

Chapter 4

The heart of the matter:
the underlying risk drivers



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Introduction

This chapter explores three underlying drivers of the disaster risk–poverty nexus: vulnerable rural livelihoods, poor urban governance and declining ecosystems. Additionally the chapter looks at the magnifying effect of climate change as a global driver of risk.

Summary of findings

1. Vulnerable rural livelihoods

Livelihood vulnerability is an underlying driver of disaster risk in many rural areas. Poverty and constrained access to productive assets mean that rural livelihoods that depend on agriculture and other natural resources are vulnerable to even slight variations in weather and seasonality. This vulnerability is accentuated by factors such as unequal land distribution, weakly developed markets and trade barriers. Very low resilience means that even small disaster impacts are translated into poverty outcomes. Resilience is further undermined by the impacts of other hazards such as conflict and HIV/AIDS.

2. Poor urban and local governance

Most cities in developing countries have only been able to absorb urban growth through the expansion of informal settlements. The location of such settlements in hazard prone areas, the vulnerability of housing and local services and the lack of provision of the infrastructure necessary to reduce hazard configure urban disaster risk. Poverty limits the capacity of many households in such cities to gain access to well-sited land and safe housing. However, the translation of poverty into risk is conditioned by the capacity of urban and local governments to plan and regulate urban development, enable access to safe land and provide hazard mitigating infrastructure and protection for poor households.

3. Ecosystem decline

Ecosystems have a declining capacity to provide both provisioning and regulating services in both rural and urban areas. Ecosystem decline increases hazard levels at the same time as it decreases resilience, acting as a third underlying risk driver.

4. Climate change

Climate change will have an asymmetric impact on disaster risk, magnifying its already disproportionate impact on the rural and urban poor. The interactions of climate change with hazard levels; exposure, vulnerability and resilience are mediated by the underlying drivers that translate poverty into disaster risk, such as vulnerable rural livelihoods, poor urban and local governance, and declining ecosystems. If the underlying drivers of risk are addressed then climate change impacts could also be addressed.

4.1 Rural livelihoods

Approximately 75% of the people living below the international poverty line of US\$ 1.25 per day live and work in rural areas¹: 268 million in sub-Saharan Africa; 223 million in East Asia and the Pacific, and 394 million in South Asia alone. Even in countries experiencing rapid economic development, such as China, there are 175 million rural dwellers below this poverty line. Rural poverty, therefore, not only characterizes least developed countries in regions such as sub-

Saharan Africa, but also stagnating rural areas in countries that are developing rapidly².

In such contexts, disaster risk is associated with livelihoods unable to sustain minimum levels of welfare and which are often exposed and vulnerable to even minor weather variations. In poor rural areas, as demonstrated by the empirical evidence presented in Section 3.7, disaster impacts are then translated into both short-term and long-term poverty outcomes, which in turn

increase vulnerability and decrease resilience to future disaster losses. Disaster losses affect huge numbers of people in poor rural areas. In sub-Saharan Africa, during the 2001–2003 drought, it was estimated that 206 million people, or 32% of the region's population, were undernourished – a little less than the total 268 million rural poor in the region³.

Poor rural areas, particularly isolated and remote regions, are often characterized by highly vulnerable housing, weak or non-existent emergency services and infrastructure (including health services and disaster preparedness and response organizations), as well as isolation and remoteness. Densely populated but poor rural areas, exposed to tropical cyclones, major floods and earthquakes, therefore have a very high mortality risk, as was documented in Chapter 2.

4.1.1 Rural livelihoods and poverty

In many rural areas across developing countries, people's livelihoods still depend heavily on agriculture and other natural resources. Rural farm-based livelihoods are generally characterized by low input and low output agriculture due to limited access to productive assets such as land, labour, fertilizers, irrigation, infrastructure and financial services. For households without the minimum assets necessary to support a viable livelihood, the result is poverty.

Without access to the necessary inputs, poor households harvest extremely low yields. Low crop yields result in low incomes and chronic food insecurity, leaving many rural households close to the poverty line. For example, average maize yields in Malawi are only one tenth of yields in the United States of America⁴. Opportunities for processing and adding value to agricultural production are also often limited, due to asset constraints, trade barriers and poor market access.

Economic poverty in rural areas is usually underpinned by a range of other factors including: lack of political participation; scant or non-existent provision of health and education services; geographical isolation or marginalization; discrimination and exclusion due to caste, race, gender or ethnicity; and the migration of the

young to cities. Such factors often influence access to infrastructure, health and education, and either obliquely or directly determine economic entitlements. Economic poverty and lack of entitlements then reiterate these other poverty factors, which in turn further limit access to assets.

Livelihoods in rural areas are further limited by a lack of economic diversification, thin markets and weak and costly mechanisms of exchange. This exposes rural producers to price swings in response to local variations in production, that can drastically reduce the income that can be obtained from harvests and may encourage a risk-averse preference for subsistence rather than market-based agriculture. The strength of markets tends to be inversely related to their distance from urban centres. Remote rural areas are more likely to have imperfect or missing markets than those closer to urban centres, often due to a lack of access to decent roads⁵. Conversely, rural areas with strong urban networks have deeper markets and a more intense exchange of commodities and services, leading to enhanced livelihood opportunities.

