations, including competing interests of senior politicians who are also real estate developers and owners of commercial land.[92] The neglect of outdated zoning regulations and inflated land markets, in particular, contributed to the overall vulnerability of Mumbai and its inhabitants to flood risk.

The experience of the slum dwellers of Mumbai and their vulnerability to flooding is rooted in the larger socio-economic processes of the city (and beyond); but failure to address this vulnerability threatens the sustainability of the city as a whole – as well as the poor majority.

Source: Stecko and Barber, 2007

in the same sites without risk reduction measures, losses recur. A great lesson was learned in Rio de Janeiro when local landslides caused 1000 deaths in 1966, after which houses were reconstructed at the original sites and 1700 people were killed the following year.[96] Relocating disaster survivors away from hazardous sites is also problematic. Social and economic networks are not easy to maintain after relocation, and the loss of these assets, combined with potentially higher transport costs to find work or education and health services, can put an additional strain on individuals and households, thus undermining resilience.

International development policy and urban disaster risk

Urban planning is influenced by national and international development frameworks and priorities. The Millennium Development Goals (MDGs) have had a great impact on prioritizing the international development agenda. The most urban focused goal, target 11 of MDG 7, demands that a significant improvement in the lives of at least 100 million slum dwellers is achieved by 2020. This is an important motor for pro-poor urban planning, and efforts to improve the lives of slum dwellers should take natural and human-made disaster risk into account. There is scope here for indicators of urban vulnerability to disaster risk to contribute to a more holistic assessment of quality of life.

Meeting other MDGs will also be hindered if disaster risk reduction is not made more prominent in urban planning. The great potential for disasters that hit urban areas to destroy critical infrastructure and set back development gains can undermine progress in meeting MDG 1, which calls for the halving, between 1990 and 2015, of the proportion of people whose income is less than US$1 per day. MDG 2 calls for governments to ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling. A great deal of investment has been made in building new primary schools; but only seldom are they designed to disaster-resistant standards. The result is that more children are placed at risk and development gains are liable to be lost. In the Pereira earthquake in Colombia in 1999, 74 per cent of the region's schools were damaged.[97]

Urban risk accumulation was accelerated by the debt crisis and subsequent structural adjustment programmes of the 1980s and 1990s that forced governments throughout Latin America, Asia and Africa to slash subsidies on food, electricity and transportation and to retrench public-sector workers. The impact of these policies was perhaps most visible in the food riots of sub-Saharan Africa, triggered by the removal of subsidies on the price of food.[98] Poor people responded to the economic downturn by putting more family members (especially women and school-age children) into the labour market and by pulling back from long-term investments in children's education and in housing improvement, in this way reducing long-term resilience to disaster. In addition, the cumulative impact of inequality and privatization may have further removed poor people from accessing legal land markets, leading to the proliferation of informal settlements, often in cheap and hazardous locations.

During the early 21st century, World Bank lending has been repackaged, with the stated aim of enabling greater country leadership through national poverty reduction strategies, initially proposed through national Poverty Reduction Strategy Papers (PRSPs). Yet, little work has examined the consequence of the PRSP framework for natural disaster reduction. One study found that few national plans mentioned disaster risk reduction beyond the need for early warning. With many municipal and city administrations having uncomfortable political relationships with national administrations, the extent to which PRSPs enable or constrain municipal government control over financial budgets and access to international support will have a profound impact on urban development and disaster risk reduction. This falls short of an integrated risk reduction approach.[99]

…efforts to improve the lives of slum dwellers should take natural and human-made disaster risk into account

Half of all post-disaster borrowing provided by the World Bank goes to housing reconstruction. A recent review of reconstruction financing argues that this practice exposes funds to capture by local and national elites, thus contributing to urban inequality and vulnerability in ways that other targets for reconstruction funds that would remain as public goods (such as critical infrastructure) might not.[100]

Opportunities for disaster reconstruction funding to contribute to the building of urban resilience have too often been missed by urban, national and international agencies. Where national catastrophe funds are not available, funds earmarked for development works are vulnerable to being diverted to finance reconstruction. This is a principal pathway for the indirect systemic impacts of disaster. International finance has similarly contributed in the past to the perpetuation of cycles of urban poverty, environmental degradation and disaster through disaster reconstruction loan agreements that have increased indebtedness, reducing options for future economic growth or anti-poverty policy.[101]

Meeting … MDGs will … be hindered if disaster risk reduction is not made more prominent in urban planning

COMPARATIVE ANALYSIS OF GLOBAL TRENDS

This section provides a comparative analysis of urban disaster incidence and impact for each world region: Africa, the Americas, Asia, Europe and Oceania. This scale of analysis covers great diversity at the national and sub-national levels, but is useful in flagging the major natural and human-made disasters affecting human settlements and the barriers to disaster prevention and mitigation specific to each region.

Africa

Flooding is the most frequent natural disaster type in Africa and results in the highest mortality (see Table 7.9). Earthquakes, floods and storms cause the greatest economic loss and drought affects the most people. Food insecurity resulting from drought can affect urban societies indirectly through food price fluctuation and the in-migration of refugees. Economic loss to disasters is low for Africa,

Table 7.9

Disaster incidence and impacts in Africa (1996–2005)

Note: For all disaster types, small events with less than 10 mortalities or 100 affected people are not included.

Source: EM-DAT, CRED database, University of Louvain, Belgium, www.em-dat.net

	Number of events	Mortality	People affected (thousands)	Economic loss (US$ million, 2005 value)
Avalanches/landslides	11	251	3	No data
Drought/famines	140	4656	173,979	334
Earthquakes/tsunamis	20	3313	361	5824
Extreme temperatures	7	168	0	1
Floods	290	8183	23,203	1880
Volcanic eruptions	5	201	397	10
Windstorms	74	1535	3902	1082
Industrial accidents	49	2785	10	838
Miscellaneous accidents	94	2847	189	23

compared to other world regions, but is high as a proportion of GDP.

Between 1996 and 2005, more people were killed or affected by volcanic eruptions in Africa than in any other region, despite incidence (five events) being low (see Table 7.9). Low incidence in Africa is explained by the long return periods for volcanic eruptions, unlike in other world regions that are more exposed to volcanic risk. The high loss-to-event ratio indicates low resilience and this was demonstrated in the volcanic eruption of Mount Nyiragongo, which destroyed 40 per cent of buildings and displaced 250,000 persons in Goma (Democratic Republic of Congo) in 2002.[102]

Neo-liberal policies … have scaled down state responsibilities for risk reduction and response…

African rates of urbanization are the most rapid in the world, albeit from a low base. The poverty of countries in this region severely limits household coping capacity and the capacity of governments to build resilience and undertake risk reduction. There is a growing and, in some cities, strong civil society presence that provides coordination for grass-roots actions. The lack of regional governance for risk reduction is a serious limiting factor preventing South–South learning across the region. Limited capacity to regulate industry also means urban settlements in this region have among the highest rates of industrial disaster worldwide. Widespread poverty and vulnerability make this region highly susceptible to the local impacts of global environmental change. Vulnerability is exacerbated by conflict, chronic disease and weak governance.

North African countries have higher levels of urbanization and development than sub-Saharan Africa. Poverty and inequality remain high; but government risk reduction capacity is stronger than in sub-Saharan Africa, although in some states limited civil society presence constrains the building of resilience outside of state-sanctioned activities. In this sub-region, risk management is led by technological and engineering sectors. For example, great advances have been made in mapping urban earthquake risk and designing earthquake-proof structures. A lack of focus on governance and social development has created challenges for implementing and enforcing codes.

Americas

Across all regions, the Americas experience the greatest economic loss from natural disasters (see Table 7.10). In 2005, Hurricane Katrina alone caused US$81.2 billion in economic damage in the US (see Table 7.3). Windstorms (including hurricanes and tornadoes) are the most frequent type of disaster, affect the greatest number of people and cause the highest total economic costs. In turn, windstorms can trigger flooding and landslides. Indeed, flooding is a high incidence event that causes the greatest number of deaths for any disaster type in the region and also records a high mortality count. In 1998, Hurricane Mitch devastated Honduras and Nicaragua, killing over 9000 people, many of whom lost their lives to landslides.[103] The impacts of volcanic eruptions have been limited despite the region experiencing 46 per cent of the global recorded events from 1996 to 2005. This suggests good levels of resilience to this hazard type.

North America is a wealthy and highly urbanized region. Canada and the US have strong states and active civil societies providing top-down and bottom-up risk reduction capacity. Mexico is a large economy with a strong state and active civil society, but is weakened by extensive poverty and tensions in governance, particularly related to indigenous and marginal urban and rural populations. Neo-liberal policies, particularly in the US and more recently in Mexico, have scaled down state responsibilities for risk reduction and response and placed greater emphasis on the role of private citizens and companies. This has had mixed results for urban

Table 7.10

Disaster incidence and impacts in the Americas (1996–2005)

Note: For all disaster types, small events with less than 10 mortalities or 100 affected people are not included.

Source: EM-DAT, CRED database, University of Louvain, Belgium, www.em-dat.net

	Number of events	Mortality	People affected (thousands)	Economic loss (US$ million, 2005 value)
Avalanches/landslides	42	1632	203	97
Drought/famines	51	54	15,287	4094
Earthquakes/tsunamis	45	2861	3757	7689
Extreme temperatures	33	1597	4037	5620
Floods	281	38,028	9525	27,903
Volcanic eruptions	23	54	283	22
Windstorms	321	28,110	25,278	234,680
Industrial accidents	39	277	576	1245
Miscellaneous accidents	70	2989	12	1609

	Number of events	Mortality	People affected (thousands)	Economic loss (US$ million, 2005 value)
Avalanches/landslides	112	5464	1579	1265
Drought/famines	87	216,923	639,190	16,380
Earthquakes/tsunamis	171	364,651	33,392	70,060
Extreme temperatures	48	9854	895	3650
Floods	472	42,570	1,255,118	129,055
Volcanic eruptions	13	3	211	3
Windstorms	340	31,900	289,215	62,449
Industrial accidents	361	10,056	716	696
Miscellaneous accidents	220	8401	172	14

Table 7.11

Disaster incidence and impacts in Asia (1996–2005)

Note: For all disaster types, small events with less than 10 mortalities or 100 affected people are not included.

Source: EM-DAT, CRED database, University of Louvain, Belgium, www.em-dat.net

resilience to natural and human-made hazards, as was seen in the failed state response and recovery efforts during Hurricane Katrina in 2005. Technical capacity for disaster risk reduction in the region is very high.

South America is highly urbanized and predominantly middle income. There is large aggregate economic capacity, but also great socio-economic inequality in the cities of the region. Financial and political instability have undermined resilience at all scales. Colombia is worst affected and suffers from significant internal conflict. Despite this, the country has also demonstrated regional leadership in urban planning for risk reduction, saving lives from landslide and earthquake hazards, in particular. Technical capacity is high and, in some countries, this is matched by strong civil society action to build physical and social resilience. Where there is state capacity, industrial hazard is contained through regulation. Earthquake, flood, drought, fire, windstorm and temperature shock are the most important natural hazards for this region.

Central America and the Caribbean comprise the poorest sub-region in the Americas. Urbanization levels are high and cities are characterized by high levels of poverty and inequality. Past political tensions have made for strained civil society–state relations; but there is capacity for coordinated top-down and bottom-up risk reduction. Industrialization is high, with potential for industrial hazard, but is spatially disbursed. Resilience comes from a strong regional level of governance, which reinforces state capacity for early warning and response capacity. Earthquakes, hurricanes and flooding are the primary hazards for this region.

Asia

Asia is the most disaster-prone region. The incidence of disasters associated with avalanches or landslides, earthquakes or tsunamis, floods, windstorms and industrial accidents is higher than for any other region. The high density population means that mortality is highest in this region for all disaster types, with the exception of volcanic eruptions. The number of people affected is also highest in this region, with the exception of volcanic eruptions and extreme temperatures (where more people in the Americas are affected). Economic loss is similarly the highest in this region for all disasters, except for extreme temperatures, volcanic eruptions, industrial accidents (Europe has the highest) and miscellaneous accidents (the Americas have the highest).

Table 7.11 shows the diversity of incidence and impacts within the region. Flooding is the most frequent natural hazard affecting the largest number of people and causing the greatest economic losses. Earthquakes and tsunamis cause the greatest mortality, with the 2004 Indian Ocean Tsunami accounting for around 230,000 deaths.[104] Human-made disasters are also high in their incidence and human impact.

Asia is the most disaster-prone region

The region's high economic and population growth rates make it set to be a major net contributor to global environmental change. Inequality in the region means that this is also a region at high risk from the local impacts of global environmental change.

Southeast Asia, from China to Indonesia, is middle income, with high levels of urbanization and urban growth rates. This region contains many countries with the highest levels of exposure to natural and industrial hazards, but also with great experience of risk management. Capacity for building resilience is limited by governance, with tensions between civil society and state actors found across the region. Political tensions, weaknesses in governance, economic inequality and rising levels of chronic illness are the chief barriers to resilience.

South Asia covers the Indian subcontinent and is a middle- to low-income sub-region. Urbanization is variable, with many large cities and megacities, but also with substantial numbers of intermediate and small settlements. With the exception of Afghanistan, strong states with good administrative capacity have led disaster management. During recent years, civil society has gained in strength, and in India, in particular, partnerships with the state have built resilience. Political tensions in the region and within countries constrain risk reduction capacity.

West and Central Asia includes middle-income states, from Turkey to Uzbekistan and Iran, as well as high-income oil-producing Gulf states. Urbanization and industrialization levels are high. The region is characterized by strong states and weak civil societies. A consequence of this is that risk reduction has tended to be delivered in a top-down manner and is dominated by engineering solutions. There is limited scope for bottom-up initiatives that seek to reduce risk through the building of social and economic capacity. Questions of governance constrain the extent to which top-down risk reduction policies have been effective in reaching the poorest and most marginalized populations with the highest levels of vulnerability. Regulation of industrial standards is similarly weakened, increasing risk from industrial hazard.

Table 7.12

Disaster incidence and impacts in Europe (1996–2005)

Note: For all disaster types, small events with less than 10 mortalities or 100 affected people are not included.

Source: EM-DAT, CRED database, University of Louvain, Belgium, www.em-dat.net

	Number of events	Mortality	People affected (thousands)	Economic loss (US$ million, 2005 value)
Avalanches/landslides	18	389	14	20
Drought/famines	14	0	1063	8019
Earthquakes/tsunamis	52	18,584	4016	29,609
Extreme temperatures	79	48,630	771	6706
Floods	229	1422	5048	47,860
Volcanic eruptions	2	0	0	24
Windstorms	110	610	7025	18,138
Industrial accidents	56	844	71	11,100
Miscellaneous accidents	73	1474	14	874

Europe

The role played by relatively high levels of economic development and political stability in shifting the impact of disasters from human to physical assets can be seen most clearly in this region (see Table 7.12). This is exemplified by volcanic eruptions, where Europe suffers the highest economic losses of any region, but no people have been killed or affected. Vulnerability and human loss is highest, compared to other world regions, for extreme temperature events. Between 1996 and 2005, Europe experienced 47 per cent of all extreme temperature events, but 81 per cent of all mortalities. Compared with Europe, the Americas experienced less than half the number of extreme weather events, with comparatively few deaths, but four times the number affected. This reflects the different severity of events, but also greater investment in early warning and response for extreme temperature in the Americas.

Within Europe, floods were the most common disaster between 1996 and 2005. Mortality was highest for extreme temperatures, with around 35,000 premature deaths from the 2003 heat wave alone.[105]

Europe is a high-income and highly urbanized region. Risk profiles for this region are split between the east and west. Western Europe has strong states and civil societies providing good capacity for resilience. It is also a region with relatively low levels of hazard exposure. Eastern Europe is more variable, with examples of strong states but weak civil society, and with governance challenges that limit regulation of industrial activity and capacity for top-down programmes aimed at vulnerability reduction. This region is also economically poorer than Western Europe.

Oceania records the lowest incidence of disasters for any region and hazard type…

Oceania

Oceania records the lowest incidence of disasters for any region and hazard type, with the exception of volcanic eruption (see Table 7.13). This is the only region not to record any industrial accidents from 1996 to 2005. The region had the lowest economic losses and absolute number of people killed and affected by all disaster types. Within the region, disasters are most commonly associated with windstorms, and these result in the greatest economic losses. Earthquakes and tsunamis account for the highest levels of mortality.

The region is of mixed economic status, but with high levels of urbanization. Poorer countries also tend to have greater political tensions, often between indigenous and immigrant populations. Many are small island developing states facing particular governance challenges within a context of limited human resources. Larger countries, especially New Zealand and Australia, have strong states and civil societies, as well as robust economies. Yet, inequality undermines resilience in these multicultural societies. For low-lying small island states, sea-level rise due to climate change will have catastrophic implications.

CONCLUDING REMARKS

Urban disasters are a product of failed urban governance and planning. Wealth is necessary for building resilience at the local and city levels, but is not sufficient in the absence of governance. Without good governance and open participation in urban planning, economic development too often leads to inequality and failures to implement regulation in the industrial and residential sectors.

The relationships between urbanization and disaster risk are dynamic. Past urban civilizations have collapsed

Table 7.13

Disaster incidence and impacts in Oceania (1996–2005)

Note: For all disaster types, small events with less than 10 mortalities or 100 affected people are not included.

Source: EM-DAT, CRED database, University of Louvain, Belgium, www.em-dat.net

	Number of events	Mortality	People affected (thousands)	Economic loss (US$ million, 2005 value)
Avalanches/landslides	8	128	1	No data
Drought/famines	8	88	1083	329
Earthquakes/tsunamis	9	2201	36	No data
Extreme temperatures	1	0	0	221
Floods	38	34	96	1735
Volcanic eruptions	7	4	49	No data
Windstorms	72	255	832	2859
Industrial accidents	0	0	0	No data
Miscellaneous accidents	4	46	12	No data

because of overstretching the ecological basis of their economies, leading to political conflict and terminal decline. Future new risks might include those associated with global environmental change and also with the increasing connectivity of urban centres worldwide that enables the transmission of economic impacts through transport and finance networks.

Global hazard maps can be used to indicate the distribution of risk. Richer countries are most at risk from absolute economic loss, whereas poorer countries suffer more human loss, as well as economic loss, as a proportion of GDP. Human-made risk and recorded loss is greatest in low-income countries, especially in sub-Saharan Africa. The largest concentrations of urban populations, in megacities, represent focal points for urban risk, especially those cities exposed to multiple hazards and with limited capacity for risk management.

Disaster impacts are seldom fully measured. This is a particular problem for cities since they house much of the accumulated cultural heritage of the world. Direct economic loss from damage and human impacts can be accounted for; but longer-term impacts on economies, or individual loss and psychological trauma, are much more difficult to measure. Disaster losses are often compounded when one event triggers a secondary event, or when recovery and reconstruction activities lead to ecological damage and social disruption. The social and political impacts of disasters are especially sensitive to reconstruction, with this being an opportunity for improvements in governance, as well as in basic needs.

This chapter identified the following aspects of urbanization that shape disaster risk:

1. Large cities and megacities concentrate and magnify risk.
2. Smaller cities (less than 500,000 residents) that are home to just over half of the world's urban population also experience exposure to multiple risks, but are likely to have limited formal capacity and organized civil society with which to build resilience.
3. Ongoing demographic and social changes in cities are a challenge since social groups at risk may alter, requiring flexibility in disaster management. Nevertheless, the economically poor, politically marginalized and socially isolated (often women) are consistently the most vulnerable.
4. Urbanization processes modify the hazard profile of the city directly – for example, through the urbanization of hill slopes and floodplains – but also indirectly as the impacts of climate change hit cities (the sites for a large proportion of greenhouse gas emissions).
5. Building standards are in place in almost all cities, but they are seldom implemented. This, more than any other policy challenge, highlights the need for social policy to connect with technical and engineering solutions to risk management.
6. The increasing numbers of urban residents forced to live in slums and squatter settlements is an indication of the depth of failure of urban governance to provide even the most basic needs and to protect the political, social, economic and cultural rights of all. Slums and squatter settlements are places of great hazard, but also of great potential. Governance structures that can partner with this local energy can reduce risk.
7. Urban planning is seriously under capacity in most cities. It is almost impossible for many planning departments to keep pace with rapid urbanization. New techniques in urban planning are needed that can extend formal practices into the informal housing sector. Meeting the MDGs is dependent upon this.

Taking urban disaster risk management seriously requires an integrated approach. For this reason, it is of concern that very few national Poverty Reduction Strategy Papers include risk management. Although it is not unusual for urban plans to integrate hazard mitigation, the next step is to match this with a commitment for vulnerability reduction that includes relevant social and economic policy.

Comparing urban risk at the regional scale re-emphasizes the centrality of urban governance as a driver for urban risk profiles. In those cities where strong government and civil society sectors take risk reduction seriously, great gains can be made.

NOTES

1 One exception is the Australian government, which defines a small disaster as one where state expenditure (on all assistance measures) does not exceed AU$240,000 (US$185,500), roughly equivalent to the cost of repairing 20 houses.
2 Kasperson et al, 1996.
3 Blaikie et al, 1994.
4 Data is drawn from the EM-DAT, CRED database. Only events that exceed a minimum threshold of 10 deaths, 100 people affected or a call for international assistance or declaration of a state of emergency are included. Consequently, many small disasters will have been excluded. This is likely to have affected data on transport and is also reflected in the absence of a category for house fires.
5 This is a term used in EM-DAT, CRED to describe accidents involving mechanized modes of transport. It comprises of four disaster subsets involving air, boat, rail and road accidents.
6 The current millennium has been dubbed the 'urban millennium' given that, in 2007, for the first time in history, the world's urban population will equal the rural population (UN-Habitat, 2006e).
7 Kreimer et al, 2003.
8 IFRC, 2003.
9 *Ibid*.
10 A global geography of natural disaster risk based on exposed populations and past losses (1980 to 2001) illustrates that both predominantly rural and urban regions are at risk worldwide. Loss to hydrological hazard (floods, landslides and hurricanes) is most widespread, affecting human settlements in China, Southeast Asia and Central America, and in a band from Eastern Europe through Central and Eastern Asia. Loss to geological hazard (earthquakes and volcano eruptions) is most concentrated in Central Asia and the Mediterranean and Pacific Rim states (e.g. Japan, the US and Central America). The Americas show variable loss, with low levels of loss in North America. Central Asia is exposed to losses from the greatest number of hazard types. Likewise, the Black Sea region, Central America and Japan face multiple hazards. Data from Dilley et al, 2005; maps also adapted from this source.
11 *Ibid*.
12 *Ibid*.
13 EM-DAT, CRED, University of Louvain, Belgium,

www.em-dat.net/ (includes industrial accidents, miscellaneous accidents and transport accidents).
14 This was calculated using data from EM-DAT, CRED, which only includes loss data for events with at least 10 mortalities, 100 people affected, a national state of emergency or a call for international assistance. Thus, the many smaller natural and human-made disasters were not included in this calculation of mortality per event.
15 Munich Re, 2004.
16 *Ibid*.
17 Özerdem and Barakat, 2000.
18 See Washington (2007) for some insight into the ways in which different psychological orientations influence decision-making.
19 Guha-Sapir et al, 2004.
20 Yong et al, 1988.
21 Conchesco, 2003.
22 McGranahan et al, 2001; Benson and Twigg, 2004; ECLAC, 2004.
23 ISDR, 2003.
24 O'Rourke et al, 2006.
25 Ministry of the Environment, Republic of Indonesia (undated).
26 Tsunami Evaluation Coalition, 2006.
27 UNEP, 2005.
28 Shiozaki et al, 2005.
29 Guha Sapir et al, 2004.
30 Swiss Re, 2007.
31 These are aggregate figures and economic damages per event are higher in the Americas than in Asia, where there is a greater frequency of events.
32 UNCRD, 1995.
33 Özerdem and Barakat, 2000.
34 Pelling et al, 2002.
35 Munich Re, 2004.
36 Wisner et al, 2004.
37 Guha-Sapir, 1997.
38 Bern, 1993.
39 Enarson, 2000.
40 *Ibid*.
41 Norris (undated).
42 Bern, 1993.
43 Delgado et al, 2002.
44 Klinenberg, 2002a.
45 Twigg, 2004.
46 Freudenheim, 1980, cited in Albala-Bertrand, 1993.
47 Abney and Hill, 1966.
48 Taboroff, 2003.
49 UNDP, 2004; UNESCO at http://whc.unesco.org.
50 Vecvagars, 2006.
51 See, for example, debates summarized from the United Nations World Conference on Disaster Reduction, Kobe, 2005, session on Cultural Heritage Risk Management, www.unisdr.org/wcdr/thematic-sessions/thematic-reports/report-session-3-3.pdf.
52 United Nations, 2005; Clark, 2000.
53 UN-Habitat, 2006e.
54 Harris, 1995.
55 Shrivastava, 1996.
56 Cities with 1 million to 5 million inhabitants are defined as intermediate, while cities with more than 10 million inhabitants are referred to as megacities (UN-Habitat, 2006e, p5).
57 UN-Habitat, 2006e.
58 Cross, 2001.
59 Hardoy et al, 2001.
60 Astill, 2004.
61 National Labour Committee, El Salvador, 2001.
62 McGranahan et al, 2001.
63 Tibaijuka, 2006.
64 IFRC, 1999.
65 Nicholls, 2004.
66 Quarantelli, 2003.
67 See www.adpc.net/audmp/India.html.
68 Satterthwaite, 2006.
69 *Ibid*.
70 Klein et al, 2003.
71 McGranahan et al, 2007.
72 IPCC, 2001.
73 Barrios et al, 2006.
74 UNEP and UN-Habitat, 2005.
75 Satterthwaite, 2006.
76 Pelling, 2003.
77 UN-Habitat, 2006e.
78 Blaikie et al, 1994.
79 General Secretariat Central American Integration System, 1999.
80 UN-Habitat, 2003d.
81 Sharma and Gupta, 1998.
82 Rashid, 2000.
83 Wisner, 1999.
84 Brown, 1994.
85 Özerdem and Barakat, 2000.
86 Kreimer and Munasinghe, 1992.
87 Save the Children, 2006.
88 ISDR, 2005a.
89 Revi, 2005.
90 Patel et al, 2002.
91 Government of Maharashtra, Department of Relief and Rehabilitation (undated).
92 Dossal, 2005.
93 Tunstall et al, 2004.
94 Mitchell, 1999.
95 Pelling, 1997.
96 Alexander, 1989.
97 UNDP, 2004; and ISDR at www.unisdr.org.
98 Walton and Seddon, 1994.
99 DFID, 2005.
100 Freeman, 2004.
101 Anderson, 1990.
102 www.volcanolive.com/news16.html.
103 www.nhc.noaa.gov/1998mitch.html.
104 www.oxfam.org.au/world/emergencies/asia_tsunami.html.
105 Bhattachatya, 2003.