Rural livelihoods are also subject to the operation of national and global markets for agricultural products. Some countries open domestic markets for imported food, which keeps prices low for urban consumers, while others protect national production through import tariffs. This affects rural households differentially, according to whether they are net producers or consumers of food. Import tariffs and subsidies to agricultural production in developed countries likewise have drastic impacts on rural livelihoods in developing countries. Box 4.1 illustrates how a food crisis in Niger was conditioned by the operation of markets.

In the light of all the above factors, and in the absence of formalized microfinance institutions in many countries, poor rural households are often forced into taking loans from money lenders at very high rates of interest. In India, close to 50% of farm households are indebted to a level that could thwart their long-term livelihood security⁹. In several Latin

**Box 4.1:
Niger food
crises⁶**

The 2005 Niger food crisis is an extreme manifestation of how structural problems and negative socio-economic conditions in countries such as Niger can create a risk nexus in the region.

Food production records for 2005 show a cereal shortfall of 9% or 250,000 tonnes in Niger mainly due to drought and locust infestations in 2004–2005. According to Oxfam, the Niger 2004 harvest was, in fact, not the lowest the country experienced in past years. It was only 11% below the 5-year average and food was available in the region during the crisis.

However, cereal shortage increased to about 16% due to a fall in purchasing capacity, especially among agropastoral populations who were isolated from trading networks and highly dependent on cereal traders especially near the Nigerian border. Weak socio-economic and political structures underpinned the very high vulnerability of these particular groups who were worst affected⁷. High market prices and increasing poverty (which increased from 40% of the population below poverty line in 1990 to 66% in 2004) provoked the food crisis in Niger, even though food was available for purchase.

Eventually, some 12 million people needed food aid in Niger and the surrounding region, with about 800,000 children affected⁸.

American countries access to formal credit is only half as common in rural areas as in urban areas, while in Pakistan and in Cameroon less than 5% of the amount borrowed by poor rural households is obtained from formal lenders. Indebtedness further constrains access to assets, entrenching poverty¹⁰.

4.1.2 High exposure and vulnerability to weather-related hazards and low resilience to loss

Agricultural livelihoods are highly sensitive to weather irregularities associated with seasonality per se. Even a brief break in rains at a key stage of the growing cycle can spell significant harvest loss. Localized weather-related hazards such as storms, frosts, floods, heat waves, cold spells and minor droughts can mean the loss of an

entire harvest. Major drought events can destroy agricultural production and livestock over wide areas for several years.

Poor rural households are often disproportionately exposed to weather-related hazards. Historical patterns of land distribution and land tenure tend to discriminate against the poor who may only have access to marginal and unproductive land including areas prone to flooding, with erratic or minimum rainfall or with poor soil. Patterns of rural land distribution remain highly unequal in many regions, particularly in Latin America.

At the same time, poor rural households are more vulnerable. For example, they usually do not have access to improved seeds, irrigation technology and other inputs that can reduce the vulnerability of crops to drought, and are often dependent on rain-fed agriculture, which is far more sensitive to even small variations in weather than irrigated agriculture. Household dependence on a single main harvest for most annual requirements of food and income further increases vulnerability.

Poor and indebted households also have little or no surplus capacity to absorb crop or livestock income losses and to recover. They thus have very low resilience to even the smallest weather irregularity or hazard impact. A small loss in income may be devastating and set off a ratchet effect that feeds back into further poverty and future vulnerability, due to a lack of asset reserves, the absence of other income earning opportunities, and the non-existence of economic and social safety-nets.

Even in good rainfall years, the annual hungry season in rural areas can last for several months, characterized by high food prices, hunger, malnutrition and debilitating diseases such as diarrhoea and malaria. There are few employment opportunities; most available work is low-paid agricultural labour, which can only be undertaken at the cost of neglecting the household's own farm, again setting up a poverty ratchet effect of low-yielding harvests, working on neighbours' farms for food and further under-production in future years.

4.1.3 Disaster losses feeding back into poverty

Livelihood strategies to minimize risks include diversifying livelihoods to spread risk, farming in different ecological niches¹¹ and building social networks that pool risk. However, many such strategies are simply short-term responses to poverty and food insecurity that may exacerbate and increase poverty and reduce human development in the longer term. For example, farmers with insecure land tenure do not invest in land improvement. Families with limited access to formal employment prefer to send their children to work rather than to school. Entrepreneurs without access to microfinance or insurance do not undertake potentially lucrative, but high risk activities.

Box 4.2: Risk averse livelihood strategies

Farmers in rural Ethiopia between 1994 and 1999 were less likely to invest in fertilizer in drought prone areas, because the investment would be lost if the harvest failed due to drought¹². However, without fertilizer productivity is very low, constraining the capacity of farmers to accumulate sufficient assets to absorb loss when a drought occurs. It was estimated that fertilizer application rates would have been 43% higher if variations in village level rainfall during this period were reduced by one standard deviation.