CHAPTER 8

POLICY RESPONSES TO DISASTER RISK

A variety of actors, ranging from the international to the local level, have sought to reduce disaster risk in urban areas through policy responses and interventions. While urban risk reduction policies are in their infancy, or altogether absent in some contexts, a number of innovative strategies have been developed and implemented successfully elsewhere. Risk reduction policies are also differentiated in terms of their orientation to shorter-term reconstruction and response needs or development-oriented strategies seeking to reduce vulnerability in the long term. These differences are partly shaped by the resources and technical capacity available to national and local actors, but also by their political will and commitment.

The aim of this chapter is to assess the policy responses of urban local authorities, national governments, civil society and the international community to disasters, both natural and human made. Responses designed to mitigate disaster impacts involve land-use planning, the design of buildings and infrastructure, early warning and emergency response systems. Hazard and vulnerability assessment techniques used to identify the locus and potential impacts of disasters are particularly useful in informing policy priorities and decisions. A critical and increasingly prevalent policy response to disaster risk focuses on strengthening household and local disaster resilience through social, legal and economic pathways. Protecting critical infrastructure and services, without which disaster response and recovery is obstructed, is also recognized as a necessary component of disaster risk reduction in cities. Financing disaster risk management remains a challenge and points to a critical role for the international community.

DISASTER RISK ASSESSMENT

The rapid growth of urban areas has, in many cases, far outstripped national and local capacities for formal data collection or planning services. Thus, a major challenge for responding to disaster risk is to assess human vulnerability, hazard and risk in a way that can enable action from national, international and local actors. Disaster risk assessment encompasses techniques that seek to determine (in quantitative or qualitative terms) 'the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend'.[1]

Risk assessment contributes to disaster risk reduction by informing policy priorities and decisions on resource expenditure. To effect change, risk assessment needs to be incorporated within new policies or legislation for disaster risk reduction. If undertaken in a participatory manner, the process of risk assessment can build local capacity and generate shared understanding of common threats and opportunities.[2] Risk assessments also provide information that is useful at all stages of the disaster risk reduction continuum: in everyday development planning, as part of preparedness and prevention pre-disaster, as well as in response and reconstruction post-disaster. There are at least ten kinds of information that risk assessment can provide:[3]

…a major challenge for responding to disaster risk is to assess human vulnerability, hazard and risk…

1. Identify those hazards from which an area is at risk.
2. Identify the location, character and probability of risks for relative risk assessment.
3. Determine who and what are vulnerable, relative vulnerabilities, and pathways that have been generated and maintained by people and places in states of vulnerability.
4. Assess the capacities and resources available for those at risk to ameliorate their vulnerability.
5. Identify perceptions of risk held by those people at risk.
6. Determine levels of risk that are acceptable to those at risk and the wider society.
7. Generate input for forecasting future human vulnerability, hazard and risk.
8. Provide input to decision-making for policy and project decision-making.
9. Generate assessments of the capacity of municipal and national governments to undertake reconstruction following disaster.
10. Catalyse the raising of risk awareness locally and among policy-makers.

Risk assessment involves not only an evaluation of hazards, but also the vulnerability of humans and the built and natural

environment vis-à-vis an analysis of exposure to hazard and susceptibility to harm, as well as capacity to respond to disasters. Hazard and risk assessments employ a range of techniques, from quantitative analysis built around scenario modelling and mapping to qualitative, non-technical approaches, depending upon the kinds of data that need to be generated.

Hazard mapping

…technical advances … for hazard mapping … are often lacking in developing countries…

Hazard assessment involves an analysis of the likelihood of occurrence of natural or human-made hazards in a specific future time period, including their intensity and area of impact.[4] Data generated through hazard assessments needs to be presented to decision-makers and communities at risk to raise awareness and enable the design of appropriate interventions and policies. One approach is the use of maps to depict the spatial location, size and frequency of hazards. This allows general statements to be made about the exposure of national urban systems and individual cities to hazards.

Mapping natural hazard

At the global scale, hazard mapping is well advanced for volcanic, earthquake, flood, wind and landslide hazards.[5] Many countries also have national hazard maps, particularly of geophysical hazards. While global- and national-scale hazard maps can help to identify national legislative or policy planning priorities, planning at the city level requires more detailed information. Many cities in middle- and high-income countries, particularly those which are administrative or industrial centres, have detailed single and multi-hazard maps. During the last decade, the number of cities with seismic hazard maps has increased.[6] Other hazards, such as flooding and extreme temperatures, vary spatially, requiring more continuous monitoring and mapping, which can be more costly.

The advent of geographic information systems (GIS), coupled with satellite imagery of disaster events, have revolutionized the amount of data that is now available worldwide. While technical advances have increased the potential for hazard mapping, they have also generated inequalities in hazard assessment capacities. Technical approaches require financial investment in hardware and human resources that are often lacking in developing countries and are beyond reach for poorer urban authorities. Partnerships between technical advisory bodies and national centres for disaster management offer a potential mechanism for technology and skill transfer. One example of this is the Government of India–United Nations Development Programme (UNDP) Urban Earthquake Vulnerability Reduction Project, shown in Box 8.1.[7]

Low-impact, high-frequency hazards are less likely to be mapped, despite their erosive impact on human health

Box 8.1 India's national hazard map: A foundation for coordinated disaster risk reduction

An example of cooperation in disaster risk reduction between an international organization and a national government is the Government of India–United Nations Development Programme (UNDP) Disaster Risk Management Programme. A key subcomponent of this programme is the Urban Earthquake Vulnerability Reduction Project, implemented between 2003 and 2007. The project aims to raise awareness of earthquake risk in urban areas among decision-makers and the public and to improve disaster preparedness.

Several of India's populous cities, including the capital, New Delhi, are located in zones of high seismic risk. National data on seismic hazard has been used to identify 38 cities with populations of 500,000 or more that have become the focus for the project. The map in Figure 8.1 was developed by the project and shows four levels of seismic risk and 60 cities from which the 38 partner cities were selected.

Key expected outcomes of the project, among others, include enhanced disaster risk management capacity, effective administrative and institutional frameworks for earthquake risk management in the most exposed urban centres, and development of emergency, preparedness and recovery plans for those urban centres. The project also intends to build local capacity for risk assessment, preparedness and response.

Source: adapted from UNDP India, www.undp.org.in/index.php?option=com_content&task=view&id=?84&Itemid=264

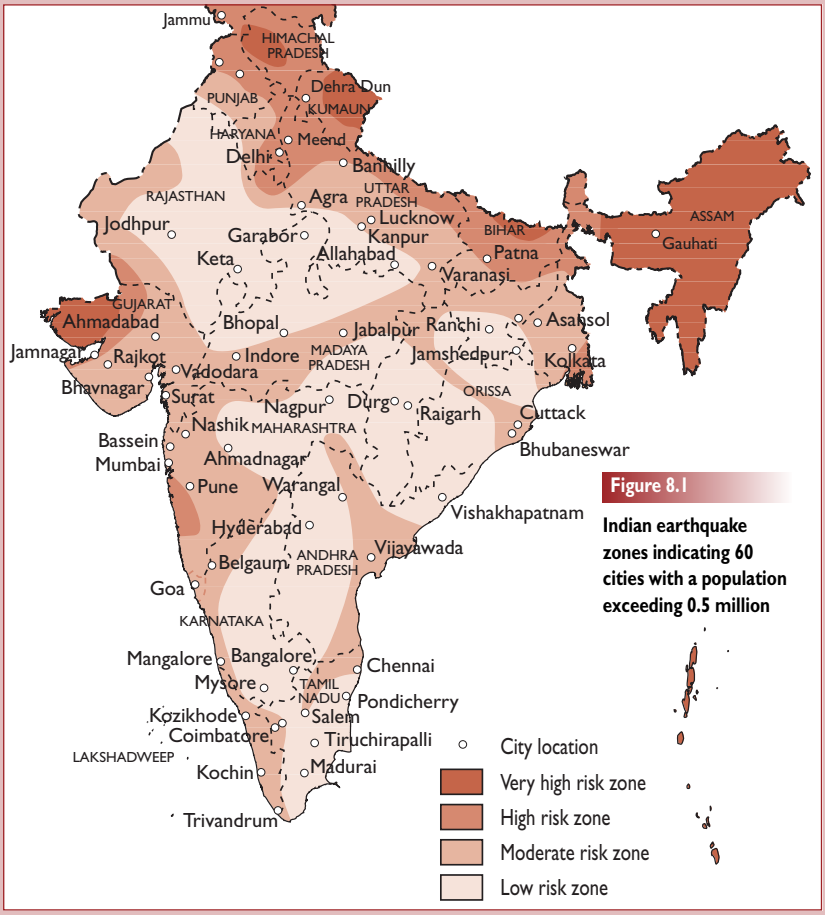


Figure 8.1
Indian earthquake zones indicating 60 cities with a population exceeding 0.5 million

and livelihoods. This gap has been filled in some neighbourhoods by community-based hazard and risk mapping projects. This data, combined with national- and city-level records of past events, can be used to identify priorities for urban planning and construction standards.

Less information is available at the global scale for hazards that affect the lifelines to a city such as drought, or emerging hazards such as heat and cold shocks. Global-scale data can be used to extend analyses of hazard exposure beyond the municipal boundary to demonstrate the vulnerability of cities to disasters affecting their hinterland by disrupting trade, or blocking access and flows of resources and waste.

Mapping human-made hazard

National directories of human-made hazards are becoming more common, and many are open to the public. In the UK, the Environment Agency hosts a pollution and hazardous waste sites inventory. This is searchable by postal code and also provides information on water quality and flood hazard.[8] In the US, Green Media's Toolshed website includes a searchable scorecard, which provides data on chemicals being released from any of 20,000 industrial facilities, or a summary report for any area in the country.[9] More difficult is the mapping of human-made risk associated with industrial facilities, buildings' integrity or transport infrastructure. Much of the information needed to build comparative hazard datasets is commercially valuable and therefore not released to the public.

Local authority land-use planning maps and schedules include information on industrial sites where hazardous activities are undertaken, and can be used as a basis for urban industrial hazard mapping. This is particularly valuable for assessing the risk of human-made disasters caused by natural hazards. More difficult is the acquisition of data on informal-sector industrial activities, such as tanneries or fireworks factories. These might not represent a significant hazard individually; but, in aggregate, unplanned industrial activity is a major risk to health from air, water and ground pollution and from fire and explosion hazards. Risk is heightened because of the unregulated nature of informal industrial activity and its close proximity to densely settled residential areas.

Risk assessments for individual cities

As noted in Chapter 7, there is limited comparative data on natural disaster risk and impacts at the city level. Two initiatives have made major contributions at this level of analysis – namely, the Natural Hazards Risk Index for Megacities by Munich Re (see Chapter 7)[10] and the Earthquake Disaster Risk Index used by GeoHazards International (GHI).

GHI developed and applied an Earthquake Lethality Estimation Method in 2000/2001. The method produces results that indicate the relative severity of earthquake risk, the sources of risk within each city, and the relative effectiveness of potential mitigation options. The same results are also produced for the exposure of school children to collapse of educational buildings. The method was applied to cities in the Americas and Asia, differentiated by city size (see Box 8.2).

Box 8.2 Estimating urban loss of life to earthquakes

GeoHazards International's (GHI) Earthquake Lethality Estimation Method estimates the number of lives that would be lost if all parts of a city experience earthquake shaking at a level that has a 10 per cent chance of being equalled or exceeded in 50 years. The method has been applied to assess the risk of life loss in 22 cities in the Americas and Asia. Deaths caused by building collapse, earthquake-induced landslides and fires are included. Capacity for organized search, rescue and emergency medical care is also considered. Results are validated over time through a comparison of estimates with actual loss. GHI's approach is especially noteworthy because of its emphasis on the safety of school children, which reflects the vulnerability of schools.

Data is collected through meetings with local experts and city officials dealing with seismology, soils and landslides; city planning; building inventory; school buildings; emergency response; medical emergency preparedness; hospital emergency preparedness; and fire preparedness.

Results show great variation in the risk of earthquake-induced loss of life in cities. For example, in the American region, a person living in Mexicali is almost three times more likely to be killed by an earthquake than a person living in Quito, and about ten times more likely than a person living in Santiago. In the Asian region, a person living in Kathmandu is about nine times more likely to be killed by an earthquake than a person living in Islamabad and about 60 times more likely than a person living in Tokyo.

GHI's approach is also able to identify differences in the immediate causes of death and, thus, guide the subsequent development of mitigation strategies and policies. For example, in a comparison between Delhi and San Salvador, while most of the deaths in Delhi will be due to building collapse and earthquake-induced fires, an important fraction of the deaths in San Salvador will be due to earthquake-induced landslides.

The analysis of school risk also shows differentiated vulnerability across cities. A school child in Kathmandu is 400 times more likely to be killed by an earthquake than a school child in Kobe and 30 times more likely than a school child in Tashkent.

Source: GHI, 2001

The philosophy of GHI is that loss estimation is both a process and a product. The process aspect engages decision-makers at the community and city levels and recognizes that data alone is insufficient to effect change in human behaviour. The process of assessment includes local expertise and favours rapid assessment that can feed into ongoing decision-making over possibly more accurate, but also more costly and less participatory, methods. Readily available information is supported with data from local experts. The final results allow a quantitative assessment of the effectiveness of mitigation options under consideration.

…there is limited comparative data on natural disaster risk and impacts at the city level

Including indicators for social vulnerability in risk assessment at the city level is difficult since it requires the availability of relevant data on population and social indicators. For instance, research on risk of heat waves in London has used census data and is appropriate for those countries that have spatially disaggregated and high-quality census data.[11] In the majority of cities, especially those that are rapidly expanding in poorer countries, this is not a reliable source of data. Other methods, such as the use of satellite information on night-time lights and fires, offer an alternative, but still not comprehensive, measurement of population density in rapidly expanding and poor cities.

Comparison of disaster risk between districts within a city has rarely been undertaken. One example of this

Box 8.3 Multidisciplinary assessment of urban seismic risk, Bogotá City, Colombia

The Holistic Vulnerability Index uses a novel methodology for incorporating social as well as physical indicators of vulnerability, and combining these with seismic hazard data to produce an assessment of urban seismic risk. The index has been applied to 19 districts of Bogotá City in Colombia. Four variables are included in the measurement of the physical vulnerability of buildings and public infrastructure:

- damaged area in square kilometres;
- mortality and number of injured;
- ruptures to water mains, gas networks and power lines; and
- number of telephone exchanges and electricity substations affected.

Hazard is measured by combining data on the propensity of each zone for accelerating seismic energy and on soil type influencing proneness to seismic amplification, susceptibility to liquefaction and landslides. Social vulnerability is measured from the sum of three compound indexes:

Exposure: population exposed, density of population exposed, exposed areas, including built areas, industrial areas and areas under government use (health, education, administration, etc.).

Social fragility: areas of illegal or marginal human settlement, annual rate of mortality by natural causes, annual number of crimes per 1000 inhabitants, and level of unsatisfied basic needs.

Resilience: number of hospital beds, number of medical professionals, area of space available for emergency housing, number of emergency and rescue workers, including trained volunteers, overall development level, preparedness, and emergency planning as appraised by a relevant city authority.

Results show the complexity and context specificity of processes leading to seismic risk. Those districts recording the highest levels of calculated risk included the middle-income districts of Tesaquillo, Chapinero and Usaquen, as well as the low-income districts of San Cristóbal, Usme and Ciudad Bolivar.

The advantage of such an approach is that it presents multiple aspects of risk simultaneously to decision-makers. This can be a pressure to put the social as well as the physical aspects of vulnerability centre stage in integrated urban planning. The 2000 Urban Master Plan for Bogotá took the results of this model into consideration.

Source: Carreño, 2007

approach is the Holistic Vulnerability Index,[12] calculated only in relation to seismic risk. It measures disaster risk as the probability of a loss occurring as a consequence of a seismic hazard with a defined magnitude over a given time. It includes indicators for physical and social vulnerability, thus demonstrating to decision-makers the need for work on both fronts. The index has been applied to various districts of Bogotá City (Colombia), and results were considered in the preparation of the 2000 Urban Master Plan for Bogotá (see Box 8.3).

In even the richest countries, there is a lack comprehensive hazards databases

Assessing human-made hazard risk

Human-made hazard risk assessments tend to be driven by a hazards focus and employ GIS software. Vulnerability is sometimes indicated through population distribution, which reflects the limited availability of geo-referenced social data. However, as has been found with urban heat shocks, social variables affecting information flows and access to resources will influence individual exposure and susceptibility through, for example, variable abilities to seek timely medical assistance.

Internet tools have the potential to greatly increase public access to geographical hazard and social data. For example, in the US, the Environmental Protection Agency,[13] the Department of Housing and Urban Development[14] and the New York Public Interest Research Group host internet resources that enable the mapping of hazardous facilities, public projects and Brownfield sites. These become powerful risk-mapping tools when combined with data from other sites that provides demographic and socio-economic characteristics of the proximate populations.[15]

GIS mapping of technological/industrial hazard and social vulnerability is faced with a number of challenges. In even the richest countries, there is a lack of comprehensive hazards databases. In some countries, industrial hazard is hidden behind commercial secrecy. Where point source data for hazards are available, modelling the geographic extent of exposure and the characteristics of affected populations is problematic. Developing models for hazards where there has only been limited experience of the health consequences of exposure is difficult. In many instances, little is known of the long-term health effects of exposure to chemicals that can cross generations. Advances in modelling and the use of proxy data sources provide ways for technological improvement; but the underlying paucity of data is much harder to address without political will.

Participatory risk assessments

Perhaps the most extensive collection of methodologies comes from participatory risk assessments. This includes a variety of approaches, all drawn from the tradition of participatory approaches.[16] Many international and national non-governmental organizations (NGOs) have developed participatory methodologies that aim to provide a structured way for local actors to reflect on the hazards, vulnerabilities and capacities influencing their lives. Examples include the International Federation of the Red Cross and Red Crescent's Vulnerability and Capacity Assessment,[17] as well as ActionAid's Participatory Vulnerability Analysis.[18]

Impetus for promoting participatory approaches in risk assessment has been provided by the Hyogo Framework

Box 8.4 How participatory is urban disaster assessment?

It is possible to assess the extent to which disaster risk assessment methodologies are participatory according to the following three features of participatory approaches:

Procedural

This differentiates approaches according to the relative distribution of power and ownership in the assessment process. At one extreme are approaches that are initiated, planned and conducted by local actors at risk, who might also be the audience for, and owners of, the results. At the other extreme are assessments that include local actors only as subjects of study or as sources of data or future project inputs.

Methodological

The chief distinction here is between the application of methods of data collection, aggregation and analysis that are quantitative or qualitative. It is often assumed that participatory approaches are predominantly qualitative; but this is not always the case. Particularly where some aggregation and up-scaling of local survey results is desired for national policy, the collection of quantitative data is included in participatory approaches. Qualitative methods are useful for collecting information, especially with marginalized populations; but this may, in turn, be aggregated for quantitative analysis.

Ideological

This distinguishes between emancipatory and extractive approaches. Emancipatory approaches tend to see participatory work as a long-term and iterative process, and as a mechanism for participants to reflect on the social, political and physical root causes of their vulnerability and level of resilience. This scope for reflection is sometimes given higher priority as an output than the generation of data for its own sake. Assessments might be initiated and/or facilitated by non-local actors, but would become owned by those at risk as empowerment takes hold. Extractive approaches are concerned primarily with the collection of data to be used by external actors, and are not intended to contribute to learning among respondents.

Source: Pelling, forthcoming

No single definition for participatory, risk assessment exists at present

for Action 2005–2015,[19] which states as a general consideration, that:

> *Both communities and local authorities should be empowered to manage and reduce disaster risk by having access to the necessary information, resources and authority to implement actions for disaster risk reduction.* (Section III A, point 13.f)

Participatory approaches offer specific entry points for this agenda.

No single definition for participatory risk assessment exists at present. Approaches are variously termed participatory, community based or local.[20] The lack of a single nomenclature reflects the diversity of interests and agencies involved with participatory approaches (and also the contentiousness of meanings attributed to terms such as participation and community). However, a lack of common understanding also opens this field of work to misplaced or exaggerated claims of participation, inclusiveness and empowerment.

Some generalizations of contemporary participatory risk assessment can be made. Mainstream extractive approaches (e.g. disaster impact household assessments) tend to be quantitative, owned by the executing or funding agency and not intended to confront existing power inequalities. In contrast, participatory approaches claim to utilize qualitative methods that produce data owned by the subjects of the research and contribute to local empowerment through the research process. However, the loose attribution of participatory status to various assessment methods has meant that this category has also been widely used to describe interventions that may use quantitative methods, where the subjects of the research rarely own the outputs or set the research agenda, and with scant evidence on the contribution of methodologies to the processes of empowerment.

As shown in Box 8.4, three aspects of so-called participatory approaches that allow closer scrutiny of the participatory claim of risk assessment have been proposed.[21] The procedural, methodological and ideological character of an assessment tool will depend upon its strategic use (e.g. is it seen as a stand-alone tool or conceptualized as part of a larger suite of tools?), its conceptual orientation (is the aim to identify local vulnerabilities and capacities with respect to a specific hazard type, or to undertake a more generic assessment?) and the position of the observer (a local resident might perceive the same tool very differently from an external implementer).

Identifying the social, political and economic root cause of vulnerability is the first step in …risk reduction

Those who employ participatory methodologies that aim towards empowerment should be careful not to raise false expectations among participants. Participatory methods can be counterproductive if they do not point to ways of raising resources to reduce risk. Identifying the social, political and economic root causes of vulnerability is the first step in making change; but resources and skills are needed to build and apply capacity for risk reduction. It might not be possible to resolve a hazard in the short term; but the building of resilience through social capacity, information and risk awareness through local risk assessments are outcomes in themselves. Box 8.5 shows an example from Lima (Peru), where a participatory methodology has contributed to the building of resilience through the strengthening of local capacity to undertake risk assessment.

The range of options for strengthening local resilience, in which participatory risk assessments can play a valuable part, are discussed in more detail later in the section on ‘Strengthening local disaster resilience’.

Box 8.5 Risk assessment strengthens local capacity and resilience in Lima, Peru

Located along the boundary of two tectonic plates, Lima is at risk from earthquakes, floods and landslides. One of the city's high-risk zones is Caquetá, a highly congested area with large amounts of waste produced by street traders and an irregular rubbish collection service. An estimated 15,500 people live in Caquetá in 3000 formal and informal dwellings consisting of a mixture of wooden shacks and four- and five-storey concrete frame/brick-infill and rendered houses. The Caquetá ravine, cut through by the Rimac River, is a site for a potentially deadly combination of hazard and vulnerability. Poorly enforced building and planning codes, high densities and rapid urbanization (due to its proximity to commercial locations) combine with frequent landslides to increase the vulnerability of the squatter housing perched on the ravine edge. As a result, shelter damage and collapse are frequent, with losses of investments and sometimes lives.