Livestock often act as a 'liquid asset', permitting their owners to undertake other, more risky, activities. A study in drought prone areas of Tanzania showed that livestock-poor households tended to grow sweet potatoes more than any other crop because it is drought resistant, despite the fact that its returns per hectare are about 25% less than sorghum, maize or cotton. In contrast, a household with an average number of livestock would have 20% less land allocated to sweet potatoes than a household with no liquid assets. As a consequence, the crop portfolio of the richest quintile yields 25% more per adult than that of the poorest quintile.

In Zimbabwe it was also found that exposure to hazards reduces growth, which in turn reduces the capital stock across households by 46%. Two-thirds of this loss was due to ex ante strategies by which households try to minimize the impact of risk (for example, by building up livestock holdings to cope with consumption risk)¹³.

As Box 4.2 shows, households may concentrate on low risk and diversified activities, foregoing higher returns from specialization. For example, a shift from cash crops to subsistence farming, and from labour-intensive to less intensive but less profitable crops may reduce short-term risk but may exacerbate longer-term food availability and access, due to reduced production and income¹⁴.

Furthermore, faced with scarcity, poor households may have to adopt depleting coping strategies, such as overgrazing, deforestation or unsustainable extraction of water resources that in the long-term magnify hazard levels and further aggravate disaster risk.

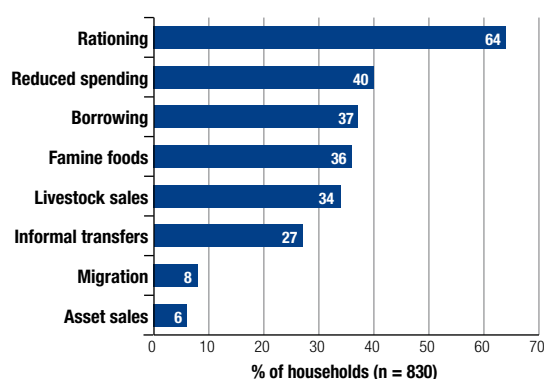
When such mechanisms fail, for example during an intensive drought event, households become acutely vulnerable to even minor losses. As Figure 4.1 shows, ex post coping typically follows a predictable and logical sequence, starting with strategies that are easily reversed, such as a mild reduction in food consumption, cutting back on non-essential spending or selling surplus livestock to buy food. These are followed by higher cost strategies that are less easily reversed, such as selling breeding livestock, borrowing at high interest rates or begging from friends and neighbours, with high social costs in terms of lost status and self-respect. Once these strategies are exhausted, families must sell their key productive assets (such as land) and migrate to survive.

As the empirical cases presented in Section 3.7 show, in general terms, households with more assets are less vulnerable because assets provide buffers against disaster loss. These include not only physical assets, such as land and livestock, but also financial assets like savings; human capital assets such as marketable skills; or social capital assets such as networks of influential friends¹⁶. For example, rural families that own many livestock can sell some animals to buy food if a drought devastates their harvest. The relationship between vulnerability and assets, however, is often not so simple. Intensive disasters may destroy all assets, reducing the value of asset buffers.

Converting future streams of income to buy food may ensure short-term survival but

Figure 4.1:
Coping strategies during a drought in Namibia, 1992¹⁵

Source: Sabates-Wheeler, et al., 2008.



ultimately decreases livelihood viability and increases long-term poverty and disaster risk. Rather than coping strategies, they could perhaps be better characterized as a failure to cope with disaster risk, with far-reaching and damaging effects on other activities and asset holdings. Over time, repeated disasters have a poverty ratchet effect on increasingly weakened livelihoods, steadily undermining the ability to recover and pushing rural households further towards chronic poverty and deprivation. Again as highlighted by the empirical evidence presented in Section 3.7, pastoralists, in particular, take much longer to recover from asset depletion than crop farmers, as they depend on reproductive capital, which once eliminated takes a long period of time to recover. In the case of repeated droughts, pastoralists do not have time to recover before another event occurs¹⁷.

Distress sales of assets also act as poverty ratchets, with irrecoverable losses of productive resources, locking people into poverty traps from which they cannot escape without external support. For example, during the food crisis in Malawi in 2002, desperate rural families sold off their most valuable possessions such as livestock, radios, cooking utensils and furniture at distress prices of less than half their replacement cost¹⁸. This further polarizes rural societies because it enables wealthy households to accumulate assets at undervalued prices.

Households may be forced into selling some of their food production at low prices after harvest to meet urgent cash needs, only to buy this food back later in the year at two or three times the selling price in order to bridge the consumption gap before the next harvest. Surplus producers benefit from price rises because their income from crop sales increases but deficit producers are impoverished by having to buy food at high prices.

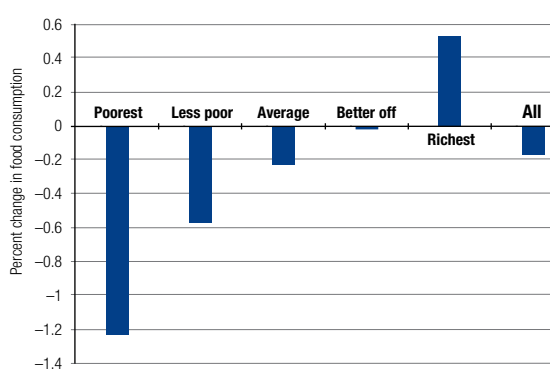
This issue is illustrated by Figure 4.2, which projects the effect of a 10% increase in maize prices on the welfare of different wealth groups in rural Malawi¹⁹.

While such seasonal price variations are normal in tropical agriculture, they are magnified following disaster losses. If food is scarce and rural households are forced into selling assets to finance food purchases, usually food prices are forced up while asset prices are forced down. In intensive drought disasters that can affect entire regions over several years, the coping mechanism breaks down completely as households have no more assets to sell and food is not simply overpriced, but generally unavailable.

In many rural contexts, the loss of production and income due to weather irregularities is only one, and not necessarily the most important, of a number of risks. Households are often faced with other hazards such as market shocks, health risks including malaria, HIV/AIDS and diarrhoeal diseases, and conflict: these configure scenarios of compound risk, where the impact of one hazard increases vulnerability to another. Disaster impacts are magnified in households where resilience has been heavily reduced by these other hazards. In such multi-hazard scenarios, it

Figure 4.2:
Projected effect of a 10% increase in maize prices on the welfare of different wealth groups in rural Malawi

Source: FAO, 2008b



is difficult to attribute risk outcomes such as malnutrition, illness or mortality to a specific hazard, as the outcome is the result of a deadly interplay between the range of hazards and vulnerabilities over time. The impact of these other hazards is examined in Appendix 2, Note 2.3.

4.1.4 Non-farm income and social protection

Household and community-level coping strategies are increasingly supported by non-farm income. At present, non-farm activities provide up to 42% of rural household income and employ up to one third of the rural labour force in the developing world. Sources of non-farm income include agroprocessing, other manufacturing, trade and transport, construction, finance and personal services, and remittances. These latter now account for a large share of non-farm income in many countries²⁰. Migration, both seasonal and more permanent, is another key coping strategy as it allows those household members

who migrated to provide income to those who remain. For example, seasonal migration in Bangladesh has always been employed by poor rural households as a strategy to maintain livelihoods and cope with drought²¹.

In addition, there is growing evidence, from South Asia in particular, that financial assistance from government and local institutions (see Box 4.3), such as NGOs, is becoming more widely available to strengthen rural livelihoods, including microfinance schemes and social protection measures²². When such schemes are available, rural households are less likely to reduce food intake or dispose of productive assets as coping mechanisms.

For example, decades before cash-for-work became a popular relief exercise, the Indian Government adopted a drought relief programme for rural communities affected by seasonal droughts. This gave them alternative seasonal employment in construction or other services with the aim of assuring a minimum wage for poor households in times of rural distress.

Subsidies towards or exemptions from fees for state services is another common channel of social assistance in low-income countries, as are programmes which target cash or in-kind benefits to children in school (e.g. the Bangladesh Food-For-Education or the Brazilian Bolsa Escola programmes). The effective application of exemption from user fees on the basis of poverty criteria is, like other forms of social assistance, a major administrative challenge – and the experience in the health field in poor countries is not always encouraging²⁴.

Similarly, as will be discussed in Chapter 6, financial mechanisms to increase resilience, such as microcredit and index-based crop insurance, are now becoming more widely available to rural households in many countries²⁵.

4.1.5 Disaster mortality risk in poor rural areas

The high structural vulnerability of housing, schools, infrastructure and other assets in poor rural areas exposed to floods, tropical cyclones and earthquakes is a direct consequence of rural poverty. Rural housing is usually built with local

Box 4.3: National Rural Employment Guarantee Programme (NREGP), India²³

The National Rural Employment Guarantee Act was notified on 7 September 2005 with the aim of reinforcing the Indian State's commitment to livelihood security in rural areas. The programme is significant in that it creates a rights-based framework for wage employment programmes and makes the government legally bound to provide employment to those who seek it. The National Rural Employment Guarantee Programme (NREGP) marks a paradigm shift from previous wage employment programmes by providing a statutory guarantee of wage employment. The objective of the NREGP is to enhance the livelihood security of people in rural areas by guaranteeing 100 days of wage employment per financial year to any rural household whose members volunteer to do unskilled manual work. The Act further aims to create durable assets and strengthen the livelihood resource base of the rural poor.

The choice of works suggested in the Act address the causes of chronic poverty such as drought, deforestation, soil erosion, etc., so that the process of employment generation is on a sustainable basis. The experience with NREGP so far suggests that it is one of the main planks of rapid poverty reduction in India's Eleventh Five Year Plan.

materials and labour, but crucially with building techniques that do not provide hazard resistance. The collapse of heavy earth walls in rural housing in Kashmir in the 2005 earthquake and the lack of protection offered by flimsy bamboo and thatch houses in the 2008 Myanmar tropical cyclone, contributed to the massive mortality in both cases. The isolation of many poor rural areas combined with under-investment by government in infrastructure, such as roads, educational or health facilities, or in disaster preparedness and response capacities, further increases asset and mortality risk. For example, as highlighted in Chapter 2, mortality risk to floods is highest in remote rural areas in poor countries. High mortality risk in such areas is a direct consequence of an absence of development.