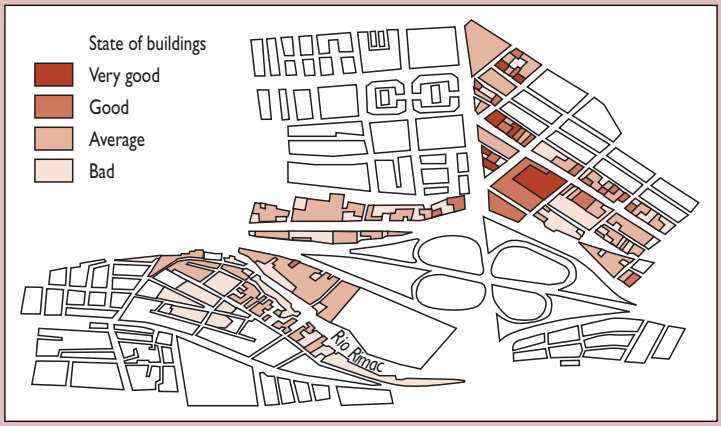


Figure 8.2

Participatory mapping of building quality: Caquetá ravine in Lima, Peru

A risk assessment was undertaken – jointly by the Oxford Centre for Disaster Studies and the Peruvian non-governmental organization (NGO) Instituto Para la Democracia Local – to gather data on hazard, vulnerability and capacity to be used for the formulation of 'risk reduction action plans. Data was gathered on the ravine area, informal markets and a consolidated squatter area in Caquetá.

The assessment was undertaken using a combination of research tools. Participatory rural appraisal tools were applied during meetings with housing and market association representatives. Activities included community mapping; time-line development to link the accumulation of risk with local disasters and recovery; the development of disaster matrices recording views of causes and possible solutions; and hazard ranking. Additional research tools included the review of existing research, preparation of maps identifying building and infrastructure standards, and administration of questionnaires with households and organizations.

The assessment helped to build relations with key actors at community, NGO and municipality levels and, importantly, provided credibility for the initiative among authorities. Findings from the assessment and the relationships built up in the process led to a three-day workshop attended by 30 representatives of local associations, municipalities, local NGOs, the fire service and international NGOs. Key problems were presented and participants scoped ideas for workable solutions. These included training for fire awareness, ravine improvement through lobbying, and information exchange. As a result of the workshop, local groups, including communities and the municipality, began to communicate more frequently, and the importance of risk awareness and vulnerability reduction was recognized.

Source: Sanderson, 1997

Risk, in any one place, is an outcome of decision-making and action – or inaction- at local, municipal, national and international scales

Challenges of urban risk assessments

Risk assessments are undertaken at a range of scales, from the local to the global. There is great diversity in the target of assessments (people, buildings and the urban economy), in the sources of data (interviews, existing datasets, satellite imagery or expert judgements) and in the degree to which they are participatory or extractive in collecting data. In all cases, assessments aim to simplify complicated experiences of risk in order to assist in decision-making. Complexity comes from:

- *The multiple hazards to which people are simultaneously exposed.* Recent and frequently experienced hazard types may be more visible to assessors than others at any one moment. Following the Indian Ocean Tsunami, many assessments of tsunami risk were undertaken despite the likelihood of a future tsunami being much lower than seasonal rainfall flooding or armed conflict.
- *The multiple sectors that are at risk.* It is difficult to aggregate vulnerability across sectors such as housing, communication networks, water and sanitation, education, healthcare infrastructure, power networks, etc. Each sector will have different exposure and susceptibility to risk and capacities and resources for coping and recovery.
- *The multiple scales at which risk is felt and responded to.* Risk, in any one place, is an outcome of decision-making and action – or inaction – at local, municipal, national and international scales. It is challenging to include all of these scales in the analysis of impacts and capacity.
- *The multiple assets to be accounted for in measuring vulnerability and capacity.* This applies to all scales, from the individual to the urban scale. Some assets will be contingent upon the utilization of others and rarely are different types of assets commensurate.

- *The multiple stakeholders with roles to play in shaping risk.* Stakeholders' actions influence the degree to which they, and others, are placed at risk. This can be hard to pin down – for example, when such actions are part of everyday development processes.
- *The multiple phases that disaster cycles pass through.* Perceptions of risk and actions to build capacity and resilience may look very different before and after disaster and during periods of everyday development.

It is precisely in urban centres where these overlapping aspects of risk are most challenging. Thus, urban risk assessment methodologies and programmes need to be multi-sectoral, multidisciplinary and sensitive to differentiated risk, vulnerability and capacity.[22]

Additional challenges of risk assessment include the following:

- While innovations in information technology, including the use of satellite imagery, offer great potential as sources of data for assessments, access to this technology is not equally distributed globally and even within countries. Inequality in the distribution of human resources, as well as hardware, and the ability to buy in data from private sources comprise a challenge for development.
- People are the true wealth of cities. However, many measurements of urban risk, particularly those operating at the urban scale, focus on built assets at risk. This may be a reflection of the economic importance of physical assets. It might also reflect the background of scientists who have led the field of urban risk modelling and assessment, an area dominated until recently by an engineering focus and an interest in earthquake risk. It also reflects the difficulty of measuring human vulnerability, particularly at larger scales.
- The fast pace of change in the physical fabric and social life of slums, and other low-income settlements, is a challenge for risk assessment. Local and participatory methodologies have partly been adopted in response to this challenge as they are easier to manage and less costly and therefore can be undertaken with greater frequency. More problematic, still, is the difficulty of including highly vulnerable people dispersed across the city, such as the homeless and illegal immigrants, in particular. This challenge is proving hard to overcome in even wealthier countries and cities.

Perceptions of risk

Perceptions of risk play an important part in disaster risk reduction. They influence the ways in which risk is measured and the willingness of citizens and authorities to undertake actions to manage risk. Planners and policy-makers often employ expert risk analysis to justify hazard mitigation policies; yet, expert and lay risk assessments do not always concur. This can undermine policy legitimization and compliance.

Perceptions are shaped by a number of factors, including the nature and availability of disaster-related information, past experiences of disaster events, cultural values and the socio-economic status of concerned individuals or households. Perceptions influence the relative importance given to natural or human-made hazards, compared to other competing needs and opportunities. In turn, the importance ascribed to disaster risks determines subsequent efforts to avoid or limit the impacts of those hazards. For instance, research in the US has found that hurricane risk perception is a useful predictor of storm preparation, evacuation and hazard adjustment undertaken by households.[23]

The pace of change in the physical fabric and social life of slums…is a challenge for risk assessment

The ability of a household or individual to act on perceived risk is also constrained by their coping and adaptive capacity and by urban governance institutions. Too often, poverty and marginalization force the most vulnerable to accept risk from natural and human-made hazards as a trade-off for access to shelter and work. Risk assessments can help policy-makers understand the multiple risks faced by those in poverty by making perceptions more tangible.

Once individuals have experienced a disaster event, they tend to have an elevated sense of future risk.[24] Without support, this can lead to stress and panic. A number of rumours and false alarms followed in the wake of the Indian Ocean Tsunami. In one instance, a rumour caused 1000 people to flee from the beach area of Pangandaran (Indonesia).[25]

Perceptions of risk …influence…the willingness of citizens and authorities to undertake actions to manage risk

STRENGTHENING LOCAL DISASTER RESILIENCE

Local disaster resilience refers to the capacity of local actors to minimize the incidence and impacts of disasters, and to undertake recovery and reconstruction activities once disasters occur. In places where hazard and loss are tangible, disaster risk reduction or reconstruction can be opportunities for improving the solidarity, inclusiveness, human skills and confidence of local groups and their leaders. Box 8.6 shows just how effective local capacity-building can be for disaster risk reduction. This section reviews social, legislative and economic pathways for building local resilience and discusses the challenges therein.

…the most vulnerable…accept risk from natural and human-made hazard as a trade-off for access to shelter and work

Social pathways

Social capital offers a resource upon which to build resilience to disaster shocks, even where economic resources are limited and political systems are exclusionary. Local stocks of social capital – norms and habits of behaviour that support reciprocity and collective action – are resources that can be used to build capacity in the face of multiple development challenges, including disaster risk. This provides a great opportunity for integrating disaster risk reduction and development at the local level.

Building local networks of support and reciprocity can increase self-reliance among households and neighbourhoods and in this way enhance disaster resilience. An example of the benefits to be gained by communities with strong social ties comes from Catuche, Caracas, in

Box 8.6 Community action builds leadership and resilience in Santo Domingo, the Dominican Republic

The Dominican Disaster Mitigation Committee (DDMC) is a national non-governmental organization (NGO) that, with support from the Organization of American States (OAS), has sought to build local capacity as an integral part of its disaster risk reduction work in the city of Santo Domingo.

Activities implemented by the DDMC include community mapping of local hazards, vulnerabilities and capacities, as well as leadership training. Communities are then invited to draw up competitive proposals for hazard mitigation projects where costs are split between DDMC and the local community. This approach generates multiple outputs. At one level, a risk reduction project is supported. More fundamental is the experience gained by grassroots actors of undertaking risk assessments and developing project proposals for external funding. The DDMC will only cover 50 per cent of the costs for any project proposal, requiring the community to raise additional funds or resources in kind through labour. The DDMC will also not provide financial support for any additional projects, thereby encouraging local actors to build on their experience to apply for funding from other NGO or government sources.

Seven communities in Santo Domingo have taken part in the programme, with 2000 people benefiting directly. Activities have included building local sewer systems, storm drains, a flood dike and an anti-landslide wall. Building local capacity in the communities has not only reduced risk, but has also enhanced disaster response. In one community, Mata Mamon, in 1998, Hurricane Georges caused damage to 75 per cent of houses. It was the local community who managed aid distribution when the first supplies arrived after ten days.

Source: Pelling, 2003; see also Dominican Association of Disaster Mitigation, www.desastre.org/home/index.php4?lang=esp

Venezuela. This community was among those exposed to the extreme flooding and landslides of 1999, which killed 30,000 people. According to an official from the organization Ecumenical Action-ACT:[26]

While community solidarity can be an asset for disaster risk reduction, communities are not inherently harmonious…

> *… the organization of the neighbourhood and the solidarity of the people saved hundreds of lives … as the flooding progressed, community members mobilized to assist one another. Neighbours who knew each other and had worked together for years communicated swiftly the news of the rising water. Older residents were helped from their homes by younger neighbours. When a few were reluctant to leave because they didn't believe the threat or because they were afraid their few possessions could be stolen, neighbours broke down doors and carried people forcibly to safety… In one incident where we were trying, unsuccessfully, to kick down the heavy door of a woman who refused to leave her house, a young gang member came along, pulled out a pistol and fired into the lock, allowing the door to be opened. The gang member then pointed his gun at the woman and ordered her out of her house. Seconds after she left the dwelling, the house fell into the raging current … perhaps as few as 15 people died, a very small figure compared to other similar neighbourhoods where hundreds lost their lives.*

The urban population is a key resource during times of disaster, as demonstrated in Mexico City, where, following the 1985 earthquake, up to 1 million volunteers helped in rescue and relief operations.[27]

Where disaster risk is a dominant aspect of everyday life, it can become a concern around which local associations organize and remain engaged with development. A great diversity of local associations can contribute to disaster risk reduction, including kinship, religious and gender- or youth-based groups, as well as groups organized around particular interests, such as sports, environmental or social improvement. All of these groups, and not only those that are development or disaster oriented, can play a role in building networks of support and, thus, disaster resilience. It is those communities who have a rich stock of associations that are also most likely to engage in risk reduction at the local level. Furthermore, local associations can act as intermediaries, conveying information between local residents and external actors seeking to build local resilience. They can also enrich externally funded risk reduction projects by sharing knowledge of local customs, environmental hazards, social vulnerability and capacity.

While community solidarity can be an asset for disaster risk reduction, communities are not inherently harmonious entities. Rather, they are heterogeneous and are often cross-cut by internal competition, information asymmetries and socio-economic inequality. This can undermine community-level risk reduction projects, leading to interventions exacerbating inequalities and undermining collective resilience. For example, in many communities, women may predominate in the membership of community groups, but may be excluded from leadership. This is a missed opportunity.[28] An Indian NGO, Swayam Shiksam Prayong, has attempted to address this concern by enacting a philosophy of not only rebuilding physical structures, but realigning social relations in post-disaster periods. A priority was to work with women to facilitate their visions of life after the earthquake, which included, for example, assigning land titles to both women and men.[29] Box 8.7 offers some examples of ways in which women have taken a lead in reducing local disaster risk.

External agencies seeking to work with community-level partners in disaster risk reduction must also be cautious not to assume that community leaders represent the best interests of local residents. Following the Bhuj earthquake in Gujarat (India) in 2001, international and government aid prioritized speed in distribution of goods, which enabled high-cast groups to capture a disproportionate amount of aid at the expense of lower-cast groups and Muslims.[30] This observation underlines the advantages of disaster risk reduction and response work that is built on sound knowledge of local political and social rivalries, as well as capacities for collective action to build resilience.

Building the capacity of local authorities is also vital for disaster risk reduction. The Asian Urban Disaster Mitigation Program (AUDMP) works to build local- and city-level capacity across Asia. One of its projects in the city of Ratnapura (Sri Lanka) seeks to improve the disaster risk management capacity of local authorities by providing them with improved tools and skills. This involved the development of a methodology for identifying hazards and determining potential losses. Outputs have included the

formation of a Disaster Management Council, guidelines for building construction in disaster-prone areas and a Disaster Management and Mitigation Plan for Ratnapura.[31]

Legal approaches

The Universal Declaration of Human Rights already supports the right to personal security and a basic standard of living during periods of unforeseen livelihood disruption.[32] The human rights agenda offers a potentially powerful tool for local actors to argue for increased pre-disaster investment and post-disaster compensation. It offers a moral imperative that could mobilize local political will.[33] Rights-based approaches that seek to justify investment in prevention are increasingly being supported by economic analysis, which shows the financial savings to be made by investing in risk reduction before a disaster, compared to the costs of managing disasters through relief and reconstruction. The UK Department for International Development (DFID) estimates that for every US$1 invested in disaster risk reduction, between US$2 and $4 are returned in terms of avoided or reduced disaster impacts.[34]

The failure of the international community to set a legally binding international treaty on disaster risk reduction in the Hyogo Framework for Action 2005–2015,[35] and the absence of disaster risk targets in the Millennium Development Goals (MDGs), however, limits the international pressure that can be used to support local actors at risk.

Nationally, an increasing number of governments are putting in place disaster risk reduction legislation. While such legislation often does not provide targets for action, it does establish responsible agencies for risk reduction, typically in local and regional government. Where legal systems are robust, legislation has proven a strong weapon to strengthen communities at risk from technological and industrial hazards, and underpins the Environmental Justice Movement. Court action taken by the survivors of the Payatas (Manila) rubbish mountain landslide in 2000 is an example. Some 300 people were killed in this event. In partnership with civil rights lawyers, survivors filed a US$20 million legal claim against the city government for compensatory and moral damages based on the assertion that city authorities were responsible for the Payatas dumpsite. That low-income survivors of an urban disaster could take legal action indicates the strength of community capacity in Payatas, and also a supporting infrastructure of civil rights lawyers, basic conditions not found in every city and especially lacking in smaller urban settlements.[36]

Where the law allows it, and where culpability can be proven, group actions brought by survivors of toxic releases against companies or the state can amount to significant sums and act as a deterrent on other companies. In South Africa, a strong legal system provides for disaster risk reduction to be a shared responsibility between national, regional and municipal governments and, in so doing, provides for collective legal action against state agencies found to be complicit in the generation of disaster risk (see Box 8.8).

Box 8.7 Women lead contributions to local disaster risk reduction in Latin America

The Pan American Health Organization (PAHO) has long worked with women and men to build local capacities for risk awareness and reduction. In a review of the contribution made by women to local resilience, it was concluded that, while women are severely affected by natural disasters, disasters often provide women with an opportunity to challenge and change their status in society.

In many (if not most) cases, women are more effective than men at mobilizing the community to respond to disasters. They form groups and networks of social actors who work to meet the most pressing needs of the community. This kind of community organizing has proven essential in disaster preparedness and mitigation. A review of PAHO field notes illustrates the contribution of women towards disaster risk reduction:

- Following Hurricane Mitch in 1998, women in Guatemala and Honduras were seen building houses, digging wells and ditches, hauling water and building shelters. This shows how willing women are to take on activities traditionally considered to be 'men's work'. Beyond increasing the efficiency and equity in disaster reconstruction, this kind of experience can also help in changing society's conceptions of women's capabilities.
- After the 1985 earthquake in Mexico City, low-income women working in factories organized themselves into the '19 of September Garment Workers' Union', which was recognized by the Mexican government and proved instrumental in lobbying for the recovery of women's employment.
- Following Hurricane Joan in 1988, women in Mulukutú (Nicaragua) organized to develop plans for disaster preparedness that included all the members of a household. Ten years later, Mulukutú was better prepared for Hurricane Mitch and it recovered more quickly than other similarly affected communities.

Source: PAHO (undated)

Economic approaches

Microfinance has a great potential to build community resilience to disasters. The extension of small loans through micro-credit enhances the incomes and assets of urban households and communities, thereby reducing their poverty. In turn, this helps to reduce vulnerability to disasters and develops greater coping capacity. Post-disaster loans and micro-insurance can help poor urban households recover more quickly. Yet, it is only recently that micro-credit and micro-insurance have been applied for building community resilience to disaster risk.

… an increasing number of governments are putting in place disaster risk reduction legislation

To date, microfinance institutions have been involved mostly with post-disaster recovery activities. There is a need, however, for microfinance to be perceived as a potential tool to better prepare communities before natural hazards strike. In particular, the scope for micro-insurance to act as an affordable mechanism for extending risk-sharing into low-income communities has recently received much attention.

Challenges remain for the role of microfinance in strengthening local resilience against disasters. The complexity of livelihoods and social life in urban areas has delayed the development of microfinance schemes, compared to some rural contexts. Disasters can also destroy the very assets in which individuals have invested micro-credit loans, leading to debt as well as loss of assets. Following a disaster, if micro-credit is available, there is a danger that survivors will overextend their ability to repay loans in efforts to re-establish livelihoods. Pre-disaster

Box 8.8 Using the law to fight technological risk in Durban, South Africa

South Durban Community in South Africa is a highly polluted area where 200,000 largely vulnerable and disadvantaged residents live side by side with heavy industries. In 2002, successful legal action was taken by the community to prevent the development of a paper incinerator by Mondi, a paper manufacturing company. This legal case was taken up by the community after the provincial government granted permission to Mondi to construct an incinerator without following proper procedures. The Legal Resources Centre lodged an appeal on behalf of the community in the Durban High Court on 11 October 2002, restraining the Minister of Agriculture and Environmental Affairs, KwaZulu-Natal Province, from approving the Mondi incinerator. The minister was interdicted pending the finalization of a judicial review.

The legal recourse was taken on the grounds that government granted an oral exemption to Mondi from conducting a full environmental impact assessment (EIA). It was argued that this exemption was invalid, according to statutory requirements, and that the failure to appoint an independent consultant, conduct a full IEA and examine the necessary alternatives was in breach of existing legislation. The Legal Resources Centre also pointed out that a proper interpretation of the EIA showed that sulphur dioxide emissions from Mondi's incinerator would exceed World Health Organization (WHO) standards and national guidelines of 1998. This, the community noted, was against their constitutional right to live in a healthy environment.

The verbal exemption from conducting an EIA given to Mondi was overruled by a high court judge and the company's proposal had to be processed again, taking into account the necessary EIA requirements.

Sources: South Durban Community Environmental Alliance, 2003a, 2003b

planning is the best way of protecting households from these and other risks. Box 8.9 presents eight ways in which this can be done.

Box 8.9 Microfinance for disaster risk reduction

It is important that gains made through microfinance are protected from the economic and human impacts of disaster. Here, eight ways of protecting microfinance clients from disaster risk are presented:

1 Meet with clients to discuss preparations for, and responses to, natural disasters.
2 Create accessible emergency funds to provide clients with a financial safety net in times of crisis.
3 Microfinance groups can provide a ready social network for promoting primary healthcare in order to build resilience pre- and post-disaster.
4 Microfinance coordinators can aid in the building of resilience through encouraging clients to diversify into disaster-resistant activities.
5 Housing is arguably the most important asset in urban livelihoods. Microfinance initiatives should consider providing savings or loan products to encourage clients to move to safer areas and to invest in more durable housing.
6 Insurance products provided by multinational financial institutions to their clients are typically designed to protect against individual crisis and not crises that affect the entire portfolio of clients. Some microfinance agencies have begun experimenting with insurance products for disaster response, in some cases turning to the re-insurance market to spread aggregate risks.
7 Microfinance coordinators can disseminate information on providers of emergency services and safe shelter in times of emergency.
8 The social network of the microfinance organization can act as an information conduit for early warning.

Source: Microenterprise Best Practice (undated)

Challenges of building local capacity for risk reduction

Local potential for disaster risk reduction can only be realized in supportive social, economic, legislative and political environments. In a recent study of slum settlements in six African countries, ActionAid found that a lack of collective action to reduce risk was a major determinant in shaping vulnerability and reducing capacity to recover from flooding.[37]

There is also an uneasy tension between the empowering of local actors to confront local causes of risk and the offloading of state or private-sector responsibilities. Decentralization of urban governance has seen many municipalities struggling with a gap between responsibilities that have been devolved from central government and the resources, which have, in many instances, not been made available. There is a danger that the same flow of responsibility without resources will result from the increasing emphasis on local actor involvement in risk reduction.

It is also important not to lose sight of the deeper historical and structural root causes of disaster risk in the national and global political economy. Community-based approaches inherently focus on the concerns of particular places and are often directed by the most immediate local development challenges. On the surface, this is reasonable; but without care, it can mask deeper social and economic structures and physical processes that are the root causes of inequality, vulnerability and hazard.

The challenge of bringing together top-down, scientific and strategic policy-driven risk reduction priorities with bottom-up, experiential and often tactical priorities of grassroots actors lies at the heart of all planned interventions for local capacity-building. Building local capacity is difficult in contexts where disaster risk reduction is not perceived to be a priority by local actors. In areas where disasters are infrequent or have had only a limited impact, it is quite rational for those on a low income, with little time to spare and subject to many hazards – from police harassment and street crime to the threat or reality of homelessness – not to want to participate in disaster risk reduction initiatives as a priority.

The tension between local and external priorities is made especially visible, but also difficult to reconcile, when external actors engage with community actors through participatory methodologies. This can mean that long-term risks, including low-frequency, high-impact hazards and low-level chronic hazards, such as air pollution, are not identified as priorities by local actors and therefore might not be addressed.

Strategies for reconciling local everyday and external strategic visions of risk are needed in order to maximize the potential for local capacity to build resilience to disaster. Three strategies are to:

- Piggyback disaster risk reduction work onto existing activities that are accepted as priorities locally. In Latin America, the Pan-American Health Organization (PAHO) has included risk reduction training and information with family and women's health issues.[38]
- Bring a wide range of actors together to highlight shared (systemic) challenges to development. The AUDMP adopted this approach in the Bangladesh Urban Disaster Mitigation Project, where community-based disaster risk management was enhanced through the wide involvement of urban actors.[39]
- Undertake a staged programme of disaster risk reduction when external agencies are committed to a long-term engagement with a community. CARE Zambia's Programme of Support for Poverty Elimination. and Community Transformation (PROSPECT) sought to confront governance aspects of urban vulnerability to multiple hazards in Lusaka. It was left open for community participants to define priority concerns.[40] As debates unfolded, the linkages between disaster risk and loss from even small events with developmental concerns became more visible.

LAND-USE PLANNING

Land-use planning is perhaps the most fundamental tool for mainstreaming disaster risk reduction into urban development processes. It provides a framework within which interventions to partner local actors for risk mapping and community resilience building can be undertaken. This includes partnerships between the municipal or city government, community groups and the private sector. Familiar planning tools such as zoning, community participation, GIS, and information and education programmes are all integral to mainstreaming risk reduction within local comprehensive land-use planning process.

Mainstreaming risk reduction within strategies that underpin land-use planning is challenging, particularly for authorities with limited human and economic resources and political influence. Perhaps most challenging of all is the aim of including all urban stakeholders in the shaping of planning policy and development decisions, with a rigorous, independent and transparent procedure for overcoming conflicting interests. This requires a multi-scaled approach, as well as one that brings together actors from different policy areas and from public, private and civil sectors. Algeria's National Land-Use Planning Model is a case in point. Developing this national framework in 2005 necessitated coordination between scientists, planners and policy-makers and harmonization with local land-use planning models.[41]

Cuba has one of the best records for integrating disaster risk planning within urban risk management. The Institute for Physical and Spatial Planning has been legally responsible for physical planning for over 40 years. Risk maps have contributed to recommendations for retrofitting, resettlement and urban growth regulation in 107 coastal settlements. In conjunction with the United Nations Educational, Scientific and Cultural Organization (UNESCO), a comprehensive development plan was developed in 1998 for areas of Havana exposed to coastal hazards. Importantly, the agency with responsibility for disaster response – the Civil Defence Service – has participated in developing these plans. Plans have included protection for the Old Town of Havana, a World Heritage site.[42] This is unusual since many places of national and global architectural importance are not adequately considered in disaster planning. The loss of Bam in Iran is only one example.

Land-use planning is perhaps the most fundamental tool for mainstreaming risk reduction into urban development processes

Designing and implementing comprehensive land-use planning is particularly challenging in many smaller cities, where municipal capacity for urban planning is limited. Initiatives that seek to extend risk reduction planning to smaller municipalities have begun to emerge, although there is still much to be done. For instance, in Nicaragua, the Executive Secretariat of the National System for Disaster Prevention, Mitigation and Response, created in 2000 by law, has, together with UNDP Nicaragua,[43] developed a programme to support local capacity-building for risk management in six municipalities. This programme has encouraged local participation in disaster risk planning. This, in turn, has been facilitated through the production of a series of four manuals based on the experience of local actors and designed to be user friendly and non-technical. They contain guidance for building community groups, conducting risk assessments and influencing the municipal government. Through this, local participation and the disaster risk reduction component in land-use decision-making can be enhanced. The success of these plans can be seen in their reaching a third publication run in as many years by 2004.

Urban risk management needs to consider not only the internal, but also the external environment

Planning to manage risk systems in their entirety further complicates land-use planning. Human settlements of all sizes are situated within larger socio-ecological systems that include environmental features (such as watersheds, regimes of coastal land erosion and sediment deposition, or earthquake zones), as well as social and cultural systems. These systems are interdependent, expressed, for example, through migration and economic exchange between rural and urban areas or across urban centres. Urban risk management needs to consider not only the internal, but also the external environment. There are few successful examples of this highly integrated approach; but there are many places where this large-scale planning might bring dividends. Box 8.10 presents an example from The Netherlands, where socio-ecological systems planning has been conducted in an open fashion, thus strengthening democratic culture, as well as reducing risk.

Extending land-use planning to informal settlements and slums

Nearly 1 billion people, or one in every three city dwellers, live in an informal settlement or slum.[44] Such areas are typically cramped, with industrial and residential land uses in close proximity (sometimes in the same building) and exposed to natural hazard through their location on hill slopes or low-lying land subject to waterlogging and flooding. Within a context of rapid urban population growth and physi-

Box 8.10 Managing socio-ecological systems to protect human settlements in The Netherlands

Much of The Netherlands comprises reclaimed lowlands and estuarine systems for the Meuse, Waal and Rhine rivers. Managing flood risk in this country, and protecting urban as well as rural settlements, livelihoods and assets, has required an integrated socio-ecological systems approach. This approach has developed over time until now and each aspect of coastal and riverine risk management can be understood to protect not only local assets, but also those of the linked socio-ecological system, and to take people's changing values into account.

The long timeframe needed to construct the Eastern Scheldt Dam, which was initiated in 1953, led to the project being halted in 1967. Originally intended to protect people against flooding from the sea, the barrier designs took little else into consideration. The original design aim was to create a freshwater lake from the Eastern Scheldt. However, during the late 1960s, new ecological awareness and recognition of the value of coastal resources such as shellfisheries for local livelihoods stimulated redesign. Because of the controversy, and the eventual political willingness to incorporate a dialogue on the process surrounding the project, technical innovations exceeded expectations, and now the barrier is one of the most highly regarded water management structures in the country, if not the world.

A second major technological accomplishment was the Maeslant Barrier, constructed in the New Waterway. The New Waterway was a shipping avenue that had to remain open. One option would have been to raise existing dikes, which had proven costly in the past and had also generated protests from residents. Dikes in The Netherlands can be several metres wide and homes have been constructed upon them, so building higher dikes often means removing property, often at great cost. To come up with a solution that was acceptable across the spectrum of stakeholders, the Ministry of Transport, Public Works and Water Management held a competition for an innovative design for the New Waterway. Like the Eastern Scheldt Dam, the Maeslant Barrier was a technological breakthrough and was completed in 1997.

Both of these technological responses to flood hazard were managed at a national scale and were underpinned by an open approach that enabled multiple stakeholders to debate and shape the final technological outcome. The open process took more time and money, but resulted in better solutions, highlighting how successful engineering-based responses to risk management can benefit from taking wider social and ecological contexts into consideration. The process resulted in a shift in flood management from a perspective that was oriented solely to providing safety, to one that, today, seeks to arrive at compromises with ecological and cultural demands.

Source: Orr et al, 2007

The provision of basic services and security of tenure has many positive consequences, including the reduction of vulnerability to disaster

cal expansion of cities, planners are often unable to keep up with mapping new settlements, let alone planning land use for them. Set against these pressures, the lack of human and financial resources and the low profile often enjoyed by land-use planning in urban planning departments are startling. Innovative methods for reaching populations at risk are thus needed.

Where there is political commitment and resources are made available, slums can be successfully brought into formal planning programmes. In Brazil, Egypt, Mexico, South Africa, Thailand and Tunisia, large-scale commitment to upgrading and service provision has led to an overall reduction in the growth rates of slums.[45] The provision of basic services and security of tenure has many positive consequences, including the reduction of vulnerability to disaster. Households that can access basic needs are not only healthier, but often have more time and, as a consequence, money and energy available for investment in household and, collectively, community improvement.

If risks are too high or disaster has already struck, re-housing can be an option. However, careful consultation with those to be re-housed and the community into which people will be moved is essential. Box 8.11 provides an example of a re-housing and relocation programme that successfully brought together local government and slum community leaders. Without significant local consultation, re-housing is in danger of leading to the break-up of social networks and livelihood resources upon which the poor and vulnerable rely.[46]

There is an added risk in re-housing programmes if the alternative sites are also disaster prone. Naga City in the Philippines is relatively small (127,000 residents) but has a considerable population of low-income citizens. The Naga City Integrated Disaster Management Plan has had significant consequences for low-income households. Before the plan was instituted, an ongoing slum resettlement programme had identified 33 resettlement areas. However, it was found that 19 of these were in flood-prone areas. In light of this, alternative sites were found that were free of flood hazard, while still offering employment opportunities.[47]

An emerging alternative to the extension of formal planning into informal settlements at risk is to work with community associations to develop local land-use plans…

An emerging alternative to the extension of formal planning into informal settlements at risk is to work with community associations to develop local land-use plans that can be extended upwards to meet with the formal planning system. These plans are owned and researched by local communities and have limited legal standing, but provide a mechanism for those left outside of the formal planning process to identify land-use challenges to disaster resilience. Such planning takes place at the micro scale and is most successful in informal settlements that have not yet consolidated. At the pre-consolidation stage, there is some flexibility in land use so that strong community groups can police collective decisions to, for example, leave spaces between housing to allow for access routes for emergency vehicles. The challenge to this approach remains the extent to which community plans can be welcomed by and integrated with formal planning systems. A careful balance has to be met between the strategic emphasis of city-level land-use planning and the more local concerns of community plans.

Unconsolidated informal settlements vary in the strength and character of leadership. Partnerships with local planning authorities can build procedural rigour and provide additional legitimacy. Such partnerships can also be a mechanism for local planning authorities to initiate regularization, which often requires significant land-use decisions to be made that can allow later provision of critical infrastructure, such as water and electricity.

Box 8.11 Relocation planning in Sacadura Cabral, São Paulo, Brazil

In 1997, relocation was proposed as part of a slum upgrading programme in Sacadura Cabral, São Paulo (Brazil). A densely populated *barrio* subject to annual flooding was chosen by city planners for relocation. A total of 200 families were to be relocated from within the settlements to allow redevelopment and upgrading of the site.

The selection of families to be moved was initially controlled by the planning authority; but this met with much local resistance and was eventually replaced by a more communicative strategy built around a series of public meetings with communities and their leaders. Relocation planning was revised as an outcome of these meetings. The new plan included a role for the local community in the selection of families to be relocated. An agreement was reached that families would be housed within 1 kilometre from Sacadura Cabral and be given access to subsidized credit. Local people were to lead the reconstruction and upgrading process, with technical assistance from the local authorities.

A particularly innovative aspect of the project that arose from local consultations was that the selection of families for relocation was not restricted to those living in areas within Sacadura Cabral to be upgraded. Instead, the whole community was included. Thus, some of those who agreed to be relocated were not living in areas to be cleared and upgraded. The relocation of these families provided space within the existing community for some people living in areas to be upgraded to be re-housed within the community.

Source: Olivira and Denaldi, 1999

BUILDING CODES, REGULATION AND DISASTER-RESISTANT CONSTRUCTION

In 2003, an earthquake in the city of Bingol (Turkey) destroyed 300 buildings and damaged more than 5000 others. One of the buildings that collapsed was a school dormitory, killing 84 children. The dormitory had only been built in 1998 and was a modern engineered structure. The fact that this event occurred only four years after the Marmara earthquake reopened the public debate on the prevailing standards and building codes that are applied or (as in the case of the dormitory) not applied.[48]

Most countries have building codes aimed at ensuring that construction meets a minimum standard of disaster resilience. In some cases, codes might not be as appropriate as they could be. For example, in Jamaica, losses to Hurricane Gilbert in 1988 included 30,235 homes. High losses have been blamed on a lack of preparedness in the physical planning and housing sectors and because the 1983 National Building Code of Jamaica was inappropriately modelled on UK standards. In contrast to the housing sector, many small businesses were well prepared and were able to return to work quickly.[49]

The United Nations International Strategy for Disaster Reduction (ISDR)[50] recommends that building codes should be:

- realistic, given economic, environmental and technological constraints;
- relevant to current building practice and technology;
- updated regularly in light of developments in knowledge;
- understood fully and accepted by professional interest groups;
- enforced in order to avoid the legislative system being ignored or falling into disrepute;
- adhered to, with laws and controls based more on a system of incentives rather than punishment;
- integrated fully within a legal system that takes account of potential conflicts between the different levels of administration and government.

The greatest challenge is enforcing adherence to building codes during construction. Failure to comply with codes is a root cause of vulnerability in buildings. Too often, perverse incentives make it more attractive for administrators, architects, builders, contractors and even house owners to circumvent construction standards. This is not simply a product of poverty, but, at heart, is a problem of governance. In Turkey, much of the loss of life associated with the Marmara earthquake in 1999 has been attributed to the ineffective regulation of construction. In this case, risk generated by ineffective governance was compounded by high inflation, which meant that few people had insurance cover. Public outrage at this failing led to a protest and reform of the system of building regulation in Turkey.

Failure to comply with codes is a root cause of vulnerability in buildings

The potential for regulation of building codes to be undertaken by the private sector has been explored in recent research. Although it is argued that it might be cost efficient for a private body to undertake site inspections, it is unclear if a private body would be any less open to the perverse incentives that distort public-sector inspection and enforcement.[51]

Even where external financing might be thought to provide additional incentives for oversight and successful use of standards, this is not always the case. A recent review of World Bank lending during the period of 1984 to 2005 found that 60 per cent of projects receiving disaster financing were damaged by a subsequent event. Of 197 completed projects with a focus on mitigation – designed to use disaster-resistant standards – 26 per cent showed flaws in design, and half had been damaged by a subsequent event. Of the 65 projects in the transportation, urban and water and sanitation sectors approved between 2000 and 2004 in countries identified by the World Bank as disaster hotspots, only 3 projects included any detailed disaster planning.[52]

In cities of lower-income countries, but increasingly also in large cities of middle-income countries, the high proportion of citizens forced to reside in informal settlements where activities operate outside the formal planning and regulatory systems is particularly challenging for build-

Box 8.12 Improving low-income housing construction in Saint Lucia

A substantial portion of the housing stock in the Eastern Caribbean is built through the informal sector and does not meet official building standards. Under the Organization of American States (OAS) Caribbean Disaster Mitigation Project, a National Development Foundation (NDF) was created in St Lucia.

In July 1994, the St Lucian NDF established a revolving loan facility to finance retrofitting for St Lucian homeowners in the low-income sector. This was intended to better enable homeowners, small entrepreneurs, contractors, artisans and non-professional builders to adopt appropriate and cost-effective disaster vulnerability reduction measures in the informal housing sector. Loans were granted to a maximum of 15,000 Euros[53] per project for not more than four years.

Preparation for this programme required marketing in order to establish demand and training of builders to deliver the programme. Demand for the programme was identified through a household survey of two pilot communities at Gros Islet and Dennery. This was followed by a more extensive market study that illustrated the extent and nature of demand and finance required for both hurricane retrofitting and household safety and improvement purposes. Marketing strategies made use of community meetings, radio and television talk programmes, press releases and church notices. Tradespeople and artisans were trained in retrofitting techniques through the Sir Arthur Lewis Community College.

The NDF was able to obtain Group Insurance at reasonable rates through a local insurance broker on the condition that all properties are retrofitted. The project officers of the foundation were trained in property evaluation by the insurer. Furthermore, the NDF agreed to loan money to meet the first year's premium for any household that was unable to pay.

Between 1996 and 2002, 345 house improvement loans had been distributed. While the specific eligibility criteria applied in this case would exclude low-income households from poorer nations, the approach has made a contribution to safety and points the way towards the potential for productive relationships to be built with private-sector insurance companies for proactive risk reduction.

Sources: OAS, 2001, 2003; UNDP, 2004

ing control. There is limited international and governmental action to address this, although some innovative responses have come from non-governmental and research organizations (see Box 8.12).

A number of international initiatives have begun to build frameworks for information exchange and learning in technical aspects of safe construction. This is most developed among the earthquake engineering community. An internet-based encyclopaedia of housing construction is being prepared by the Earthquake Engineering Research Institute in the US[54] and by the International Association of Earthquake Engineering in Japan.[55] The World Seismic Safety Initiative,[56] a coalition of academic and professional engineers, has sought to extend public awareness and government commitment to earthquake safety through working in partnership with national associations such as Nepal's National Society for Earthquake Technology and Uganda's Seismic Safety Association. GHI has applied a Global Earthquake Safety Initiative to 21 urban areas, including regional as well as capital centres and megacities.[57]

Megacities are the urban centres that have received most coordinated attention at the international level. Prominent is the Earthquakes and Megacities Initiative,[58] linked to the World Seismic Safety Initiative. This was initiated in 1997 to promote comprehensive city-wide disaster management systems in large cities exposed to seismic hazard. The project is noteworthy in advocating for policy on land-use planning and recovery, as well as structural mitigation through construction standards and engineering-based initiatives. City-to-city learning is facilitated through the Cluster Cities Project and a Training and Education Programme directed at professional groups. The holism of this approach can be seen in the Americas Cluster Project Workshop held in Ecuador in 2001, where key areas for collaboration included community-based vulnerability reduction, population needs and healthcare delivery in disasters, and promoting a culture of prevention.[59]

Disaster events often provide an opportunity for training those working in the construction industry in safe construction techniques. This can contribute towards addressing the great gap between construction standards and their implementation if local artisans have the skills and knowledge to build safely. Where the additional costs are minimal, safer building might become more achievable. Yet, costs of safer building construction are often relatively high.

There is much to learn from vernacular building design and practices. Work on vernacular housing, including the training of local builders, has been reported by the ISDR from Bangladesh, China, Colombia, India and Peru.[60] Reports from earthquakes in the Himalayas, in Srinagar, Himachal Pradesh and the Garhwal Highlands, have shown vernacular housing to be the most resistant to earthquake damage.[61]

…costs of safer building construction are often relatively high

PLANNING TO PROTECT CRITICAL INFRASTRUCTURE AND SERVICES

Chapter 7 noted how the impacts of a disaster can be magnified through the domino effects of secondary and indirect losses caused when critical infrastructure or services are damaged by disaster. This is, of course, precisely why acts of terror and war are targeted at critical systems. The damage caused by Storm Lothar, which hit France in December 1999, was greatly magnified by the indirect impacts on the 3 million people whose electricity supply was cut.[62]

Critical infrastructure includes:

- electricity (generation, transmission and distribution infrastructure);
- natural gas and liquid fuels (storage, transportation and distribution infrastructure);
- potable water and sanitation (collection, treatment, storage, transportation and distribution infrastructure);
- telecommunications (broadcasting, cable transmission and cellular telephone infrastructure);
- transportation (road systems, mass public transport, and air and sea transport systems).

Critical services include:

- hospitals and access to healthcare;
- police and maintaining the rule of law;
- banks and stability in financial services.

Protecting critical infrastructure and services against all conceivable sources of harm is prohibitively expensive, especially so for countries and cities with small economies. Resilience targets can be used in planning to act as goalposts when determining a minimum level of capacity to be protected in the case of a disaster. These are rough guidelines; but they enhance transparency in priority setting. Such a target could be that for a city there should be a 95 per cent chance that 80 per cent of hospitals can operate at 90 per cent of their capacity within 24 hours of an earthquake of a particular severity. Monitoring performance can include simple metrics. In the case of transport infrastructure, for example, possible criteria could include total vehicle hours travelled post- and pre-earthquake (congestion); total vehicle kilometres travelled post- and pre-earthquake (detour length); time delay between critical origin/destination pairs (e.g. from damaged areas to emergency hospitals); and restoration time to, say, 80 per cent of pre-earthquake capacity.[63]

Critical infrastructure and services share a reliance on networks that allow for the movement of information and commodities. These networks are fundamental in ensuring the health and safety of the population and the functioning of the urban economy. They are interdependent so that a failure in one system can lead to repercussions in associated systems. The links that unite life-support networks and convey vulnerability can also be a source of resilience, offering alternative routes for information flow and feedback in the system or for overlapping functions and spare capacity. In any system, it is important that both direct and indirect links are made visible. Indirect links are those that cascade through intermediary networks and are often hardest to perceive. For example, storm winds toppling power cables will lead to blackouts with direct impacts on business; but business will also be affected if the blackout cuts off power to public mass transport.

There is a large technical literature on risk management for critical infrastructure and services. The majority concerns risk management procedures to be undertaken as part of good management practice. There has been relatively little work on linkages with the urban planning community. The majority concerns internal risk management, with only a relatively small part oriented towards the urban planning community. As shown in Box 8.13, a review of this literature from the perspective of natural disasters argues that risk communication should be a central pillar for building resilience and response capacity.[64]

Protecting critical infrastructure and services against all conceivable sources of harm is prohibitively expensive

PAHO has been a leading organization pushing for health services to be incorporated within disaster planning. It has produced a number of studies on protecting health services through appropriate construction, design and management of health facilities. For example, in Peru, legislation has been drawn up to encourage the inclusion of disaster reduction activities in health-sector action plans.[65]

In the education sector, the goal of meeting the education targets of the MDGs has raised the political impor-

Box 8.13 Risk communication for critical infrastructure and services

A communication system is needed to ensure the transfer of information between linked critical infrastructure and services. It should aim to help in the coordination of risk reduction, the containment of disaster impacts and in speedy recovery. It is recommended that a formally constituted risk management committee (RMC) should be established with representatives from all linked networks and associated local stakeholders who would be affected by decisions, as well as municipal and national authorities with responsibility for overseeing operations in these life-support systems. The RMC would have subcommittees for particular domains of expertise and be driven by four areas of work:

Risk prevention

The first responsibility of the committee is to ensure that vulnerability is adequately reduced to provide an acceptable level of risk. Any residual risk with implications for the population will require a policy on disclosure.

Risk preparation

Each life-support network has the responsibility of reaching a level of preparedness that permits it to maintain or re-establish, in the shortest possible time, the functions that allow it to fulfil its mission during a disaster. Certain elements will need to be planned jointly with the RMC, including early warning criteria; a protocol for exchanges between networks; channels for communication or exchanges; agreements on encoding and decoding transmitted information, as well as feedback processes; the implementation of mitigation measures at the level of operations and infrastructure; and decision-making levels required and involved in these information exchanges.

Risk intervention

Direct links between managers and experts of linked life-support systems must be established for use during a crisis. Preferred channels of communication must transport high-quality, concise, precise and tangible information; transmit information quickly and without distortion; transmit information that sets mitigation measures in motion; transmit information that integrates with the operations of the destination networks, and establish a direct link between personnel of the hierarchical and operational levels; and create robust, redundant and compatible links between the networks. All mechanical and electronic means can be considered. The RMC can provide a review for the system or a reference point for networks seeking advice on how to connect to the system.

State of readiness

The RMC has responsibility for maintaining the system. It must agree on responsibility for maintenance of the communication channels; verification of the robustness of these channels; training of personnel who intervene in emergency situations; and preparation of joint exercises, allowing the readiness of all participants to be verified.

Source: Robert et al, 2003

tance of securing educational facilities from natural disaster risk. The fact that many school buildings also double as shelters in times of emergency also increases the value of investing in secure construction for schools. Nevertheless, many schools are not constructed or retrofitted to safe standards. More than 1000 school children were killed by inadequate school building standards in Spitak (Armenia) in 1988.[66] The Unit for Sustainable Development and Environment of the Organization of American States (OAS), PAHO and ISDR developed a programme,[67] in 1993, to build disaster resilience in educational services. The programme has focal points in Argentina, Costa Rica, Peru, Trinidad and Tobago, the US and Venezuela. In Peru, for example, work on schools in Quito has revealed design weaknesses, such as short columns, inappropriate joint designs and lightweight roofs. In Quebec, the Canadian Red Cross has worked with teachers to help children aged 5 to 16 psychologically prepare for the aftermath of natural disasters.[68]

Early warning is a cornerstone of disaster risk management

Risk to critical infrastructure and service networks in cities of developing countries is exacerbated by the complexity of their evolution and maintenance. Design is often piecemeal, the product of individual infrastructure development projects, with resulting networks being eclectic and varying in age, form and operational criteria. This serves to complicate and delay reconstruction of critical infrastructure as experts are called in from other cities or overseas. This is complicated further by informal-sector provision of critical services, such as potable water and policing. In an increasing number of cities, informal provision of such services is the primary distribution mode for the majority of citizens. The coordinated identification of network vulnerability and subsequent risk mitigation with informal-sector actors outside of regulatory control is challenging.

…translating scientific information on approaching hazard into language that results in action continues to challenge risk managers

EARLY WARNING

Early warning is a cornerstone of disaster risk management. Despite this, few cities have early warning systems or even hold data on past hazards and disaster events. Losses to the Indian Ocean Tsunami in 2004, the 2003 heat wave in Europe and the Bhopal chemical gas release in 1984 have all pointed to gaps in early warning systems that have since become political priorities for action. There are four interdependent components of early warning systems: risk knowledge; monitoring and warning; communication; and response capacity.[69] The capacity of an entire system is threatened if any one of these components is weak. This section reviews policy for early warning, risk knowledge, risk communication and response capacity.

In 2005, the ISDR undertook a survey of capacities and gaps in global early warning systems. The survey found that considerable progress had been made in developing the knowledge and technical tools required to assess risks and to generate and communicate predictions and warnings. Early warning system technologies are now available for almost all types of hazards and are in operation in at least some parts of the world. The weakest elements of warning systems concern warning dissemination and preparedness to act. Early warnings may fail to reach those who must take action, and may not be understood or address their concerns. Root causes appear to be inadequate political commitment, weak coordination among the various actors, and lack of public awareness and public participation in the development and operation of early warning systems.[70]

Risk knowledge and warning

Risk assessment is based on the tracking of information on hazards at a range of scales, from local to global, depending upon the character of the hazard and the nature of the city's vulnerabilities. Many of the techniques discussed earlier in this chapter can be used to generate baseline data against which subsequent assessments can measure risk trends. Shifting social contexts as well as environmental changes can make historical comparisons of risk over time difficult. An additional challenge for the monitoring of technological risk is the secrecy of industrial interests (public as well as private). For example, both the gas release from Union Carbide (India) Ltd's plant in Bhopal in 1984 and the release of radioactive particles from a nuclear power plant in Chernobyl (Ukraine) in 1986 were associated with technical and management failures inside the plants that should have been detected and responded to by a risk management system.[71]

Risks associated with natural hazards can require surveillance of physical phenomena locally – as, for example, in river-level gauges in the city – and at a distance. More distant measurements of risk can provide additional time for defensive action to be taken. Examples include water levels in rivers or dams, satellite tracking of tropical cyclones and storms, or seismic activity, as done by the International Tsunami Information Centre warning system.[72]

Risk communication

Technologically driven systems for risk identification and assessment routinely attract investment, as can be seen from the number of private-sector, national and international scientific bodies working in this field. But translating scientific information on approaching hazard into language that results in action continues to challenge risk managers.

People-centred approaches to risk communication and planning for appropriate response to early warnings require systems of communication to be in place and the use of appropriate language. There are many examples where risk identification has not led to timely warning and action due to a lack of clear lines and methods of communication. Seismic activity resulting in the Indian Ocean Tsunami was detected; but with no established lines of communication at the international level, information was not acted upon. Less well known is the 2002 volcanic lava flow that destroyed 40 per cent of the town of Goma in the Democratic Republic of Congo. This event was predicted by a local academic geologist; but in the absence of a municipal or national early warning system, his information was not acted upon. In response, the NGO Concern initiated a Community Preparedness for Volcano Hazards Programme (2002 to 2004). This programme built local resilience to volcanic risk

by strengthening community understanding of risk, information networks and disaster response of partners and communities. This is an example of an early warning project embedded within a wider risk reduction programme. It involved administrative representatives, health and education staff, local Red Cross representatives, and the sub-commissions for education and civil protection set up in the wake of the volcanic eruption of 2002.[73]

Box 8.14 presents a success story of a people-centred early warning experience from Honduras that built local resilience through early warning, even when national early warning systems failed.