The direct economic cost of asset loss in rural areas may be very low, precisely because

of the low monetary value and scarcity of rural assets and under-investment in infrastructure and services. The replacement of assets such as houses may be less of a challenge than in urban areas, precisely because so many of the inputs are non-monetary. However, the apparent rapidity of recovery is deceptive. Large-scale mortality and injury and the loss of livestock and household possessions can devastate rural livelihoods, feeding back into increased poverty and vulnerability in the face of more frequently occurring localized weather events.

Case studies from Pakistan (see Box 4.4) and Myanmar (see Box 4.5) illustrate how poor rural livelihoods in remote areas configure mortality risk for earthquakes and tropical cyclones.

Box 4.4:
Earthquake
impacts in
rural Kashmir,
Pakistan²⁶

In 2005, the Kashmir region in Pakistan experienced an earthquake of 7.6 magnitude. Four districts – Bagh, Muzafarabad, Neelum and Rawlakot – in the Kashmir region were affected by the disaster. The earthquake killed over 46,500 people, while 33,489 were injured. Around 329,600 houses collapsed, which resulted in displacement of over 2 million people.

Casualties and injuries in the region were attributed to the collapse of poor quality, single storey, un-reinforced stone masonry buildings and reinforced concrete frame school buildings. The stone masonry walls consisted of irregularly placed undressed and mostly rounded stones that were laid in mud mortar or even dry in some cases. It was observed that local people did not have knowledge about earthquake resilient construction technologies, the cost of which was beyond the capacity of the majority.

Kashmir is a predominantly rural society, with the majority living in small settlements on mountain sides. The rural economy mainly depends upon agriculture and livestock rearing. There is no irrigation system and the crops are mainly rain-fed. Some households have orchards of fruit trees, such as apple and almond. The little income that people have from crops and orchards is barely enough for their subsistence. People do not have savings to use on improving their living or housing standards or

to develop other income generating ventures. The second key source of income is remittances from migrants. In the earthquake affected area of Northern Kashmir, skilled people from the region migrate in search of better opportunities. Those left behind are mainly the unskilled, illiterate, women and the elderly. They are dependent for their survival upon remittances and are responsible for taking day-to-day decisions, such as about the construction of a house. Most of the mountainous settlements are not connected to paved roads and transport to and from cities is scarce. Given the geography of the region and the lack of proper road infrastructure, it is extremely difficult for people to bring in construction materials such as steel, bricks and cement from outside even if they could afford it.

In this scenario it is unrealistic to expect safer construction practices in Kashmir. In the aftermath of the earthquake, the Earthquake Reconstruction and Rehabilitation Authority, in collaboration with the National Society of Earthquake Technology, have trained thousands of masons in safer construction practices. However, since local people cannot afford the higher wages demanded by the trained masons, many have left for cities, such as Karachi, where they are better paid. This indicates the difficulty of promoting earthquake safety in Kashmir until development conditions such as income, education and road networks are improved.

**Box 4.5:
Tropical cyclone
Nargis in the
delta region of
Myanmar²⁷**

Tropical cyclone Nargis was the worst disaster in the recorded history of Myanmar and the sheer magnitude of devastation typifies how lack of development configures disaster risk. On the 2nd and 3rd May 2008, the Ayeyarwady Delta region of Myanmar was battered by the tropical cyclone. Official government figures put the number of dead or missing at more than 130,000. About 2.4 million people were severely affected out of a total of 4.7 million people living in the affected areas.

During the Village Tract Assessment (VTA) carried out under the Post-Nargis Joint Assessment, more than a quarter of those interviewed at the community level cited late or incomplete warning as one of the primary reasons for widespread destruction. At the same time, Myanmar’s Department of Meteorology and Hydrology indicates that it was continuously tracking the tropical cyclone and issued timely warnings of an impending landfall. However, the warning never reached the communities at risk. Delta residents can only access one radio channel and most residents do not even have a radio let alone money for expensive batteries since the electricity supply broke down. As a result, on the eve of the tropical cyclone making landfall in the delta, most residents were asleep when the last warning was issued on national radio.

More than 75% of those interviewed by the VTA cited weak buildings, particularly houses, as the primary cause of the widespread destruction. More than 80% of rural houses were made of poorly constructed wattle-and-daub walls (a coarse wooden lattice covered with clay) and thatch roofs providing barely adequate protection during

normal monsoon months. More robust forms of construction, using brick, cement and steel and better building skills, have not penetrated the rural areas of the Ayeyarwady Delta.

The State plays a negligible role in the day-to-day life of most rural communities in the Delta. Even in a highly centralized system of governance and decision-making, the presence of the State below the township/district level is minimal. Communities rely on themselves for almost all the basic services – water supply, transport, health and basic agricultural extension services – and have devised their own coping mechanisms including rainwater harvesting and community managed seed banks and systems for production of building materials. These coping mechanisms have served them well in the cases of small- and medium-scale events that occur every three to five years. But a large-scale event like Nargis overwhelmed these community-level systems.