Effective early warning requires trust between those giving and receiving information. Some degree of coordination can give legitimacy to national early warning systems, although this is not always the case, especially where past experience of the state has eroded local trust in its institutions. The experience of La Masica is not unique in showing the advantages of decentralized systems. Transparent and clear information flows can help to build trust by constraining opportunities for the concealment of imminent hazards. Local and national governments have sometimes kept the public in the dark when receiving technical information on imminent threats to prevent unease among investors, especially in tourist economies. There are also cases where the public may refuse to heed early warnings from authorities. In both cases, clear and balanced information is critical, even when some level of uncertainty remains.[74]

Communicating risk to the public is less problematic in urban than rural areas because of the high density of communication infrastructure and social networks. This may not hold true for smaller, isolated and informal settlements or slums. Maintaining early warning communication systems where hazards are infrequent but potentially capable of delivering a high impact is especially difficult. Communication infrastructure may not be tested regularly and social contacts might be lost over time. One way around this is to build early warning communication systems on top of everyday communication networks. For instance, where mobile phones are common, they offer a potential network for spreading early warning and preparedness advice.

Response capacity

More difficult in cities is the coordination of action in response to alerts and early warnings. Pre-planning and clear communication with the public are needed to prevent inappropriate action or panic. In Lagos (Nigeria), a city where trust in officials is strained, more than 1000 people were killed in 2002, most by drowning, while fleeing in panic from an explosion in an army barrack.[75] This contrasts with Hong Kong, where tropical cyclone bulletins include practical advice on securing homes and businesses and how to access more information.[76]

In congested cities with overburdened transport networks, evacuation can be challenging. Cuba has perhaps the best track record on urban evacuation with a well-managed and frequently practised evacuation strategy as part of its risk reduction system (see Box 8.15). Clear lines of authority and cultural acceptance of large-scale public evacuation are elements in this success. In 2004, Hurricane Charley severely damaged 70,000 houses, but killed only four people thanks, in part, to the evacuation of over 2 million people.[77] The Cuban system contrasts with that of the US, which has increasingly relied on individuals to take responsibility for their own evacuation and safety following an early warning. Huge numbers of people successfully do this. Over 2.5 million people were evacuated from Florida following an early warning in advance of Hurricane Charley.[78] But, as was seen in 2005 during Hurricane Katrina, there will always be a sizeable urban population who lacks access to private transportation and will rely upon a well-organized public evacuation service.

Box 8.14 People-centred early warning: La Masica, Honduras

The experience of La Masica in Honduras shows that small urban centres can successfully build their own resilience to disaster risk through people-centred early warning. The system developed in La Masica is relatively low cost and operates independently of outside information flows or resources, thus increasing its robustness during times of emergency.

La Masica's early warning system was put to the test during Hurricane Mitch in 1998. Hurricane Mitch killed over 20,000 people in Nicaragua and Honduras. In La Masica, despite flooding and economic damage caused by the nearby River Lean, none of the municipality's 25,000 residents was killed.

The early warning system had been initiated a few years before Hurricane Mitch, with the full involvement of the municipality's residents. The area had suffered in 1974 from Hurricane Fifi, and from smaller flooding incidents. Recognition of the community's high exposure to hazard catalysed the local early warning and preparedness programme. The programme included participatory risk assessments with local people observing river flow, the establishment of a local risk management organization, and the drawing-up of emergency plans for responding to rising water levels. Many of those involved in the programme were women.

The success of La Masica's local early warning system contrasts with the national flood warning system, which was disabled by flood waters and technical difficulties with satellite data. In this case, local organization based on simple technology provided greater resilience than the national high-tech alternative.

Source: Lavell, 2005, in Wisner et al, 2005

Effective early warning requires trust between those giving and receiving information

FINANCING URBAN RISK MANAGEMENT

City authorities seldom generate sufficient funds to meet all their development and risk reduction needs. Thus, they face the twin challenge of attracting finance and balancing the conditionalities that come with this support against local priorities and strategies for disaster risk management. Inefficient or inadequate fiscal decentralization further reduces the financial capacity of local governments. This is especially the case in poorer or rapidly expanding cities where the proportion of residents and organizations who contribute to the city revenue can be low.

National governments finance urban infrastructure works through project grants or line financing through ministries with responsibility for infrastructure in the urban sector. In Guyana, central government is responsible for sea defence and land drainage work, which nonetheless protects

Box 8.15 Lessons in risk reduction from Cuba

Cuba's integrated system of disaster risk management has succeeded in saving many lives and has built resilience beyond the level that might be expected from the country's economic status. Between 1996 and 2002, six hurricanes hit Cuba, causing 16 deaths in Cuba out of the total of 665 deaths they collectively caused. What is Cuba doing right?

Central to Cuba's successful risk reduction is the government's stated priority that its fundamental commitment during a hurricane is to save lives. The country's risk reduction plan and disaster preparedness structures support this commitment to save lives through the following:

- a disaster preparedness plan, which incorporates a specific focus on the most vulnerable, provides for monitoring their situation and adapts plans to address their specific needs;
- the national civil defence structure, which uses sub-national government at the provincial, municipal and local level for disaster preparedness and response (in most disasters, local knowledge and leadership play key but unacknowledged roles in disaster risk reduction; the Cuban model incorporates these as central);
- practical, effective lifeline structures, with particular emphasis on mass evacuation and use of safe secure shelters;
- a 'culture of safety' that creates the trust and awareness necessary to motivate people to cooperate and participate in risk reduction;
- citizen participation by incorporating community mobilization in a three-tiered system of participation in planning, community implementation of lifeline structures and the creation and building of social capital.

Since 75 per cent of Cuba's 11 million people are urban, the country's disaster preparedness plan has a strong focus on being operational in urban areas.

Cuba's model also owes a lot to its unique system of government and its socio-economic model, which has consistently addressed risk reduction through policies of social and economic equity and poverty reduction. These policies have produced 'multiplier effects' that enhance risk reduction in many ways. The adult population is 100 per cent literate and therefore can access educational materials about disasters, and all children are exposed to disaster preparedness in school curricula. There is an adequate road system in the country that facilitates speedy evacuation and building codes are enforced, which reduces the element of highly vulnerable substandard construction. Approximately 95 per cent of the households in the country have electricity and therefore can access information about disasters through radio and television. Finally, the intricate web of social, professional and political organizations in the country provides organizational structures that can be quickly mobilized in disaster. Surprisingly, the economic crisis triggered by the collapse of the Soviet Union has not affected Cuba's success in protecting the lives of its population from hurricanes.

The Cuban government is unique in that it has paid an equal amount of attention to the structural and physical aspects of disaster preparedness, but also created a 'culture of safety' through successful education and awareness campaigns. It has also demonstrated the central importance of management capacity and political will in successful risk reduction. This holds out real possibility and hope for other countries, rich and poor alike, facing the growing dangers of natural hazards.

Source: Thompson, 2007

National budgets for disasters tend to prioritize relief and emergency responses

the capital city, Georgetown, from flooding. Political and personal rivalry between the leaders of city and national governments is, at times, interpreted as a cause for delay or withdrawal of funds.

National budgets for disasters tend to prioritize relief and emergency responses. Prevention and mitigation are less attractive as funding choices. After all, governments get less praise from the electorate and the international community for reducing disaster risk than they do for a speedy and generous emergency response.[79] A number of countries have special calamity funds to cover the additional costs of reconstruction (e.g. India, the Philippines and Colombia), while some in Latin America and the Caribbean make special mention of municipal-level support for risk reduction.[80]

Social funds and public works programmes are more normally associated with large-scale rural disasters as mechanisms for supporting livelihoods; but they have potential for urban areas too. In Nicaragua, following Hurricane Mitch in 1998, social fund financing was released through four regional offices and used to build shelter, water and sanitation systems, and bridges. This was essential for enabling critical services and market access to smaller towns and rural settlements.[81]

…bilateral and multilateral donors … have a history of supporting disaster reconstruction

Like national governments, bilateral and multilateral donors, including international development banks, have a history of supporting disaster reconstruction. The Asian Development Bank (ADB), the Inter-American Development Bank (IDB), the UNDP, the World Bank and the African Development Bank all have policies covering natural disasters and implement projects in this area. Only the UNDP funds relief; but all are active in reconstruction. With the exception of the African Development Bank, disaster reconstruction can be funded by drawing on funding already allocated to development projects. The World Bank's approach to disasters, for instance, has tended to be reactive rather than tactical (see Box 8.16). Disasters have been treated as interruptions in development rather than as a risk that is integral to development. Few Country Assistance Strategies or Poverty Reduction Strategy Papers (PRSPs) supported by the World Bank mention disaster risk.

Recent initiatives, notably by the IDB, the Caribbean Development Bank, the DFID and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), among others, indicate a reappraisal and recognition of the value of investing in risk reduction. For example, in 2006, the DFID committed to allocating approximately 10 per cent of its

Box 8.16 World Bank funding for disaster risk reduction and reconstruction

As a proportion of World Bank lending, disaster lending has increased from 6 per cent during the period of 1984 to 1988 to 14 per cent from 1999 to 2003. Four times as much disaster lending is spent in rural than urban areas. Emergency recovery loans (ERLs) provided under the World Bank's Emergency Recovery Assistance Policy are made available to countries undertaking disaster reconstruction. ERLs were first adopted during 1970 following an earthquake in Peru. These loans are intended for recovery from natural and human-made disasters, but also economic shocks following biological and political events, such as foot-and-mouth disease outbreaks and political violence, including terrorism. However, a large amount of the World Bank's disaster response lending takes place outside of ERLs. For instance, only 2 out of 95 fire-related projects and 23 out of 59 earthquake-related activities are ERLs.

ERLs are disadvantaged since they are limited to a three-year timeframe. This has led to delays in implementation because projects that could benefit from attention to social and economic concerns have been prepared too quickly. Current policy does not support the purchase of consumables that might be used for disaster relief. This closes an opportunity for supporting countries hit by catastrophic events, such as the incapacitation of major and capital cities, which are beyond the capacity of governments, bilaterals and humanitarians to support. The World Bank has shown some flexibility by financing temporary shelter programmes in Colombia, El Salvador, Honduras, India and Turkey, as well as cash transfers to earthquake-affected populations in Chile in 1985, Turkey in 1999, and in response to the 2004 Indian Ocean Tsunami in Sri Lanka and the Maldives.

In addition to ERLs, World Bank emergency assistance is available through reallocation, redesign of pipeline projects, freestanding mitigation projects and assessments. This provides some useful flexibility for countries. What is missing is a mechanism for providing rapid lending for relief that does not involve opportunity costs over the medium term. The World Bank is good at supporting infrastructure reconstruction, but neglects the support for social organization that is necessary for building sustainability into investments. This observation might be linked to the failure of many projects to incorporate the findings of disaster prevention studies that have been commissioned as part of the project. Of 197 projects focusing on disaster mitigation or prevention, 142 included such studies, but only 54 took these studies into account.

Recent work in the World Bank has moved in a positive direction and begun to embrace prevention and mitigation to include non-structural measures, such as institution building for hazard management, land-use planning, enforcement of building codes and insurance mechanisms. But more work is still to be done. In particular, challenges remain in supporting institutions and developing lending tools that encourage maintenance of investments; in reviewing procurement strategies that do not go through competitive bidding; in coordinating between donors, including non-governmental organizations (NGOs); and in strengthening community level involvement and capacity.

Source: World Bank Independent Evaluation Group, 2006

funding for natural disaster response to prepare for and mitigate the impact of future disasters, where this can be done effectively. The DFID expects this new financial support to be particularly relevant for sudden onset disasters and it will only apply to responses that will cost more than UK£500,000.[82] Large-scale urban disasters are likely to fall within this new scheme. United Nations organizations (notably, the Bureau for Crisis Prevention and Recovery at UNDP and UN-Habitat) and some international NGOs, such as the International Federation of the Red Cross and Red Crescent Societies (IFRC) and Tearfund, have championed the risk reduction agenda. These organizations are active in lobbying internationally for risk reduction and have emphasized the need for risk reduction in urban contexts.

Private-sector insurance is important as a means of financing reconstruction and as a source of foreign currency with which to offset balance of payments deficits during the reconstruction period.[83] Insurance companies have also been active in promoting secure building practices. In areas of high potential loss, private-sector insurance has been underwritten or replaced by government insurance. This is the case in the US, where Florida's catastrophe fund reimburses insurers when disaster losses exceed set levels.[84]

Private sector insurance is important as a means of financing reconstruction

DISASTER RESPONSE AND RECONSTRUCTION

This section reviews the roles played by local authorities and others, including local people and international agencies, during response and reconstruction phases of disaster. In particular, the aim of this section is to review the challenges to 'building back better' during these phases. First, issues of common concern to response and reconstruction are discussed and then each phase is reviewed in more detail.

Municipal authorities and local government are well placed to coordinate emergency response and reconstruction

The role of local authorities

Municipal authorities and local government are well placed to coordinate emergency response and reconstruction. They can link response and reconstruction to pre-disaster development goals and, indeed, can provide a forum for pre-disaster development goals to be reappraised in light of the disaster event. Table 8.1 describes the core activities of local authorities during response and reconstruction phases. There is a good degree of overlap in basic roles such as assessment for planning, coordination with civil society and other government agencies, liaising with international agencies, monitoring progress, establishing lines of finance, reviewing performance and providing public information. The distinction between relief and reconstruction is even less clear on

the ground. This is especially the case in urban contexts where many different sectoral actors are involved and disasters have led to different scales of destruction in different parts of a settlement or city. Consequently, some sectors or areas of a city, or individual settlements, may be progressing towards development-oriented reconstruction, while others are still coping with relief work.

During large events, where response and reconstruction involve international actors, it can be hard to retain control over coordination, especially for local authorities with limited capacity. Even where joint coordination systems work, the myriad of smaller agencies (many of which may be new to development and humanitarian work) are often not identified and are not party to management and coordination decisions. Loss of coordination through swamping from international agencies, or as a result of the diversity of small groups, can erode local self-reliance and hinder the integration of development within reconstruction. Pre-disaster planning that includes organizational structures to manage joint action and, as far as possible, to decentralize decision-making to sectoral, regional and community levels is the best way to avoid loss of strategic control.

The building-back-better agenda crystallizes the aim of building development into post-disaster work

Building-back-better agenda

The building-back-better agenda crystallizes the aim of building development into post-disaster work so that vulnerability is reduced and life chances are enhanced as a result. The tension between speed of delivery and the desire for inclusive and participatory decision-making is a theme that runs throughout the integration of development into response and reconstruction. Established cultures of response privilege speed and efficiency in delivery; but this has meant that an opportunity has been lost for furthering development aims through post-disaster action.

A continuum of actions from relief through response to development and preparedness exists. Developmental and emergency thinking and actions are needed at each stage. The emphasis is different at each stage and, in practice, it is proving difficult to integrate the right balance of humanitarian and development actors and ideas; but progress is being made. Innovative planning for shelter reconstruction in Kashmir following the South Asian earthquake in 2005 included not only cash for work, where survivors were paid to clear land, but also cash for shelter. Affected people were provided with building materials and then paid for construction work. The rush to build before the coming winter was made sustainable through designs that could be upgraded to more permanent structures over time. Through these two mechanisms, reconstruction became developmental.[85]

The challenge to 'build back better' confronts a number of dominant practices in reconstruction work. These are well exemplified in experiences that have arisen from planned housing reconstruction in the Andaman and Nicobar Islands after the Indian Ocean Tsunami. After the tsunami, the Government of India offered to replace nearly 10,000 homes. But lack of participation led to inappropriate building design and materials, as well as selection of settlement sites. Moreover, a preference for external contractors missed an opportunity to strengthen local livelihoods. The depth of alienation felt by survivors in this project erupted in protests that left more than 100 people injured.[86]

Capitalizing on the opportunity that disaster presents to build back better requires pre-disaster planning. From the perspective of human settlements, land-use titling and the granting of secure tenure before a disaster occurs make the distribution of recovery support (potentially including relocation or rebuilding) more transparent and efficient. The rationalization of planning and building regulations and administrative approaches that reach the poor will not only reduce loss, but act as benchmarks for reconstruction building. Without the enforcement of such guidelines, risk will be built into new construction.

More generally, reconstruction after the Indian Ocean Tsunami has provided much experience in attempts to build back better. A number of lessons can be learned that will have resonance for all housing and infrastructure reconstruction projects, including:[87]

- A clear policy framework that articulates objectives, entitlements of affected families, decision-making criteria, timetables and grievance-settling procedures helps

Table 8.1

Local authority actions during disaster relief and reconstruction

Local authority role	Relief	Reconstruction
Assessment for planning	Undertake a rapid impact assessment to help judge the scale of response and rehabilitation to be undertaken.	Monitor human and economic impacts as they unfold. A dynamic approach to impact assessment is particularly important to be able to track inflationary consequences of reconstruction materials and any shortages in food supplies.
Coordination	Coordinate administrative and technical aspects of disaster emergency response with emergency services, the armed forces, the Red Cross/Red Crescent and other civil society groups. This work should involve liaison with managers of critical infrastructure and services.	Bring together stakeholders to plan the transition from emergency to reconstruction and from reconstruction to development. Consider to what extent development pathways led to the accumulation of risk and eventual disaster event, and the opportunities for building risk reduction into reconstruction, rehabilitation and post-disaster development.
Liaise with national and international agencies	Determine if national and international assistance is required for emergency response.	Determine if national and international assistance is required for reconstruction and rehabilitation.
Monitor progress	Monitor and review the performance of emergency services.	Monitor and review the performance of reconstruction services.
Seek finance	Facilitate access to finance through access to local and national emergency funds.	Facilitate access to finance through emergency funds and private insurance. Enable private remittance flows.
Review performance	Document decision-making for future analysis and learning.	Review the performance of pre-disaster policy and organization for risk reduction, early warning, disaster response and reconstruction. Document and evaluate the programmes.
Public information	Keep the public informed at all times.	Keep the public informed at all times.

to foster trust and collaboration between stakeholders.

- The criteria for identifying beneficiaries must be clear. In developmental approaches, consideration is given to supporting those vulnerable households who were not affected by the disaster.
- Involving local participation in the selection of resettlement sites improves final choices and increases acceptability.
- Information dissemination systems can regularly report on progress directly to affected families and individuals in order to reduce stress and tension.
- Reconstruction is a prime opportunity to enhance women's property rights. This has been done by giving new ownership titles jointly to husband and wife or in the name of the female head of household in single parent families.
- The best building design is flexible. Families use houses differently and have diverse traditions of design and use. Those who will live in houses should be allowed to contribute in the design stage in order to diversify and make appropriate use of architectural styles. Where vernacular housing design has proven resilient to hazards, this should be given preference.
- Particularly when large contracting firms are used, the most successful projects have built-in mechanisms for community oversight.
- Reconstruction provides a great opportunity to support the local economy. Local craftspeople should be employed or trained in preference over external firms. Traditional materials and technologies can be used.
- The environmental impact assessment (EIA) of reconstruction is seldom taken into account and, in large schemes, can be considerable, including the generation of local hazard (e.g. by felling mangrove stands or construction in low-lying places). The best EIAs include not only damage onsite, but also the carbon costs of sourcing and transporting materials.

The following discussion analyses in greater detail the roles that can be played, in particular, by local authorities in pro-development disaster response and reconstruction.

Disaster response

Effective disaster response rests on having a prepared and rehearsed plan with clearly identified responsibilities. The stakeholders involved in response are broadly similar for natural and human-made disasters. Initial response includes neighbours and community organizations, emergency services and civil defence. Emergency response can overlap with development, so that, increasingly, development actors (including those with experience in urban planning and construction), along with international agencies such as UN-Habitat, become involved.

In those cities and parts of cities where municipal resources are limited, self-organized and community-based response plans can save many lives. Residents of Los Manguitos, an informal settlement in the city of Santo Domingo (the Dominican Republic) did not receive government or NGO support for two weeks following Hurricane Georges in 1998. Pre-disaster social organization enabled community members to undertake social care, policing and housing repairs during this period of uncertainty.[88]

More broadly, the state has responsibility for maintaining the rule of law and to protect property and people from looting and violent crime during disasters. This is a major task during reconstruction. There may be a role for civil society groups or international observers to oversee activities or work in partnership with security agencies, such as the army, police or civil defence. This is particularly the case in cities where the state or para-statal groups have had a violent relationship with citizens pre-disaster.

Reconstruction provides a great opportunity to support the local economy

Some people are more at risk than others of being left out of relief and response programmes. Women, children and orphans, the elderly and those who are marginalized because of language, culture or social class are especially liable to not having their entitlements met during relief and response. The social pressures that create pre-disaster inequality underpin how people fare during disaster response. This is a particular challenge because it means that it is not sufficient to follow local demands and directions on aid distribution. These must be questioned in light of the prevailing development context. Accounts from the South Asian earthquake in 2005 note that women were largely dependent upon men for access to relief. Few women received tents or food or came forward to participate in food or cash work programmes. Even when this gender disparity was recognized by agencies, it was difficult to find skilled women, underlining the influence of pre-disaster inequalities on post-disaster work that aims to build back better.[89]

Security is also a concern if temporary shelter is provided in camps. Women are often most at risk from violence, but also suffer from a lack of privacy and from inadequate provision for personal hygiene.[90] In Sri Lanka, after the Indian Ocean Tsunami, women were seldom found among the managers of camps. Indeed, the Sri Lankan Parliament Select Committee on Natural Disasters, mandated to assess disaster preparedness and mitigation, had only 2 women out of its 22 members. Many tent villages set up after the South Asian earthquake have been reported to have little or no functional security.[91]

…where municipal resources are limited, self-organised and community-based response plans can save many lives

Careful coordination of response activities can help families to stay together, and to protect women, children and the aged. But this relies on pre-disaster registration and on safe record-keeping. Birth registration forms and formal identification documents are often lost in disasters; but are essential tools for protecting individuals' rights, including access to relief and in reuniting families.[92] The best relief is a product of pre-disaster training and preparedness based on local decentralized control.

Reconstruction for risk reduction

Strong local government is needed to oversee reconstruction and to help control profiteering over land held for resettlement.[93] Reconstruction is a period when urban land rights are often contested or fought over by competing interests. It is not uncommon for those with only usufruct or customary

rights, or for the poor or tenants, to lose claims over high-value land, and for this to be transferred to speculators and developers in the process of reconstruction. If land titles did not exist before the disaster or have been lost, proxy indicators are useful. Where such measures are not possible, alternative means need to be found to ensure that land is not seized outright or that fraudulent claims are not honoured.

Reconstruction is a period when urban land rights are often contested or fought over by competing interests

Following the Indian Ocean Tsunami in 2004, reconstruction planning for Aceh (Indonesia) recognized the opportunity to build back better through the provision of land titles. Land rights were correctly understood to be the cornerstone upon which communities rebuild their homes and livelihoods. They provide a solid, legal foundation for spatial planning, reconstruction and long-term economic development. Reconstruction has been supported by a multi-donor fund of US$28 million. Under the project, some 600,000 land parcels are to be titled, many for the first time ever, since less than 20 per cent of the landowners in Aceh had legal titles prior to the tsunami. This developmental aspect of reconstruction will enable citizens to use their land as collateral for financing homes and businesses. Yet, a review of progress in December 2006 found that while field-based teams had surveyed and adjudicated over 120,000 parcels of land, bureaucratic obstacles had resulted in the disbursement of only 7700 titles. Political will as well as technical capacity is needed to push forward ambitious programmes for building back better.[94]

The basic need for shelter should not be used as an excuse for overly rapid and socially unsustainable housing reconstruction

The overall aim of building back better is to use reconstruction as an opportunity to improve the economic, physical and social infrastructure, and to support the asset bases of individuals and households at risk. Reconstruction becomes a project for improving survivors' life chances and resilience, not returning them to pre-disaster levels.

If reconstruction programmes are to build back better, they must take into account the needs of families and be sensitive to gender, age and culturally specific needs and norms. The basic need for shelter should not be used as an excuse for overly rapid and socially unsustainable housing reconstruction. Too often, household livelihoods requiring access to external space (such as peri-urban agriculture) are lost when reconstruction planning places excessive emphasis on value for money. The misapplication of a development approach was seen in the Indian Ocean Tsunami in 2004, where efforts were made to strengthen the local livelihood base beyond pre-tsunami levels through the widespread provision of fishing boats. In some communities, this led to a lack of crew and the withdrawal of older male children from school.

…local economic development must be restarted as soon as possible after a disaster

One positive outcome of reconstruction that takes development goals into account can be the strengthening of social capital, which, in turn, builds resilience. In cities were civil society is strong, disasters can be opportunities for pushing reforms in urban planning. Popular action in Mexico City, following the 1985 earthquake, prevented the implementation of city plans to redevelop low-income inner-city tenements for higher-income uses.

The International Labour Organization (ILO) Crisis Response Programme aims to promote social development during reconstruction by helping to save existing jobs and creating new ones through the reconstruction process. The response package to the 2001 Gujarat earthquake in India included a model programme for social and economic reconstruction in ten villages in the Kutch district, funded by the ILO and implemented by the Self-Employed Women's Association (SEWA). In response to the earthquakes in El Salvador and in Peru in 2001, rapid employment impact projects were launched in partnership with the UNDP.[95] In order for households and communities to recover, local economic reconstruction must be restarted as soon as possible after a disaster. This means developing local markets through cash-for-work schemes, as well as direct support for local businesses requiring new premises or tools to restart. Often called 'foundation markets', these include consumer and retail services – stalls and shops.[96]

A final act in the transition to (realigned) development has often been to memorialize a disaster. Memorials can serve to support the healing process and help as a reminder of what can result from inappropriate development. Memorials are especially powerful when they gather together data and experiences – perhaps conflicting – of the event, its causes and consequences.

There is great scope for disaster impacts to be reduced if development actors are invited to contribute to planning reconstruction and rehabilitation. The inclusion of UN-Habitat in planning reconstruction following the earthquake in Bam (Iran) in 2003 led to a policy of supporting residents in reconstructing their own homes, including the incorporation of improved seismic resistance in preference to the established procedure of placing residents in temporary shelters.[97]

CONCLUDING REMARKS

The components of urban risk policy outlined in this chapter are mutually reinforcing. Successful early warning relies upon risk assessment and strong local communities for information transfer and action. Risk assessment feeds directly into land-use planning decisions. These and the other activities outlined in this chapter offer opportunities to build back better when they are considered in reconstruction, as well as in preparedness for disaster. They are key pathways for meeting developmental activities with the humanitarian imperatives of relief and reconstruction and point towards mechanisms for urban disaster risk reduction.

Local authorities are the most important actors in urban disaster risk reduction. Local authorities are the level of government closest to the ground and most directly answerable to those at risk. They occupy a strategic institutional position, mediating between competing interests in the city and beyond, and as a conduit of information and resources between communities and external actors. Their scope for action is, however, often severely limited by lack of finance, human skill shortages, an overburdening of responsibilities and political constraints.

The most successful partnerships for risk reduction invariably include local authorities and communities, often also with civil society organizations involved. Such partnerships can combine the scale of action and resources of

government, on the one hand, with sensitivity for local diversity held by community-based organizations and the technical ability of NGOs, on the other. If urban governance systems are to take disaster risk reduction seriously, greater support for multi-stakeholder planning and project implementation is needed. Reforms in international financial organizations indicate greater support in the near future for building risk reduction into development planning and for a reconsideration of reconstruction financing in order to create real opportunities for progressive urban risk reduction.

The following key challenges remain; but progress is being made:

- Urban disaster continues to be predominantly managed in low- and middle-income countries by emergency response and reconstruction, rather than mitigation, preparedness and investing in disaster-resilient development. Changes in international funding regimes can help move the risk reduction agenda forward.
- A lack of routine and rigorous collection of data on city-wide vulnerability and loss contribute to the low policy status of risk reduction.
- Where formal planning capacity is unlikely to meet demand in the foreseeable future, recent innovations in extending urban planning and building construction controls into the informal sector have met with some success and point the way forward in large and small cities alike.
- Early warning continues to be dominated by techno-centric approaches. Technology is a helpful, but partial, solution to early warning. Investment in piggybacking early warning systems onto existing social networks can be a cost-effective and sustainable way forward.
- A lack of transparency in reconstruction can lead, for example, to economic investments being recycled into the international economy, thus missing an opportunity for enhancing local safety, security and long-term development through reconstruction. The rapidity with which reconstruction is undertaken should be more seriously weighed against the potential for more participatory approaches that offer downward accountability.

NOTES

1 ISDR, 2004a.
2 For a discussion and examples of community capacity-building through hazard and vulnerability mapping, see ADPC (2004).
3 This list builds on ISDR, 2004a.
4 ISDR, 2004a.
5 See UNDP, 2004, and www.ldeo.columbia.edu/chrr/research/hotspots/.
6 Seismic hazard maps aim to show the susceptibility of an area to damage from energy waves travelling through the ground caused by earthquakes. They vary in comprehensiveness, from those based on geological information alone to those that incorporate soil properties and building resistance.
7 In 1997, the Government of India produced a national *Vulnerability Atlas*, which has been instrumental in helping state and municipal authorities strengthen land-use and construction codes and mainstream disaster risk reduction into development planning. See www.bmtpc.org/disaster.htm.
8 UK Environment Agency, www.environment-agency.gov.uk/maps/.
9 See www.scorecard.org/index.tcl.
10 Munich Re, 2004.
11 McGregor et al, 2006.
12 Carreno et al, 2007.
13 See www.epa.gov/enviro.
14 See www.cmap.nypirg.org.
15 See www.hud.gov/emaps.
16 For a wealth of theoretical and practical experience on participatory approaches in general, see the International Institute for Environment and Development, Participatory Learning and Action Notes, accessed at www.iied.org/NR/agbioliv/pla_notes/index.html.
17 See www.provention consortium.org/?pageid=39.
18 See www.provention consortium.org/files/tools_CRA/ActionAid_PVA_guide.pdf.
19 See www.unisdr.org/eng/hfa/hfa.htm.
20 For an updated collection of case studies and guidance notes on participatory methods, see www.?provention consortium.org/?pageid=43.
21 Pelling, forthcoming.
22 ADPC, 2005.
23 Peacock et al, 2005.
24 Greening et al, 1996.
25 *Taipei Times*, 2006.
26 Jeffrey, 2000.
27 Cross, 2001.
28 Enarson and Morrow, 1997.
29 See http://sspindia.org.
30 Wisner et al, 2004.
31 Asian Urban Disaster Mitigation Programme (undated).
32 See www.fourmilab.ch/etexts/www/un/udhr.html.
33 Wisner, 2001.
34 See www.dfid.gov.uk/news/files/disaster-risk-reduction-faqs.asp.
35 See www.unisdr.org/eng/hfa/docs/HFA-brochure-English.pdf.
36 Pelling, 2003.
37 ActionAid, 2006.
38 Pelling, 2003.
39 ISDR, 2004a.
40 Hedley et al, 2002.
41 ISDR, 2005b.
42 ISDR, 2004a
43 These plans were also supported by the Swiss Development Cooperation Agency and the Nicaraguan Institute for Municipal Development and implemented in Dipilto, Mozonte, Ocotal, Ciudad Darío, San Isidro and Sébaco. See www.sosnicaragua.gob.ni.
44 UN-Habitat, 2006a.
45 UN-Habitat, 2006a.
46 See Chapter 12 for a more detailed discussion of challenges and good practice guidelines for re-housing.
47 Asian Urban Disaster Mitigation Programme, 2001.
48 See www.info-turk.be.
49 Pelling et al, 2002.
50 ISDR, 2004a.
51 See www.provention consortium.org/.
52 World Bank Independent Evaluation Group, 2006.
53 Around US$6000.
54 See www.eeri.org/.
55 See www.iaee.or.jp/.
56 See www.wssi.org/.
57 See Box 8.2 and www.geohaz.org/project/gesi/GesiOver.htm.
58 See www-megacities.physik.uni-karlsruhe.de/.
59 ISDR, 2004a.
60 *Ibid*.
61 Sharma, 2001.
62 See www.unisdr.org/wcdr/thematic-sessions/presentations/session4-8/buckle.pdf.
63 Robert et al, 2003.
64 *Ibid*.
65 See www.paho.org/english/PED/publication_eng.htm.
66 See www.unisdr.org/wcdr/thematic-sessions/presentations/session5-1/fsss-mr-wisner.pdf.
67 Known as the *Hemispheric Action Plan for Vulnerability Reduction in the Education Sector to Socio-Natural Disasters* (or *EDUPLANhemisférico*).
68 International Federation of the Red Cross and Red Crescent Societies, www.ifrc.org/Docs/pubs/?disasters/reduction/canada-case-en.pdf.
69 ISDR, 2006a.
70 *Ibid*.
71 See Box 7.3.
72 See http://ioc.unesco.org/iocweb/disasterMitigation.php.
73 ISDR, 2004b.
74 ISDR, 2006b.
75 BBC News, 2003.
76 WMO, 2002.
77 For more detail on the Cuban risk reduction system, see Box 8.15.
78 Wisner et al, 2005.
79 For a full discussion of the institutional barriers to disaster risk reduction, see DFID, 2005.
80 ISDR, 2004a.
81 UNDP, 2003.
82 DFID, 2006.
83 Pelling et al, 2002.
84 See www.bisanet.org/bism/2004/getting_smart.html.
85 AIDMI, 2006.
86 Rawal et al, 2006.
87 *Ibid*; Christoplos, 2006; Oxfam International, 2005b.
88 Pelling, 2003.
89 Fordham, 2006.
90 Fordham, 2003.
91 Fordham, 2006.
92 Plan International, 2005.
93 World Bank, 2005.
94 Breteche and Steer, 2006.
95 Calvi-Parisetti and Kiniger-Passigli, 2002.
96 Billing, 2006.
97 DFID, 2005.

CHAPTER 9

SMALL-SCALE HAZARDS: THE CASE OF ROAD TRAFFIC ACCIDENTS

As noted in Chapter 7, a hazard is a potentially damaging event that causes loss of life or injury, property damage, social and economic disruption, or environmental degradation.[1] A number of less frequent and smaller-scale hazards influence safety and security in urban areas. Yet, while hazards that trigger large-scale disaster events and thus cause huge losses are well documented, smaller-scale hazards that result in aggregate loss over a longer period of time are often not recorded. Fire, flooding, building collapse and traffic accidents are some of the small-scale hazards common to urban areas.

The significance of small-scale hazards is particularly illustrated by the incidence and impacts of road traffic accidents, which result in more deaths worldwide each year than any large natural or human-made disaster type. Traffic accidents cause extensive loss of human lives and livelihoods in urban areas, killing over 1 million people globally every year.[2] An absence of systematic data collection on the incidence and impacts of traffic accidents, however, leads to their invisibility to urban planners and policy-makers.

This chapter examines the trends and impacts of road traffic accidents in urban areas. The substantial human and economic losses from traffic accidents and their linkages to processes of urbanization are elaborated upon. Traffic accidents are examined here in detail because, in aggregate, they cause more loss of human life and economic productivity than larger-scale natural and human-made disasters. Furthermore, it is important to consider traffic accidents in urban development since they are the products of policy failures and omissions, not of urban life *per se*.

INCIDENCE AND IMPACTS OF ROAD TRAFFIC ACCIDENTS: GLOBAL TRENDS

Traffic accidents, which are reviewed here from a human settlements perspective, include those involving road-based motorized and non-motorized vehicles of various capacities. Traffic accidents range from major events resulting in high loss of human life to everyday incidents whose impacts are only felt at the individual or household level. They pose a serious threat to the safety and well-being of urban households on a daily basis by generating economically and socially unsustainable outcomes. It is thus important to review traffic accidents as a key hazard threatening the safety and security of urban inhabitants.

The following discussion first examines the global and regional incidence and impacts of traffic accidents through lives lost and economic losses. Different vulnerability factors are then explored since the distribution of traffic accident loss in urban areas is not random. In analysing the impacts of traffic accidents, comprehensive and comparative analysis of risk and loss at the national and city levels is difficult since data is not available for some potentially high-risk locations. Mortality should be seen as a tip-of-the-iceberg measure of loss. Data on those injured is less reliable, with many cases not being reported, and therefore has not been used in this report. Indirect impacts are also difficult to analyse with current available data.

Traffic accidents cause extensive loss of human lives and livelihoods in urban areas, killing over 1 million people globally every year

Impacts on human lives

Losses to traffic accidents are commonplace and needlessly deadly aspects of urban life. The scale of impact of traffic accidents at the aggregate level is disturbingly large. The World Health Organization (WHO) estimates that 1.2 million people are killed in road crashes each year, and as many as 50 million are injured.[3] In effect, 3242 individuals die daily from traffic accidents worldwide.[4] Projections indicate that these figures will increase by about 65 per cent over the next 20 years unless there is new commitment to enhance prevention. Indeed, by 2020, road traffic injuries are expected to become the third major cause for disease and injury in the world. Nevertheless, the everyday nature of traffic accidents means that they attract less policy and media attention than the consequent high loss rates deserve.

…a disproportionate 90% of the deaths from traffic accidents worldwide occur in low and middle-income countries

Currently, a disproportionate 90 per cent of the deaths from traffic accidents worldwide occur in low- and middle-income countries.[5] Table 9.1 presents a breakdown of the distribution of reported traffic mortality by world region for the year 2002. Separate data is presented for middle-, low- and high-income countries within each world region. It is the low- and middle-income countries in Africa

World Region	Mortality per 100,000 individuals	
	Low- and middle-income countries	High-income countries
Africa	28.3	–
The Americas	16.2	14.8
Asia (Southeast Asia)	18.6	–
Asia (Eastern Mediterranean)	26.4	19.0
Europe	17.4	11.0
Western Pacific	18.5	12.0

Table 9.1

Traffic accident mortality rates by world region, 2002

Source: WHO, 2004

and Asia that have the highest mortality rates resulting from traffic accidents, with high-income countries in Europe and the Western Pacific having the lowest mortality rates. Studies have shown that traffic accident fatality is high when gross domestic product (GDP) is low and then declines with continued GDP growth.[6]

For those countries where data is available, it is striking that mortality rates are much higher than the regional averages shown in Table 9.1. Some of the highest mortality rates (deaths per 10,000 motor vehicles) worldwide occur in African countries such as Ethiopia (195), Uganda (122) and Malawi (193). Two countries, South Africa and Nigeria, account for more than half of Africa's road fatalities.[7] In the People's Republic of China, despite huge investments to improve road networks, the rapid development and increasing number of vehicles have substantially increased road accidents and loss of life. During the period of 2000 to 2004, over 500,000 people were killed and around 2.6 million injured in road accidents in the People's Republic of China, equivalent to one fatality every five minutes, the highest in the world.[8]

Pro-poor urban policies need to consider traffic accidents as a factor that…can tip households into poverty or collapse

High rates of mortality are also found in some Latin American countries (41.7 per 100,000 individuals in El Salvador; 41 per 100,000 in the Dominican Republic; and 25.6 per 100,000 in Brazil), as well as some countries in Europe (22.7 per 100,000 individuals in Latvia; 19.4 per 100,000 in the Russian Federation; and 19.3 per 100,000 in Lithuania) and Asia (21.9 per 100,000 individuals in the Republic of Korea; 21 per 100,000 in Thailand; and 19 per 100,000 in China).[9]

Mortality rates are high in low- and middle-income countries despite their relatively low levels of vehicle ownership and use (see Table 9.2). For instance, for every 10,000 vehicles in circulation, the average Latin American country registers around 18 traffic fatalities per year. In the US, Canada, Japan and several European countries belonging to the Organisation for Economic Co-operation and Development (OECD), the average is only 2.4 fatalities per 10,000 vehicles.[10] Africa's global road fatality share is three times as large as its motor vehicle share.[11] The Asia–Pacific region has only around 18 per cent of the world's motorized vehicle fleet, but is disproportionately affected by traffic hazards, accounting for around 50 per cent of global road deaths.[12]

This provides a strong indication that the scale of motorization in a country or city's transport system is not of itself a sole indicator for, or a cause of, traffic accidents. The higher number of cars in richer countries means that potential hazard is high; but through road traffic planning, the education of different road users and emergency response teams, risk has been reduced, although it remains a significant challenge. This observation clearly shows the potential for risk management to reduce loss from traffic accidents.

Although a substantial increase in road traffic mortalities is expected over the next 20 years if current policies are not adjusted,[13] these trends vary by region. In Europe and North America, mortality rates have been in decline since the 1960s. Elsewhere, rates have been on the increase, most notably in Latin America and the Caribbean and in the Middle East and North Africa, with a slower increase for sub-Saharan Africa. By 2020, high-income countries are expected to experience a 30 per cent decline in fatalities from traffic accidents, while low- and middle-income countries will record a phenomenal increase of 80 per cent.[14] South Asia alone will experience a 144 per cent rise in fatalities from traffic accidents by 2020.

Table 9.2

Motorization rates by Human Development Index (HDI)

Notes: * Data is for 2003 or most recent year available. Motor vehicles include cars, buses and freight vehicles, but do not include two-wheelers. Population refers to mid-year population in the year for which data is available.

Source: UNDP, 2006b; World Bank, 2006c

Country		Human Development Index (HDI)	Number of vehicles (per 1000 persons),* 1990	Number of vehicles (per 1000 persons), 2003
High HDI	Canada	0.950	605	577
	Germany	0.932	405	578
	Japan	0.949	469	582
	Poland	0.862	168	354
	Republic of Korea	0.912	79	304
	UK	0.940	400	442
	US	0.948	758	808
Low HDI	Ethiopia	0.371	1	2
	Kenya	0.491	12	11
	Swaziland	0.500	66	83
	Pakistan	0.539	6	8
	Uganda	0.502	2	5

Economic impacts

Economic costs of traffic accidents are difficult to calculate, given that there are many indirect impacts to consider. The WHO estimates that the total economic cost of traffic accidents is 1 per cent of gross national product (GNP) for low-income countries, 1.5 per cent in middle-income countries and 2 per cent in high-income countries. Low- and middle-income countries lose US$65 billion a year in traffic accidents, more than they receive in development assistance.[15] To put this in perspective, the annual average estimated economic damage due to natural disasters over the 1990s was US$62 billion.[16] The significance of traffic accidents when taken in aggregate is thus very clear.

Table 9.3 presents calculated economic costs of traffic accidents in 1997 by continent. Road accidents cost US$65 billion in developing and transitional countries, and US$453 billion in highly motorized countries (considered equivalent to OECD countries), amounting to a crude estimated total of US$518 billion worldwide.[17] As the analysis uses 1997 loss data, current losses can be expected to exceed these values.

Pro-poor urban policies need to consider traffic accidents as a factor that, like other hazards, can tip households into poverty or collapse. The consequences of traffic accidents extend far beyond the individuals concerned. Loss of an economically productive member of the family, and perhaps one in whom the family has invested valuable

resources for education, can drive families into poverty (see Box 9.1). Such high economic impact at the household level is explained by most road fatalities and injuries being among young men, the most economically active social group in these societies. In Kenya, for example, more than 75 per cent of road traffic casualties are among economically productive young adults.[18] The impact of accidents is likely to be especially magnified in those societies where there is limited or no state support for medical treatment or social security for those who are unable to work as a result of disability following an accident. The psychological and financial burden of caring for a previously economically active family member who has been disabled through an accident can be even more destabilizing for the household economy. The second leading cause of orphaned children in Mexico is the loss of parents as a result of road traffic accidents.[19]

VULNERABILITY AND CAUSES OF ROAD TRAFFIC ACCIDENTS

Road traffic accidents result from a combination of structural, physical and behavioural factors (see Box 9.2). While the exposure of road users to traffic accidents is shaped by physical aspects of the road environment, individual behaviour, awareness of safety regulations and travel habits also determine vulnerability to traffic accident risks. In addition, the safety and design features of vehicles shape the likelihood of being involved in a traffic accident, as well as the severity of the impact.

World region	Regional GNP	Estimated annual accident costs	
		GNP (percentage)	Cost (US$ billion)
Africa	370	1.0	3.7
Asia	2454	1.0	24.5
Latin America and the Caribbean	1890	1.0	18.9
Middle East	495	1.5	7.4
Central and Eastern Europe	659	1.5	9.9
Highly motorized countries	22,665	2.0	453.0
Total			517.8

Table 9.3

Economic costs of traffic accidents by world region, 1997

Source: Jacobs et al, 1999

Vulnerability to injury and death from traffic accidents also varies according to the mode of transportation used. In societies with high levels of motorization, vehicle users are most vulnerable to accidents (see Figure 9.1). In middle- and low-income countries, vulnerability is highest for unprotected road users – pedestrians, cyclists and motorcyclists. For instance, causalities are highest among two-wheel vehicle users in Thailand, Indonesia and Malaysia (see Figure 9.1). This is not surprising given the dominance of two- and three-wheeled vehicles in the region, accounting for well over 70 per cent of vehicles in countries such as Cambodia, Indonesia, the Lao People's Democratic Republic and Viet Nam.[20]

In Kenya, between 1971 and 1990, pedestrians represented 42 per cent of all traffic accident fatalities, and pedestrians and passengers combined accounted for approximately 80 per cent of all fatalities each year.[21] In Nairobi (Kenya), between 1977 and 1994, 64 per cent of road users killed in traffic crashes were pedestrians.[22] In Beijing (China), about one third of all traffic deaths occur among bicyclists.[23]

Box 9.1 The impact of traffic accidents on the urban poor in Bangladesh and India

A study of the differentiated impacts of road traffic accidents on households in Bangladesh and India clearly illustrates the association between traffic accidents and urban poverty. While the poor were not necessarily at greater risk of death or injury from traffic accidents, many urban households became poor following the death or injury of a member.

Breadwinners were most at risk in urban Bangladesh, where income from the urban poor killed by traffic accidents amounted, on average, to 62 per cent of their household's total income. Likewise, Bangalore (India), poor households suffered disproportionately given that those killed by traffic accidents contributed 59 per cent of the household income.

Road crashes imposed a double financial burden on poor households. At the same time that they faced unexpected medical, if not funeral, costs, they also lost the income of the victim and/or carer. Urban poor households in Bangladesh paid the equivalent of almost three months' household income on funerals, a significantly greater proportion of household income than the non-poor.

Table 9.4 Household impacts of serious traffic accident injury in Bangladesh

Consequence of serious injury		Urban poor* (percentage)	Urban non-poor* (percentage)
Income decreased	Yes	57	33
	No	43	67
Food consumption decreased	Yes	59	25
	No	41	75
Living standards decreased	Yes	58	25
	No	42	75
Arranged loan	Yes	62	35
	No	38	65

In contrast to non-poor households, the majority of urban poor households reported decreased income, food consumption and living standards. Most poor households also borrowed money, thereby facing debt. Almost none of the households received insurance compensation, while only 13 per cent of the urban households received a private settlement.

Source: Aeron-Thomas et al, 2004

Note: * The poor were identified on the basis of official government estimates of poverty, household per capita income (not victim's income alone) and post-crash household income (not pre-crash household income).

Box 9.2 Risk factors determining incidence and severity of traffic accidents

Factors that contribute to the risk of occurrence of a road crash include:

Exposure: amount of travel undertaken, defined as the number of trips, the distance travelled, or time in the road environment.

Behavioural factors: human behaviour, including the extent of knowledge and understanding of traffic systems, driver experience, skill and attitudes to risk, and the relationship between risk and factors, such as speed choice and alcohol consumption.

Vehicle factors: vehicle design and safety features, such as braking systems, lighting and tyre quality.

Road environment: road safety engineering and traffic management make a direct contribution to reducing crash risk. Road design affects road user behaviour and crash risk through the speed that drivers will perceive as appropriate, through detailed design factors such as curves, gradients and road markings, and through failure to provide facilities for vulnerable road users.

The likelihood of injury occurring is determined by the above factors, but also:

Vulnerable road users: road users such as pedestrians, cyclists and motorized two-wheeler riders are especially vulnerable to injury worldwide.

Use of safety devices: these include seat belts and helmet use.

Post-crash medical care: the outcome of a road crash for the victims, in terms of their chance of survival and long-term prognosis, is affected by the level of available medical care.

Source: Commission for Global Road Safety, 2006

Vulnerability to death from traffic accidents is … differentiated by gender and age

Vulnerability to death from traffic accidents is also differentiated by gender and age. In 2002, 73 per cent of all people who died from road traffic accidents were men.[24] Road traffic mortality rates were found to be higher among men than women in all world regions, regardless of income level, and also across all age groups. This difference is likely to result from a combination of greater exposure to traffic, partly through a gendered division of employment, and also of social factors such as greater risk-taking behaviour among young men.

Age is also associated with vulnerability to traffic accidents. The youth have been recognized as a particularly vulnerable group in a recent report launched during the first United Nations Global Road Safety Week (23–29 April 2007).[25] Worldwide, 30 per cent of those killed by road traffic accidents are under the age of 25. Road traffic accidents are the leading cause of death for young people aged 15 to 19, and the second leading cause of death for those aged 10 to 14 and 20 to 24.[26] Mortality data shows that young men are the most vulnerable to traffic accidents.