The unique development assistance context of Myanmar has meant that support is targeted almost exclusively at the lowest income households. While this has kept the targeted households just above the subsistence level, local small enterprises – such as rice mills that employ up to 50 workers each – are outside the net of most assistance. As a result, local economies have not developed resilience to absorb shocks from major natural hazards. In such a context, a discussion on disaster reduction – whether community-based or focused on country-wide system building – that is divorced from local development issues and resilience of rural livelihoods seems superfluous.

4.2 Urban and local governance, poverty and disaster risk

People, poverty and disaster risk are increasingly concentrated in cities. By 2008, over half the world’s population was living in urban areas. Since 1950, the urban population of low- and middle-income nations has increased sevenfold. By 2010, it is projected that 73% of the world’s urban population and most of its largest cities will be in low- and middle-income nations²⁸. In Asia, 43% of the population (or 1,770 million people) will be urban; 79.4% (or 471 million people) in Latin America and the Caribbean, and 40% (or 412 million people) in Africa. Almost all

global population growth until 2025 will be in urban areas in these regions²⁹. How this large and rapid increase in urban population is governed will have major implications as to whether disaster risk can be reduced.

In 2000, it was estimated that there were 258 million urban poor³⁰. However, as poverty becomes urbanized, the structure of household income and consumption changes dramatically. The proportion of income spent on housing, water, sanitation, health care, education and transport increases. The use of a US\$ 1.25

poverty line disguises the real dimension of urban poverty, given the high monetary costs of non-food necessities. If poverty includes all those with insufficient income to cover basic needs and who are either homeless or live in poor quality, overcrowded and often illegal accommodation, at least 900 million urban dwellers were poor in 2000. Similarly, at least 900 million urban dwellers lack protection from common life- and health-threatening diseases and injuries³¹.

Chapters 2 and 3 highlighted two concatenated processes through which the urban poor become prone to disaster risk. On the one hand, urban and economic development expanding *outwards* generates new patterns of extensive risk, associated mainly with flooding and other weather-related hazards and affecting informal settlements on the periphery of large cities, as well as those in small and medium urban centres. At the same time, as cities grow and develop there is an *inward* concentration, or intensification of disaster risk, associated mainly with earthquakes, tropical cyclones, floods and other major hazards and that causes major asset loss and mortality amongst the urban poor. In both processes, the damage to and destruction of assets, such as housing and local infrastructure, negatively impact the urban poor. For many poor households, houses are assets that not only represent the pooling of inter-generational savings, but also provide a base for livelihood activities.

The following section explores how poor urban and local governance in many rapidly urbanizing contexts is the underlying risk factor that shapes both these processes. Urban and local governance influences not only how and where cities develop, but in particular, whether the urban poor have access to safe land, housing and the essential infrastructure and services required to live in security.

4.2.1 From poverty to risk

Urbanization, understood as an increasing proportion of a nation's population living in urban centres, is strongly associated with economic growth. By 1940 more than half of global GDP was generated by industry and services. Currently this figure is 97%. By 1980

more than half the global labour force was working in industry and services, a figure that now stands at 65%³². The nations with the wealthiest economies are all heavily urbanized. Unless they are already predominantly urban, those with the fastest growing economies are urbanizing most rapidly. Nations with stagnant economies are generally those that are urbanizing least. There is also an economic logic to the location of large cities and where rapid city growth takes place; globally and within each continent, the largest cities are heavily concentrated in the largest economies³³.

Cities in low- and middle-income nations concentrate a large proportion of global urban poverty because their economic base does not generate sufficient employment and livelihoods to sustain a rapidly growing population. There are no precise figures on urban poverty because many aspects are not measured. Most poor urban households derive most or all their income from work in the informal economy for which there are no income data, while many poverty lines are set without data on the costs of non-food necessities³⁴. If allowance is made for the cost of non-food necessities, it is common for 35–60% of the urban population in low- and middle-income countries to have incomes below the poverty line. Table 4.1 provides estimates for different aspects of poverty in low- and middle-income nations.

Cities in high-income countries typically have a life expectancy of 75–85 years, under-five mortality rates of less than 10 per 1,000 live births, no informal settlements and close to 100% coverage of water, sanitation and health services. In contrast, cities in least developed and low-income countries, particularly in sub-Saharan Africa and the poorer parts of Asia, often have an average life expectancy of only 40–55 years, under-five mortality rates of 80–160 per 1,000 live births, 40–70% of their population in informal settlements, and low levels of access to water, sanitation and health services. Within informal settlements in poor cities, these figures are usually higher still. For example, in Nairobi, under-five mortality rates were 150 per 1,000 live births in informal settlements but only 61.5 for the city as a whole³⁹. Urban poverty is associated with a range of everyday risks including the