Worldwide, injuries among children under the age of 15 present a major problem. The extent and patterns of child road injury are linked to differences in road use. In Africa, children are more likely to be hurt as pedestrians and as users of public transport. In Southeast Asia, it is as pedestrians, bicyclists and, increasingly, as passengers on motor scooters, and in Europe and North America, it is as passengers in private motor cars and as pedestrians, that children are at greatest risk of a road traffic injury. The burden of injury is unequal. More boys are injured than girls, and children from poorer families have higher rates of injury. Even in high-income countries, research has shown that children from poorer families and ethnic minority groups have higher rates of road traffic accident injury, particularly in the case of child pedestrians.[27]

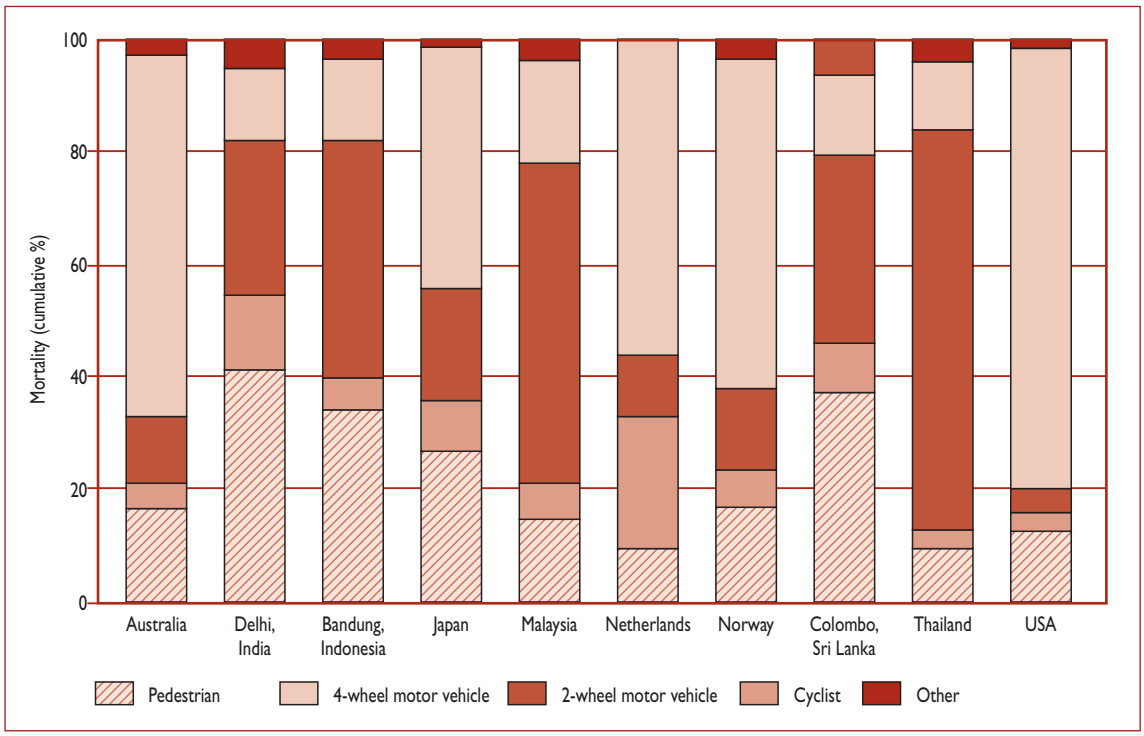


Figure 9.1

Road users killed by transport mode as a proportion of all road traffic deaths

Source: Mohan, 2002b; note that data is from various years

URBANIZATION AND TRAFFIC ACCIDENTS

Urban areas are the main locus of traffic accidents, given the concentration there of vehicles, transport infrastructure and people. For example, in Latin America, about half of all traffic accidents take place in the region's cities, and between one half and one third of those killed are pedestrians. In many cities, high accident rates among pedestrians are related to dense populations and walking as a main form of transport, so that many people are exposed to traffic hazard. Exacerbating this vulnerability in many cities is the failure of transport management systems, which often focus on planning for cars rather than for people.[28]

Uncontrolled and unplanned urban growth can increase the likelihood of occurrence of traffic accidents. This is especially the case in many developing country cities where rapid urbanization and the consequent explosion of motorized vehicles, unplanned settlements and human populations seriously threaten road safety (see Box 9.3). In Europe, urban growth, characterized by geographical dispersal of the territory within which inhabitants carry out their daily activities and greater use of private cars, is thought to increase the risk of traffic accidents, given the diversity of road uses and increase in travel, traffic flows and crossings of these flows.[29]

Across the globe, there is an evident rise in the use of motorized forms of transportation in urban areas, although at differing paces. In particular, with greater affluence, private vehicle ownership and use have increased in cities around the world. For instance, car ownership in the 15 European Union member states (EU-15)[30] has trebled in the last 30 years and continues to rise by 3 million every year.[31] As illustrated by the case of São Paulo Metropolitan Area (Brazil), increased motorization is accompanied by a number of negative externalities, including traffic accidents, congestion and declining use of public transportation (see Box 9.4). While private car ownership may be on the rise in some countries, motorization is characterized by an increase in two- and three-wheeled vehicles elsewhere. For instance, in India, motorcycle ownership increased 16-fold between 1981 and 2002, while private car ownership increased sevenfold during the same period.[32] Rates of motorization are also higher in richer countries, compared with poorer countries, with lower Human Development Index (HDI) levels (see Table 9.2).

Urban poverty and vulnerability to injury from traffic accidents are linked. Although the urban poor have environmentally friendly travel habits through a dependence upon non-motorized and public modes of transportation, they are the main victims of road traffic accidents.[33] Urban transport systems influence patterns of vulnerability in that they can force the poor into choosing high-risk transport options. In Bangladesh and India, a recent study shows that the poor are killed and seriously injured mainly as vulnerable road users (i.e. while walking or using two- or three-wheeled transport, both motorized and non-motorized).[34] In cities where public transport has become unreliable, expensive or does not serve areas of rapidly expanding settlements, privately

Box 9.3 Factors threatening road safety in India's cities

Traffic accidents pose a serious threat to residents of India's cities. Since 1971, traffic fatalities have increased fivefold in India. The massive growth in motor vehicles is thought to be the main factor underlying this rise in traffic accidents. Between 1971 and 2001, there has been a 20-fold increase in the combined number of cars, taxis, trucks and motorcycles. A number of additional factors threaten road safety in India's cities:

- limited network of roads, often narrow, poorly maintained and unpaved;
- unsafe driving behaviour, which results from virtually non-existent driver training, extremely lax licensing procedures and lack of traffic law enforcement;
- unsafe vehicles;
- inadequate or non-existent traffic signals and signage and lack of traffic management;
- almost complete lack of infrastructure for pedestrians and cyclists;
- forced sharing of narrow, crowded rights of way by both motorized and non-motorized vehicles, pedestrians, animals and street vendors; and
- overcrowding of buses, rickshaws and even motorcycles.

Source: Pucher et al, 2005

Box 9.4 Increasing use of the automobile: The case of São Paulo, Brazil

Comprised of 39 cities, the São Paulo Metropolitan Area has a population of 17 million. It has experienced not only rapid urban growth over the last few decades, but also a sixfold increase in its motorized vehicle size between 1970 and 1996. A study of transportation and traffic accidents in the area (for the period of 1967 to 1997) illustrates how increasing use of automobiles is causing a range of negative externalities, such as traffic accidents, congestion and pollution, to sky rocket. The sharp rise in the use of private transportation has been accompanied by a concomitant decrease in the use of public transportation.

Results from the study indicate that the mobility-income paradigm, where those with higher income enjoy greater mobility, has been maintained. The individualization of motorized mobility is evident: between 1987 and 1997 alone, 75 per cent of all additional trips were made by car. An analysis of changes in mobility by income level between 1987 and 1997 illustrated a decrease in mobility based on public modes of transportation.

A number of factors are thought to have contributed to the increasingly unsustainable changes in São Paulo Metropolitan Area's transport systems, including:

- conflict and lack of coordination between institutions concerned with decisions on land use, transport and traffic at both the federal and local levels;
- policies supporting automobile use and less prioritization of public modes of transportation (e.g. 27 per cent of the budget of São Paulo city was used for road construction between 1967 and 1977);
- lack of integration between modes of public transportation (e.g. only 10 per cent of trips between the subway and rail are integrated, while there is no integration between suburban trains and bus services);
- the poor and deteriorating quality of public modes of transportation (service irregularity, unreliability, increased travel time and discomfort), yet increasing cost of fares; and
- inadequate enforcement and safety education and campaigns.

The transformation of the roadway system to accommodate automobile use is thought to have increased the vulnerability of pedestrians and non-motorized transportation modes to traffic accidents.

Source: Vasconcellos, 2005

owned minibuses, trucks or cars have filled the transport gap, often without adequate regulation and consideration of safety measures. Examples of informal or semi-formal transports include the *matatu* in Kenya (minibuses); Manila's *jeepneys* (remodelled trucks); the *dolmus* of Istanbul (minibuses); the *dala dala* of Tanzania (minivans); the *tro-tro* of Ghana (minivans); the Haitian *tap-tap* (remodelled trucks); and the *molue* (large buses, locally known as 'moving morgues') and *danfo* (minibuses, locally referred to as 'flying coffins') in Nigeria.[35] Safety is often compromised by informal transport operators due to competition, lack of awareness or flagrant violation of traffic rules, and poor vehicle maintenance.[36]

Safety is often compromised by informal transport operators…

PREVENTING AND MITIGATING LOSS FROM TRAFFIC ACCIDENTS

Traffic accidents and subsequent loss are the products of human behaviour, but also of urban planning and design, both of which are amenable to development policy. Preventing and mitigating the impact of traffic accidents requires interventions to address the multiple risk factors underlying those accidents (see Box 9.2). This section explores contemporary policies to reduce traffic accidents and improve road safety, in general. These include transport and urban planning; the promotion of safe behaviour; improvement of accident response and recovery; improvements in traffic accidents data collection; traffic management and building institutions; and enhancing awareness of road safety. Other aspects of transport safety that do not touch upon urban planning or social and economic development, such as vehicle design, safety standards and hospital capability, are not discussed in detail.

Road crash injury is largely preventable and predictable…

The WHO recommends that the severity and consequences of injury from traffic accidents can be controlled by acting on four fronts: reducing exposure to risk; preventing road traffic accidents from occurring; reducing the severity of injury in the event of an accident; and reducing the consequences of injury through improved post-accident care. High-income countries have successfully reduced injuries from traffic accidents by adopting such multifaceted policy approaches (see Box 9.5). Policies targeting a single mode of transportation, although effective, need to be supplemented by interventions addressing related factors that reduce road safety. For instance, Box 9.6 describes the experience of transport safety reform targeting minibus taxis in Kenya. It is not unusual for such reforms to be met with resistance from those with a vested interest in the status quo. In cities and countries where the transport sector has political and economic clout, change can be very slow.

The need for innovative and dedicated work to reduce mortality and injury from traffic accidents worldwide has been widely recognized by the international community. The WHO's proposed seven-point plan for understanding and reducing road traffic accidents may be an appropriate starting point in the global fight against traffic accidents:[37]

1. Road crash injury is largely preventable and predictable – it is a human-made problem amenable to rational analysis and counter-measures.
2. Road safety is a multi-sectoral and public health issue – all sectors, including health, need to be fully engaged in responsibility, activity and advocacy for road crash injury prevention.
3. Common driving errors and common pedestrian behaviour should not lead to death and serious injury – the traffic system should help users to cope with increasingly demanding conditions.
4. The vulnerability of the human body should be a limiting design parameter for the traffic system, and speed management is central.
5. Road crash injury is a social equity issue – the aim should be equal protection to all road users since non-motor vehicle users bear a disproportionate share of road injury and risk.
6. Technology transfer from high-income to low-income countries needs to fit local conditions and should address research-based local needs.
7. Local knowledge needs to inform the implementation of local solutions.

Improving road safety through transport and urban planning

The urgent need to address transport and road safety concerns in cities is evident; yet, several challenges remain. Rapidly growing megacities are especially constrained in this regard; but medium-sized and small urban centres should not be neglected either. It is particularly important to focus on medium-sized centres, given that these are the cities where future population growth may be most rapid in aggregate and where planning now can potentially avoid some of the problems being experienced by the largest cities.

Recent work on medium-sized cities in Asia shows the potential for coordinating urban and transport planning to simultaneously address road safety, air pollution and pro-

Box 9.5 Reducing road traffic injuries: The experience of high-income countries (HICs)

Fatalities from road traffic accidents rose rapidly in high-income countries (HICs) during the 1950s and 1960s, following rapid motorization, eventually peaking in the 1970s. Since the 1980s and 1990s, injuries have been reduced in many HICs by as much as 50 per cent despite continued traffic growth. This has been attributed to a shift from focusing on 'behaviour' alone to safety systems such as good road and vehicle design and traffic management. A combination of measures has been taken by HICs to reduce road injuries, including:

Safe road users: enforcement of laws to moderate the behaviour of drivers, such as speed limits, drink-driving laws, seat belt-use laws and helmet-use laws, have been very effective.

Safer vehicles: improvements in vehicle design have improved the chances of survival in motor vehicle crashes.

Safer road infrastructure: engineering measures such as signs, lane separation, pedestrian crossings and traffic-calming measures have helped to reduce road traffic causalities.

Source: Commission for Global Road Safety, 2006

Box 9.6 The struggle for road transport safety in Nairobi, Kenya

In 2006, over 1900 people lost their lives in traffic accidents on Kenyan roads. Only malaria and HIV/AIDS claimed more lives. Public transport in Nairobi and Kenya, more generally, relies primarily upon *matatus*, or minibuses. In October 2003, Legal Notice No 161 was issued to regulate this sector – a comprehensive notice aimed at reducing the danger and insecurity faced by *matatu* users. This was to be achieved through more effective policing of speeding; encouraging greater professionalism and accountability to customers by drivers and conductors; and tighter restrictions on operating routes.

In order to achieve these important goals, specific actions were proposed by the government, including:

- fitting speed governors to limit speed to 80 kilometres per hour;
- fitting seat belts on all vehicles (both public, commercial and private);
- employing drivers and conductors on a permanent basis;
- issuing badges to drivers and conductors;
- issuing uniforms to public service vehicle drivers and conductors;
- indicating route details and painting yellow bands on all *matatus* for the purposes of easy identification;
- re-testing drivers after every two years;
- asking every driver to prominently display their photograph.

Breaches of any regulations were to be punishable by a fine.

The success of this act in road safety terms is clear. The number of traffic-related deaths in 2006 was lower than the World Health Organization (WHO) estimate of average annual mortality from traffic accidents in Kenya (3000 people). Accidents were reduced by 73 per cent in the first six months of implementation, compared to the same time during the previous year. However, the act met a good amount of resistance from the *matatu* lobby. Lack of political will has also threatened advances made in road safety.

Source: WHO, 2004b; Chitere and Kibual, 2006

Transport planning…models itself on a vision of the city that is firmly tied to the motor car

poor transport. Each of these three critical agendas for sustainable development in cities has common practical solutions. Some solutions are relatively inexpensive, such as separating pedestrian walkways and bicycle lanes from motorized transport. Others, such as the integrated planning of residential and employment space with good quality public transport, require strategic planning. It is in medium-sized cities undergoing rapid population growth where strategic planning that can be proactive may have the most impact with the least cost.[38]

Promoting public and non-motorized transportation

Transport planning too often overlooks the needs of the majority of urban residents for whom non-motorized and public transport may be the norm. Instead, planning models itself on a vision of the city that is firmly tied to the motorcar. As a result, there is a lack of investment in technological support for pro-poor transport, as shown in the case of Delhi (see Box 9.7). In planning decisions, the needs of pedestrians and cyclists come second to those of motorized transport.[39] Low- and middle-income countries seeking to promote economic growth, trade and employment are particularly preoccupied with investments in road infrastructure.[40]

Yet, road construction and increasing capacity to accommodate cars may not necessarily reduce the negative externalities of motorization, such as traffic accidents and congestion. For instance, after constructing at least 2 ring roads, over 100 flyovers and almost 200 overpasses, the rush-hour average speed on Beijing's trunk roads remained at 13 to 19 kilometres per hour.[41] Indeed, increased traffic volume resulting from road construction may result in additional traffic congestion.[42] Private cars, in particular, require a great deal of space, both for their movement and parking, when compared with other modes, especially highly space-saving modes of public transport.[43]

For a large majority of the urban poor in developing countries, public transportation and non-motorized transport are the only affordable means of travel.[44] However, the state of public transportation systems in developing countries, often poorly constructed and maintained and heavily burdened by excessive overloading, is itself a risk factor contributing to the rising incidence of traffic accidents.[45] For instance, in India, buses account for 90 per cent of the transport in cities.[46] Yet, India's public modes of transportation are described as being overcrowded, uncomfortable, undependable, slow, uncoordinated, inefficient and dangerous.

Thus, improving the quality and functioning of public transport can enhance road safety and thereby reduce traffic accidents. Mass forms of transportation not only reduce negative externalities of greater motorization, but are able to deliver high-quality mass transportation at a cost that is affordable to most municipalities, including those of low-income countries. One example is the bus rapid transit system, which is growing in popularity globally compared to other forms of mass transit (such as light and heavy rail), especially in Asia, South America and Europe.[47] Bus rapid transit is particularly efficient as it offers greater network coverage, value for money, service capacity and relative flexibility. Widely acclaimed examples include the TranMilenio bus rapid transit system in Bogotá (Colombia) and that of Curitibá (Brazil).

…improving the quality and functioning of public transport can enhance road safety

Improved public transportation may also enable the poor to make choices that improve other aspects of their safety and security. Often, the urban poor have to tolerate poor housing conditions in environmentally or socially hazardous locations due to lack of reliable, affordable and accessible transport.[48] The 'choice', if there is one, is between settlements that are hazard prone, but close to employment and livelihood opportunities, and those that may be less hazardous, but do not meet short-term economic needs.

Box 9.7 Challenges and opportunities for a sustainable transport system in Delhi, India

In some respects, Delhi has led the way in sustainable transport. In others, progress has been less comprehensive. Some 77 per cent of Delhi's population (about 10 million people) live in inadequate housing, many in inner-city slums or peripheral informal settlements. This majority group of the city's population relies mainly on public transport, walking or bicycles for travel. A total of 50 per cent of the city's residents can only afford non-motorized transport. There are estimated to be 1.5 million bicycles and 300,000 cycle-rickshaws in the city. Public transport in Delhi is provided mainly by buses, which make up only 1 per cent of the city's vehicles, but serve about half of all transport demand. Since 1992, the private sector has played an increasing role in bus transport. Privatization has increased the size of the bus fleet; but buses continue to be overcrowded and poorly maintained.

A key challenge within Delhi's transport system is overcoming the negative stereotypes about non-motorized forms of transport that are too easily seen as being anti-modern or as a cause of traffic congestion. On the contrary, non-motorized forms of transport are less dangerous and more sustainable forms of transport. Encouraging non-motorized transport and providing safety from the hazard generated by motor vehicles while preventing congestion is problematic.

Where investments in traffic improvements have occurred, they repeatedly promote mechanized transport and further marginalize more environmentally sustainable and pro-poor modes, such as walking, cycling and good quality public transport. The city government has enhanced its worldwide reputation and markedly improved air quality through the transition of public transport to compressed natural gas; but similar innovation and leadership are harder to see in city transport planning that can serve the poor majority.

Road systems in Delhi and other Indian cities can be redesigned to meet the needs of the poor majority and increase road safety. Road geometry and traffic management can be altered to better reflect the diversity of road users, with an emphasis on the needs of pedestrians, cyclists and public transport users. Delhi is fortunate in having many wide roads with additional service lanes that could be converted into segregated space for pedestrians, bicycles and motorized vehicles. Segregated traffic systems are likely to reduce congestion and ease traffic flow if such a policy is implemented.

Source: ORG, 1994; Tiwari, 2002

…road users may not give up use of private cars easily

Promoting public transportation use in place of private vehicles may prove difficult, in practice. In richer countries, a range of techniques are available, often best applied in tandem, to provide disincentives for private car use (such as environmental fuel levies or congestion charges) and incentives for a switch to public transport (such as improved service, park-and-ride schemes, easily available information on timetables, and low fares). Deregulation and the consequent involvement of the private sector in public transport provision have enabled innovation in public transport service provision within European countries.[49] However, even where public transportation infrastructure and services are available in richer countries, road users may not give up the use of private cars easily. For example, a study in London (UK) illustrated how perceptions that alternatives to the car are not viable and long distances between work and home discourage widespread use of these services.[50] Intra-urban economic inequalities within developed country cities may also cause differentiated uptake and implementation of policies seeking to promote non-motorized transport. For instance, a study in Auckland (New Zealand) shows how the Walking School Bus scheme, whereby children are escorted by volunteers between home and school to protect them from traffic accidents, was more widely adopted in affluent neighbourhoods.[51] In poorer countries, public transport systems are often in a state of collapse and may not offer greater safety than private transport options. Furthermore, private vehicle users in developing countries from middle- and high-income groups may not be willing to sacrifice the comforts and convenience of personal transport.[52]

Rationalizing road space allocation by accommodating commonly used forms of transportation … may help to reduce traffic accidents

Safer transport infrastructure

Road infrastructure design — in terms of road networks, mix of types of traffic and types of safety measures – determines the likelihood of traffic accidents occurring in urban areas. Road design and facilities influence driver behaviour through amenities such as curves, gradients, road markings and the provision of facilities for vulnerable road users. Initiatives that can readily be used without major re-planning of urban neighbourhoods include the installation of traffic lights, pedestrian-only streets, lighting, bus lanes, pedestrian walkways, video monitoring of traffic and speed bumps.[53] It is important to maintain the goodwill of road users when implementing such road safety measures. For example, the importance of drivers' acceptance of automatic speed limiters in order to implement the policy has been illustrated in a study undertaken in Leeds (UK).[54]

Vulnerable road users are disadvantaged in modern road systems, most of which are designed to cater for motor vehicles.[55] If road design does not take into account the needs of pedestrians, bicyclists and public transport vehicles, they will still use infrastructure that is not designed for them – hence, increasing accident risks for all road users.[56] Rationalizing road space allocation by accommodating commonly used forms of transportation, such as two- and three-wheeled vehicles and non-motorized transport, may help to reduce traffic accidents. For instance, the construction of a segregated lane for bicycles in Delhi would increase the road space available for motorized traffic by 50 per cent on three-lane roads while meeting the needs of bicyclists. The provision of a high-capacity bus lane would increase capacity by 56 to 73 per cent; while the inclusion of separate

lanes for non-motorized vehicles and bus priority lanes would reduce traffic delays by 80 per cent and reduce injury accidents by 40 per cent and fatalities by 50 per cent.[57]

Road designs that cater for non-motorized and public forms of transportation have been more widely implemented in richer countries. For instance, a review of good practice for safer cycling on UK roads provides some examples of innovative redesign to encourage bicycle use.[58] A danger reduction benchmark was awarded to Devon County Council for experimenting with radical measures to reduce traffic speeds on a high-speed road. Here, a two-lane road has been narrowed to a single track with passing places and the old carriageway surface has been broken up. This has successfully reduced speeds and diverted speeding traffic onto more suitable routes.

The integration of safety concerns within road design and construction is also increasingly evident in developing countries. In one crash hotspot on the main Accra–Kumasi Highway in Ghana, speed bumps have reduced the number of crashes by 35 per cent between 2000 and 2001. Fatalities fell by 55 per cent and serious injuries by 76 per cent. Following on from this success, rumble strips have been constructed on the Cape Coast–Takoradi Highway, the Bunso–Koforidua Highway and the Tema–Akosombo Highway. Speed humps, to slow down vehicles and improve pedestrian safety, have been applied in the towns of Ejisu and Besease on the Accra–Kumasi Highway.[59]

Separating road users has also proven an effective method for reducing traffic accidents. The banning of motorized through traffic from street markets and from high-density residential areas saves lives, reduces local air pollution and can provide a stimulus for economic development. The historic centres of many cities have been 'pedestrianized' to encourage tourism-led regeneration. Giving priority on roads to public transport vehicles or non-motorized transport can help to encourage people onto buses. Curitibá in Brazil, a city often used to exemplify best practice in integrated transport and urban planning, has a high-capacity traffic management system that provides segregated bus lanes, priority at traffic lights for buses, as well as safe and fast access for users.

Land-use planning

Integrated land-use and transport planning may also contribute to reducing traffic accidents by minimizing the number and length of journeys taken. Where safe workplaces and residential and recreational land uses are in close proximity, non-motorized transport or short journeys by car and bus are more likely. This also has a knock-on effect in reducing atmospheric pollution and greenhouse gas emissions and provides a framework for community-building.[60] For instance, Singapore has been successful in cutting car journeys and alleviating severe traffic congestion through its comprehensive and coordinated land transport policy, which combines integrated land-use and transport planning, as well as demand management measures (see Box 9.8).

In Costa Rica, the development of a five-year National Road Safety Plan uses a performance-based incentive scheme to encourage organizations and individuals involved in road-building and transport engineering to adopt better practices. A similar approach is being proposed for medium-sized municipalities in Brazil.[61]

Box 9.8 Reducing traffic congestion by integrating land-use and transport planning, Singapore

Singapore is a densely populated urban area (5900 individuals per square kilometre) and thus faces severe scarcity of land, exacerbated by a growing population. At the same time, increasing affluence and the consequent increase in car ownership and usage during the 1970s and 1980s has resulted in severe congestion in the island. Cognizant of these issues, the government developed a strategic plan in 1972, focusing on land-use–transportation relationships.