Table 4.1: Estimates for the scale of different aspects of urban poverty in low- and middle- income nations	Type of poverty	Numbers of urban dwellers affected	Notes
	Inadequate income in relation to the cost of basic needs	750–1,100 million	No accurate figures are available on this and the total varies depending on the criteria used to set the poverty line (the 'income-level' required for 'basic needs') ³⁵ .
	Inadequate or no provision for safe, sufficient water and sanitation	More than 680 million for water and 850 million or more for sanitation	These are estimates for 2000, drawn from a detailed global UN review of individual city/urban studies ³⁶ . They differ from the official WHO/UNICEF statistics; however, these official statistics recognize that they are not measuring the proportion of people with access to adequate provision.
	Under-nutrition	150–200 million	In many Asian and sub-Saharan African nations, 25–40% of urban children are underweight.
	Living in housing that is overcrowded, insecure and/or of poor quality	924 million	Based on a global UN review of the proportion of people living in 'slums' in 2000 ³⁷ .
	Homelessness (i.e. living on the street or sleeping in open or public places)	Approximately 100 million	UN estimate ³⁸ . There are also large numbers of people living on temporary sites (for instance construction workers and often their families living on construction sites) that are close to homeless.

impacts of house fires, traffic accidents, pollution and domestic and occupational accidents. These losses feed back into increased poverty and decreased resilience to disaster risk.

Informal settlement, inadequate housing, non-existent services and poor health, are reflections of poverty. However, they are also reflections of weaknesses in the way urban growth is planned and managed. The concentration of private capital and economic opportunity in a city does not of itself produce the institutional means to ensure that the supply of land for housing, infrastructure and services keeps up with population growth; nor does it produce the regulatory framework to ensure that the environmental, occupational and natural-hazard related risks generated through urban growth are managed. In poor countries, there is often a mismatch between the economic drivers of urban expansion and the institutional mechanisms to manage or govern the direct and indirect implications of this concentration. This mismatch may be aggravated in some cities by a lack of real will to engage with the urban poor by both national and local governments and by the relative voicelessness of the urban poor⁴⁰ including those at risk⁴¹.

Many hazard prone cities in wealthy countries, such as in Japan or the United States of America, have been able to grow and adapt without an unmanageable explosion of disaster risk. Urban populations in high income nations take for granted that a web of institutions, infrastructure, services and regulations protect them from hazards. In contrast, only a very small proportion of urban centres in low- and middle-income nations have these capacities, although there are very large variations between cities. In such countries, the application of land-use planning and zoning regulations, infrastructure provision, and services such as refuse collections or emergency response are generally limited to wealthier formal areas of cities. Additionally, support for disaster response and recovery is often limited for the urban poor and may actively discourage the recovery of their land and the rebuilding of their homes and livelihoods.

As a consequence, urban expansion often occurs outside the legal framework of building codes and land use regulations and of officially recorded and legally sanctioned land transactions⁴². Land ownership patterns and the absence of public sector policies to provide access to land or housing in many cities, means that the

only way to absorb large increases in population is through the uncontrolled growth of informal settlements. Inevitably, those with the least purchasing power and least political influence have to occupy land or housing that no-one else wants.

Household and community-based action can help reduce disaster risk in urban areas but there are limitations to what this can achieve without government support and without the broader infrastructure and service framework into which community provision can integrate. Many of underlying factors, such as land tenure and the legal status of informal settlements are structural and cannot be addressed easily through local community initiatives. On its own, community-based action cannot finance and build trunk infrastructure, deal with the causes of flooding that are outside their community, equip and staff hospitals, and so on.

The translation of urban poverty into disaster risk therefore is related to the quality of urban and local governance: the risks faced by the urban poor have often been constructed and amplified by poor governance. As will be highlighted later in this Report, good urban governance both in the sense of competent, effective, accountable local government and good working relationships with civil society is perhaps the most important factor that can limit, reduce or break the relationship between poverty and disaster risk in cities⁴³.

Extensive risk

As documented in Chapter 3, extensive risk, in urban areas, is strongly associated with the impact of localized flooding, fires and landslides in informal settlements. The evolution of extensive risk patterns mirrors that of urban development and territorial occupation and is associated with the increasing hazard exposure of the urban poor, the vulnerability of housing and local infrastructure to hazards and a chronic under-investment in infrastructure such as drainage by city authorities.

In most cities, extensive disaster risk is configured by a significant proportion of the population living in informal settlements on

dangerous sites and lacking infrastructure and services. Sites exposed to hazard include steep landslide prone slopes, ravine sides and river banks subject to erosion in areas with poor drainage and subject to flooding, and those on landfill and reclaimed land with high levels of seismic hazard. Informal settlements on landslide prone hillsides exist in cities such as Rio de Janeiro (Brazil), La Paz (Bolivia) and Caracas (Venezuela); in deep ravines in Guatemala City; or on land prone to flooding or tidal inundation in Guayaquil (Ecuador), Recife (Brazil), Monrovia (Liberia), and many others⁴⁴.

Informal settlements, and occasionally government sponsored, low-income housing⁴⁵, develop on such sites because the land is deemed unsuitable for residential or commercial development, and because city governments have usually been incapable of addressing the land needs of the urban poor. Because most informal settlements are illegal, they usually have serious deficiencies in infrastructure and service provision.

Those who settle and build their homes in such areas have more chance of avoiding eviction because of their proximity to income-earning opportunities. Accepting disaster risk may, in itself, be a strategy to cope with and minimize other kinds of risk. Access to employment, markets, transport and economic opportunities usually plays a vital role in defining where poor people choose to live in a city. Having to cope with periodic flooding may be considered a minor nuisance if livelihood security is increased.