A key recommendation of the strategic plan was the development of regional centres to ensure greater employment decentralization, thereby reducing congestion in the central business district and improving home–work relationships. The government has also sought to improve the efficiency of the public transport system by merging private bus companies and rationalizing their services, and later integrating these with a mass rapid transit system introduced in 1987. A number of measures were also put in place to improve traffic management through controlling vehicle ownership and usage, including the Area Licensing Scheme, which was unique in the world when it was introduced in 1975. This scheme required cars entering designated restricted zones during peak hours to pay a fee.

A study of the Tampines Regional Centre (TRC) of Singapore illustrated that regional centres have a great potential for reducing work travel in terms of distance travelled and number of trips generated across the island. In the long term, the promotion of regional centres is likely to result in more efficient land-use relationships and less dependence upon cars. Similarly compact and high-density cities may learn from this strategy; but those facing urban sprawl and low-density suburbs may have to take a different approach.

Source: Sim et al, 2001; Willoughby, 2001

> Separating road users has … proved an effective method for reducing traffic accidents"

Promoting safe behaviour

Promoting changes in behaviour can reduce people's exposure to traffic hazards. This involves, among others, interventions seeking to enhance driver skills and training, to reduce impaired driving and to promote the use of safety equipment. Driver training and licensing are important forms of promoting safe behaviour. The age of qualification and rigour of testing varies greatly from city to city. Malaysia has recently increased the legal riding age for two wheelers from 16 to 18 years and reduced accidents as a result.[62]

Education and legislation are both instrumental in increasing the use of safety equipment in vehicles. The introduction of a helmet-wearing law in Thailand for motorcycles saw helmet use increase fivefold, head injuries decrease by 41 per cent, and deaths decrease by 20 per cent.[63] In the Republic of Korea, seat-belt use rose from 23 per cent in 2000 to 98 per cent in 2001 (sustained during 2002), following a national campaign of police enforcement, a publicity campaign and an increase in fines for non-use. This resulted in a 5.9 per cent decrease in fatal road traffic crashes.[64] Safety equipment can also extend to pedestrians. In South Africa, a pedestrian visibility campaign using reflective material has been added to the uniforms and school bags of 2500 school children.[65]

> Education and legislation are both instrumental in increasing the use of safety equipment in vehicles

Driver impairment

Driver impairment leading to dangerous driving may be the result of a number of factors, such as alcohol or drug

consumption, injury, infirmity, fatigue, the natural ageing process and distractions including mobile phone use, or a combination of these factors. A recent global review indicates the role of impairment as a cause of traffic accidents.[66] In Bangalore (India), 28 per cent of crashes involving males over the age of 15 were attributable to alcohol. Roadside breath tests conducted as part of the same project concluded that 30 to 40 per cent of night-time drivers were in a state of intoxication. One study in Colombia found that 34 per cent of driver fatalities and 23 per cent of motorcycle fatalities are associated with alcohol. They also report that a study in Argentina found 83 per cent of drivers acknowledge that they drink and drive.

Substance abuse is also a key cause of road accidents. A recent study in France of drivers aged less than 30 and killed through road accidents indicates that as much as 39 per cent of the drivers had consumed cannabis.[67] The study highlights the increasing prevalence of substance abuse among French drivers, especially drugs such as cannabis, amphetamines and cocaine. While legislation against driving under the influence of drugs has been introduced by the French government, the need for greater public sensitization through campaigns and roadside testing is noted.[68] Similarly, a study of fatally injured drivers in Sweden between 2000 and 2002 showed a significant increase in the detection of illicit drugs, from 5.4 to 10 per cent.[69]

Legislation prohibiting drinking and driving is included in most countries' traffic laws; but enforcement is lacking and public awareness is poor

Fatigue caused by overwork, excessive hours of driving, lack of rest and lack of nourishment may also cause driver impairment. In Ghana, demands for increased returns by transport owners force drivers to speed and work when exhausted.[70] In Kenya, on average, a public minibus (or *matatu*) driver works 14 hours a day for seven days a week. Traffic regulations in many countries often limit driving time for commercial drivers, including coach and bus drivers. As with drinking and driving, enforcement is greatly improved by information campaigns.

A global review of alcohol-, drug- and fatigue-related impairment found systematic data collection, comprehensive legislation and rigorous enforcement lacking in most middle- and low-income countries.[71] Only in Latin America was it common to find a government agency with responsibility for coordinating road safety: Colombia, Argentina, Brazil, Chile, Costa Rica and Mexico all have an institutional framework based on a National Road Safety Council, with Costa Rica leading in a national campaign to reduce drinking and driving.

Legislation prohibiting drinking and driving is included in most countries' traffic laws; but enforcement is lacking and public awareness is poor. In many countries, a legal alcohol limit is in force, backed up by frequent public information campaigns and enforcement operations by the police. In Australia, since 1993, random breath testing has led to an estimated reduction in alcohol-related deaths of around 40 per cent. In some countries, such as the US, lower thresholds are in force for younger and inexperienced drivers. Information campaigns are used to increase awareness of the risks of driving after drinking alcohol and of the legal penalties imposed, but can also help to make drinking and driving less socially acceptable. Legislation for other causes of driver impairment is less advanced and, alongside enforcement mechanisms, represents a major area for enhancing road safety.

The limited existing levels of engagement with impaired driving in developing countries suggests that there is significant scope for reducing traffic accidents through controlling drinking, drugs and fatigue through education, legislation and enforcement. Small reductions in the amount of drunk driving can result in significant reductions in the incidence of traffic accidents. Drivers' perceptions of risk, police powers and monitoring equipment all need to play a role in reducing impaired driving. While most countries have legislation in place, coordination that can bring political will to this area is lacking. Political will is needed if the scope of education, legislation and enforcement is to reach beyond drunk driving to include other causes of impairment, such as fatigue, and new causes of distraction, such as mobile phone use.

Accident response and recovery

First responses are critical in reducing loss from traffic accidents. The capacity to respond to traffic accident injury and to minimize bodily harm varies according to levels of economic development. Half of all fatalities in European countries occur at the scene of the traffic accident or on the way to the hospital, while death before arrival at the hospital can be as high as 80 per cent in low- and middle-income countries.[72]

Trained first-aiders not only save lives, but also prevent unnecessary injury sustained through inappropriate action taken following an accident. As with disaster preparedness work, the piggybacking of transport first-aid skills onto more established public service or civil society delivery programmes is cost effective. In low- and middle-income countries, there is little access to emergency vehicles, increasing the benefits from widespread public education programmes in first aid. Such training has been given to police in Uganda and the general public in India.[73]

Traffic management

Basic traffic regulations and signage to manage traffic are essential instruments for enhancing road safety. Enforcement of such regulations remains a key challenge in cities worldwide. Table 9.5 makes a sharp distinction between Kuwait, the US and the UK, where regulation and enforcement for road users is in place, and other countries where road safety is yet to have been addressed comprehensively. Mortality as a proportion of car ownership rates is an order of magnitude lower in the former group of countries. This is a clear indication that traffic mortality is a product of social policy and cultural context as much as engineering.[74] Managing traffic safety in the future will need to consider the specific characteristics of the automobile culture of each country.

The effectiveness of traffic regulation enforcement in promoting road safety has been documented in several low- and middle-income countries. For instance, through the introduction of a new traffic code in January 1998 and heavier penalties for non-compliance, Brazil has succeeded in increasing the use of safety equipment by motorcycle and car drivers.[75] Accordingly, non-use of motorcycle helmets decreased from 62.5 per cent in 1997 to 13.9 per cent in 2000. In Costa Rica, a public awareness campaign was launched between 2003 and 2004 to promote seat-belt use. This was supported by national television adverts and linked to a national seat-belt law. The combined effect of the campaign and enforcement resulted in an increase in seat-belt use from 24 to 82 per cent.[76] In Khon Kaen Province in Thailand, authorities introduced legislation making helmet wearing mandatory for motorcyclists. Together with an awareness campaign, the legislation led to a 90 per cent helmet wearing rate, a 40 per cent reduction in head injuries and a 24 per cent reduction in motorcycle injuries in 1996.[77] Good governance and anti-corruption measures are particularly important in improving the enforcement of traffic and road safety regulations.[78]

Evidence suggests that partnerships between community groups, civil society and organizations and the police can help in enforcing traffic regulations. Barriers to partnerships exist on both sides, with accident victims often anticipating unfair police treatment. Drive Alive, a non-governmental organization (NGO) working on road safety in South Africa, aims to reduce traffic accident deaths and injury through education campaigns, lobbying for stricter legislation against impaired driving and advocating increased traffic laws.[79] In the US, Mothers against Drunk Driving (MADD) has grown substantially since being founded in 1980. Among other objectives, this non-profit organization seeks to stop drunk driving and related injuries.[80] More broadly, four different kinds of community involvement in road traffic policing have been identified:[81]

- partnerships between community groups and local authorities to help identify road hazards;
- volunteer traffic wardens and school patrols;
- formal partnerships between the police and citizen groups (here, citizens partner police in road traffic monitoring exercises);
- higher political attention to advocacy for road safety.

Building institutions and awareness for road safety

Sensitizing road users as well as relevant decision-makers about the causes and consequences of traffic accidents and relevant risk reduction strategies is a key starting point for improving road safety. Once available, information on traffic accidents needs to be communicated to relevant actors through appropriate and effective media. As noted earlier, the availability of road traffic accident data in developing countries is limited, thereby also restricting levels of awareness. Furthermore, the design of policies and interventions is constrained by the lack of adequate data and knowledge on trends and impacts of traffic accidents.

Country	Mortality rate per 100,000 individuals (1998–2003 average)	Car ownership per 1000 individuals (2004)
China	19.0	7
Colombia	24.2	36
Dominican Republic	41.1	44
El Salvador	41.7	20
Peru	17.6	30
Nicaragua	20.1	13
Kuwait	23.7	432
US	14.7	459
UK	6.1	499

Table 9.5

Comparing national car ownership and mortality rates

Source: Wells, 2007

Implementation of road safety measures and policies requires the necessary institutional capacity and resources, which may be absent in poorer cities and countries. The Asian Development Bank (ADB)–Association of Southeast Asian Nations (ASEAN) Regional Road Safety Programme, for instance, aims to build institutional capacity to address issues of road safety in member countries (see Box 9.9). In a bid to improve road safety in the region, the programme identifies key institutional constraints, most of which are shared in common with other developing countries of the

Box 9.9 Association of Southeast Asian Nations' ASEAN's Regional Road Safety Strategy and Action Plan, 2005–2010

The Association of Southeast Asian Nations (ASEAN) Regional Road Safety Strategy and Action Plan recognizes key constraints impeding the development and implementation of interventions and policies to improve road safety in member countries. These include inadequate awareness of the scale of loss on the part of decision-makers; gaps in the knowledge and expertise of local professionals; limited collaboration and knowledge-sharing; and lack of multi-sector and multidisciplinary plans to provide holistic approaches. Accordingly, the strategy focuses on the following key areas:

Analysis and understanding. Significant improvements are needed in all countries in terms of data collection, analysis and systems.

Advocacy and/or awareness-raising. Getting international organizations, development partners and ASEAN governments to recognize the seriousness and urgency of the problem – so that adequate funds are allocated and priority is given to improving road safety in the ASEAN region – is important.

Institutional strengthening. Improved safety management structures and data systems and more effective coordination and funding mechanisms are needed to assist individual countries in implementing safety improvements. Knowledge and skills of key professionals with road safety responsibilities must be upgraded through training.

Cooperation. Regional activities and workshops must be developed to share knowledge and documents, disseminate best practices, develop a knowledge network, and share mechanisms among ASEAN countries. Networks of special interest groups should be created to share, develop and exchange knowledge and experience in each sector.

Collaboration. Greater private-sector, civil society and non-governmental organization (NGO) participation in safety activities should be facilitated, and their active involvement in the national and regional road safety action plans should be encouraged, as should collaboration between central and local governments.

Coordination. Road safety activity has to be orchestrated, developed and managed for it to achieve optimal effectiveness. Regional activity will need to be coordinated with in-country initiatives. Efforts of the private sector, NGOs, governments and international development partners need to be harmonized, and this, if done well, will contribute significantly to improving road safety in the ASEAN region.

Source: Asian Development Bank, www.adb.org/Documents/Reports/Arrive-Alive/default.asp

world.

Engaging multiple stakeholders is particularly essential in raising awareness and institutionalizing road safety among all road users, but especially among drivers of motorized vehicles. Problems of coordination between different governmental bodies at various levels and with private-sector operators of transport services pose a serious challenge for cities of developing countries, such as Seoul and Mexico City.[82] In India, the National Urban Transport Policy proposed the creation of unified metropolitan transport authorities in cities with at least 1 million inhabitants in order to improve interagency cooperation on transport planning.[83]

Traffic deaths and injuries remain largely invisible to society and policy-makers …

Improving traffic accident data collection

Traffic deaths and injuries remain largely invisible to society and policy-makers because they are mostly scattered individual events with low impact.[84] This is exacerbated by a lack of capacity to collect and compile traffic accident data, especially in developing countries. For instance, only 75 countries report data on traffic mortality to the WHO. Where national-level data on traffic safety is incomplete, it limits strategic planning. Data on mortality is often available; but casualty information is needed for a more comprehensive analysis of the impact of traffic accidents on livelihoods and economies. One way forward is to develop integrated recording systems for police and hospitals. Where national- or city-level data is available, it is not always clear that this has been used in policy development, suggesting a potential opportunity for more evidence-based planning.

Continued international cooperation and support are vital for the reduction of road traffic accidents, especially in developing countries

More work is needed to help understand the full economic costs of road crashes and to assess performance of policies aimed at reducing traffic accident risk. Policy assessments could combine accident statistics with other performance indicators, especially those that can be targeted at improving vulnerable road user safety (such as the number of pedestrian crossings installed, safety audits conducted and hazardous locations improved).[85]

Access to accident statistics is also a critical determinant of risk perception by road users, which, in turn, shapes their behaviour.[86] Moreover, it is an important basis for publicity and education campaigns designed to promote road safety.

INTERNATIONAL COOPERATION IN ROAD SAFETY PROMOTION

A major advancement in the road safety agenda over the last decade has been the growing number of United Nations, multilateral and bilateral donor organizations that have developed road safety policies.[87] In October 2005, the United Nations endorsed a historic Resolution on Improving Global Road Safety in recognition of the limited capabilities of developing countries and countries with economies in transition to address road safety concerns and the need for international cooperation.[88] This led to a call for a Global Road Safety Week, the first of which was held in April 2007 in order to raise awareness on road safety concerns (see Box 9.10). Furthermore, the WHO was mandated to coordinate road safety issues across United Nations agencies and with other international partners through the United Nations Road Safety Collaboration.[89] Since its establishment, this collaboration has been active in the areas of data collection and research, technical support provision, advocacy and policy, and resource mobilization.[90] The collaboration has also established an Annual World Day of Remembrance for Road Traffic Victims.[91]

Another influential international collaborative effort is the Global Road Safety Partnership (GRSP) (see Box 9.11). The GRSP provides non-financial support for country and city governments by improving global dissemination of road safety lessons and through a series of partnership-based road safety projects. The GRSP concentrates its resources among a group of highly vulnerable countries where partnerships for road safety could be built. These are Brazil, Costa Rica, Ghana, Hungary, India (Bangalore), Poland, Romania, South Africa, Thailand and Viet Nam. Initial work has been successful in generating data and raising the profile of road safety, and pilot projects have shown ways of reducing risk.

The work inspired by the GRSP shows that safety can be gained in even the most vulnerable countries. The partnership approach has meant that non-governmental road safety projects do not compete with government schemes. Partners have been varied and the private sector has played a role. In South Africa and Thailand, multinational corporations have been involved in road safety initiatives. In Ghana and India, local business partners are more important. Community actors have also contributed in India and South Africa – for example, in creating 'safe zones' as a public way of generating demand for safer roads. In Poland, the Technical University of Gdansk has become a partner with the GRSP. The key to success in building awareness of, and support for, road safety has been partnerships to institutionalize road safety, an area of work that many other countries could learn from.[92]

A number of other initiatives illustrate the attention that road traffic accidents are receiving internationally. The Commission for Global Road Safety recently established by the FIA Foundation[93] seeks to examine the framework for, and level of international cooperation on, global road safety and to make policy recommendations.[94] The World Bank's Global Road Safety Facility, launched in November 2005, intends to generate increased funding and technical assistance for initiatives aimed at reducing deaths and injuries in low- and middle-income countries.

Continued international cooperation and support are vital for the reduction of road traffic accidents, especially in developing countries. In the 2007 Accra Declaration, African ministers of transport and of health reaffirmed their commitment to road safety and called upon the 2007 G8 Summit to recognize the need to improve road safety in Africa and to incorporate this agenda in development assistance programmes.[95]

CONCLUDING REMARKS

Traffic accidents are the most significant cause of injury and death associated with small-scale hazards in urban areas. Global trends indicate that the incidence and impacts of traffic accidents will increase by 2020 if no action is taken. High-income countries will experience a decline in road traffic accident fatalities, while regions dominated by low-income countries will experience a phenomenal increase in mortality from road traffic accidents. The magnitude of loss both in terms of human life and economic assets is substantial. However, loss and injury vary greatly across countries, cities and within cities. Mortality is highest in Asia and Africa, while Asia and Latin American and Caribbean countries experience the highest economic losses. Within cities of developing countries, unprotected road users (cyclists, pedestrians and motorcyclists) are most vulnerable to death and injury from traffic accidents, while a proportionately higher number of people are injured as users of four-wheel vehicles in developed nations such as the US, Australia and The Netherlands.

A variety of interrelated factors determines the incidence and severity of traffic accidents, including behavioural factors, vehicle factors, road environment, vulnerability of certain road users and post-accident medical services. Reducing the risk of traffic accidents in urban areas thus requires action on a combination of fronts. Successful policies and interventions to reduce the risk of traffic accidents combine legislation, enforcement and public education.

At the international level, frameworks and guidelines are required to support government actions to reduce traffic accident risk. Current international cooperation and lobbying with respect to traffic accidents is encouraging; but low- and middle-income countries require additional support to increase their technical and legislative capacities to reduce risk. At the national level, legislation and policies should be introduced to improve road user behaviour, road safety awareness and transport infrastructure investments. Policies governing levels and rates of motorization at the national level should consider the consequences of increased motorization for traffic accident incidence. City authorities should seek to reduce traffic accident risk through traffic management, road design and safety, road space allocation, land-use planning and accident response capacity.

Box 9.10 The first United Nations Global Road Safety Week, 23–29 April 2007

In October 2005, the United Nations General Assembly invited the United Nations Regional Commissions and the World Health Organization (WHO) to jointly organize the first United Nations Global Road Safety Week. The week was modelled after previous road safety weeks orchestrated by the United Nations Economic Commission for Europe and after World Health Day 2004.

The theme for the week was 'young road users' as young people constitute a major group at risk of death, injury and disability on the road. While the focus was on young road users, the actions resulting from the week are intended to benefit road users of all ages. During the course of the week, a large number of local, national and international events were hosted all over the world. Numerous partners participated in these events, including governments, United Nations agencies, non-governmental organizations (NGOs) and the private sector.

The main objectives of this first United Nations Global Road Safety Week were to:

- raise awareness about the societal impact of road traffic injuries, highlighting the risks for young road users;
- promote action around key factors that have a major impact on preventing road traffic injuries: helmets, seat belts, drink driving, speeding and infrastructure;
- highlight the fact that road safety happens not by accident, but through the deliberate efforts on the part of many individuals and many sectors of society (governmental and non-governmental alike), as emphasized in the slogan for the week: 'Road safety is no accident.'

Sources: WHO, www.who.int/roadsafety/week/en/; General Assesmbly Resolution, 60/5

Box 9.11 The Global Road Safety Partnership (GRSP)

The Global Road Safety Partnership (GRSP) was initiated in 1999 by the World Bank with partners from business and civil society, as well as bilateral and multilateral donors. The secretariat is currently hosted by the International Federation of Red Cross and Red Crescent Societies (IFRC) in Geneva. The GRSP has worked alongside city and national governments seeking to promote road safety. Activities focus on efforts to change the behaviour of road users as a means of reducing risk.

In Ghana, work has focused on a Voluntary Code of Conduct, launched in 2004. The project aims to improve the road safety performance of individuals driving, in particular, for work purposes by asking them to sign up to a Voluntary Code of Conduct. The code of conduct increases drivers' awareness of the primary risk factors involved in crashes, including excessive speed, alcohol, fatigue and mobile phone use.

In Thailand, among a number of initiatives, the Safer Schools Zones project engages most with land use. The project has installed pedestrian crossing signs and undertaken education programmes on road safety with children and local residents, including competitions on road safety for school children. Monitoring shows that safe behaviour is more common among children who completed a road safety education course. The behaviour of parents, however, does not seem to have changed.

In Poland, inadequate pre-hospital care and slow emergency response times lead to complications and increased mortality from traffic accidents. The need for advocacy and training on emergency response was recognized and a workshop held with a small group of decision-makers and experts. The primary goal of the workshop was to generate action on the part of key stakeholders in Poland to increase the effectiveness of the pre-hospital care and emergency preparedness and response systems in Poland. The workshop led to an evaluation of the pre-hospital care system in Poland involving experts from the World Health Organization (WHO), Austrian Red Cross, Holmatro and the World Rescue Organization.

Source: GRSP, www.grsproadsafety.org/

NOTES

1 See www.unisdr.org/eng/library/lib-terminology-eng%20home.htm.
2 WHO, 2004b.
3 WHO, 2007.
4 WHO, 2004b.
5 *Ibid*.
6 Commission for Global Road Safety, 2006.
7 Jacobs et al, 1999.
8 Asian Development Bank, www.adb.org/Projects/PRC RoadSafety/road-safety.asp.
9 WHO, 2004b.
10 Gold, 2000.
11 Jacobs et al, 1999.
12 Asian Development Bank, www.adb.org/Projects/PRC RoadSafety/road-safety.asp.
13 Kopits and Cropper, 2003.
14 WHO, 2004b.
15 *Ibid*.
16 EM-DAT CRED, www.em-dat.net.
17 Jacobs et al, 1999.
18 Odero et al, 2003.
19 Hijar et al, 2003.
20 ADB, 2002.
21 Odero et al, 2003.
22 Khayesi, 2003.
23 WHO, 2004b.
24 *Ibid*.
25 WHO, 2007.
26 *Ibid*.
27 WHO, 2004b.
28 Gold, 2000.
29 Milliot, 2004.
30 The EU-15 includes member countries in the European Union prior to the accession of ten candidate countries on 1 May 2004. The EU-15 is comprised of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the UK.
31 European Commission, 2001.
32 Pucher et al, 2005.
33 Tiwari, 2002.
34 Aeron-Thomas et al, 2004.
35 WHO, 2004b.
36 UNCHS, 2000a.
37 General Assembly Resolution 58/289 (adopted 11 May 2004).
38 Davis et al, 2003.
39 Barter, 2001.
40 Commission for Global Road Safety, 2006.
41 Tiwari, 2002.
42 *Ibid*.
43 Barter, 2001.
44 Srinivasan and Rogers, 2005.
45 UNCHS, 1993; Pearce et al, 1998.
46 Pucher et al, 2005.
47 Hensher, 2007.
48 Barter, 2001.
49 Ongkittikul and Geerlings, 2006.
50 Kingham et al, 2001.
51 Collins and Kearns, 2005.
52 UNCHS, 1993.
53 Gold, 2000.
54 Comte et al, 2000.
55 Commission for Global Road Safety, 2006.
56 Tiwari, 2002.
57 *Ibid*.
58 Cyclists' Touring Club, 2002.
59 Afukaar et al, 2003.
60 Hummel, 2001.
61 GRSP, undated.
62 GRSP, www.grsproadsafety.org/.
63 GRSP, www.grsproadsafety.org/?pageid=28#GRSP%20in%20Thailand.
64 GRSP, www.grsproadsafety.org.
65 GRSP, www.grsproadsafety.org/?pageid=22&projectid=58#58.
66 Davis et al, 2003.
67 Mura et al, 2006.
68 *Ibid*.
69 Holmgren et al, 2005.
70 Davis et al, 2003.
71 Jacobs et al, 1999.
72 Commission for Global Road Safety, 2006.
73 WHO, 2004b.
74 Tiwari, 2002.
75 Bastos et al, 2005.
76 Commission for Global Road Safety, 2006.
77 *Ibid*.
78 *Ibid*.
79 See www.drivealive.org.za.
80 See www.madd.org.
81 Dimitriou, 2006.
82 Vasconcellos, 2005.
83 Pucher et al, 2005.
84 Commission for Global Road Safety, 2006.
85 Aeron-Thomas et al, 2004.
86 Zheng, 2007.
87 Aeron-Thomas, 2003.
88 United Nations General Assembly Resolution A/RES/60/5.
89 See www.who.int/roadsafety/en.
90 *Ibid*.
91 The third Sunday of November every year has been dedicated to this day of remembrance.
92 GRSP, www.grsproadsafety.org.
93 Fédération Internationale de l'Automobile (FIA) Foundation.
94 See www.fiafoundation.com/commissionforglobalroadsafety.
95 ECA and WHO, 2007.