This kind of urban development also magnifies hazard levels. In many urban areas flooding is a product of increased run-off due to building on green areas, an underinvestment in drainage with sufficient capacity to evacuate the run-off, and the encroachment by urban development on natural drainage channels or areas such as flood plains that dissipate flood waters. These factors are often aggravated by the lack of maintenance of existing drainage channels or their obstruction with garbage. As informal settlements are often located in low-lying areas with poor natural drainage and where investment in infrastructure is lowest it is unsurprising that

increasing flood risk predominantly affects the urban poor. Informal settlements often occupy steep slopes, which decreases slope stability and increases the risk of landslide and rockslide hazards, as described in Box 4.6. In other cases (Box 4.7) they may be located on garbage tips. Building on landfill sites or swampy areas is often extremely hazardous in earthquake prone areas. Closely packed settlements of wooden or thatch houses exacerbate fire hazard. The loss of mangrove ecosystems on urban fringes aggravates coastal erosion and increases exposure to storm surges.

Box 4.6:
Hillside collapse
in El Agustino,
Lima⁴⁶

The informal settlement called 9 October was founded in 1975 on a rocky hillside in the district of El Agustino, Lima. The hillside was urbanized informally from the bottom upwards by nearby agricultural workers. Early constructions of bamboo matting were soon replaced by multi-storey concrete and brick houses and by the 1990s, 9 October had a population of more than 1,300, as well as domestic electricity, water and telephone connections, and property titles. In 1999, a local development plan classified the area as a zone of environmental risk and social vulnerability due to high salinity in the soil which was eroding foundations and containing walls; two and three story houses occupying unstable sites without load-bearing capacity; and leaks from a deteriorated water and sanitation network, which were causing subterranean erosion. In June 2003, part of the hillside subsided and collapsed, damaging 280 houses of which 70 were destroyed.

The housing stock in informal settlements is often highly vulnerable to hazard events. Houses are built and modified informally and illegally and, therefore, without reference to hazard resistant building standards where these exist. The absence of land titles often means that households have neither the incentive to improve housing standards, due to the risk of eviction, nor access to housing finance and technical assistance. When land tenure is obtained it is common for additional stories to be added to buildings without reference to the bearing capacity of walls and foundations. Structurally weak and badly built houses are highly vulnerable to earthquakes, tropical cyclones and floods, further increasing the propensity of the urban poor to suffer loss.

The high vulnerability of housing usually extends to infrastructure and basic services. The development of infrastructure and provision of services, including emergency services, often ignore or discriminate against informal settlements, due to legal or other reasons. Much service provision (for example water, sanitation, health care, solid waste management, and sometimes even schools) is therefore private, informal and of poor quality or with inadequate coverage. A high proportion of urban economic activity and the livelihoods it provides, is also outside the formal, regulated economy.

Table 4.2 summarizes the different factors that increase both everyday as well as extensive and intensive disaster risk for the urban poor.

Intensive risk

Extensive risk characterizes areas, usually settled by the urban poor, in and around both large cities and small urban centres. Localized hazards may also cause intensive impacts as Box 4.7 illustrates.

Often, however, intensive risk affects entire cities – or large areas of cities – when they develop and expand on seismic fault lines, close to active volcanoes or on coastlines exposed to tropical cyclones, coastal flooding or tsunamis. Box 4.8 explains why cities grow in areas exposed to major hazards.

Urban growth in hazardous locations increases the intensity of risk. Given that a significant proportion of a country's population and GDP is often concentrated in one or two large cities, intensive risk may have national rather than local impacts. If the city plays a key role in global economic flows, intensive risk may have international implications.

Box 4.9 describes an example where a catastrophic hazard event affected everyone in a city, through the interruption of essential services such as water, sewerage, electricity and public

Table 4.2:
Summary of
disaster risk
factors for the
urban poor

Aspect of urban poverty	Implications for everyday risk	Implications for extensive and intensive disaster risk
1. Inadequate and often unstable income and thus inadequate access to necessities (food, safe and sufficient water, rent, transport, access to toilets, school fees); indebtedness, with debt repayments significantly reducing income available for necessities; and/or incapacity to afford rising prices of necessities.	Very limited capacity to pay for housing, which in urban areas means living in the worst quality homes and neighbourhoods in the least advantageous locations. This often means living in poor quality housing in illegal settlements on dangerous sites lacking provision for infrastructure and services.	In most cities and many urban centres in low- and middle-income nations, most low-cost housing is on land sites at risk from flooding, landslides or other hazards, in part because of the location, in part because of the lack of public provision for infrastructure and services. Housing is often of poor quality, so is at risk from storms/high winds and earthquakes.
2. Inadequate, unstable or risky asset base (non-material and material assets, including educational attainment and housing) for individuals, households or communities, including those assets that help low-income groups cope with fluctuating prices or incomes.	Very limited capacity to cope with stresses or shocks in everyday life, including rising prices or falling incomes, injuries and diseases.	Very limited capacity to cope with disaster events when they occur.
3. Poor quality and often insecure, hazardous and overcrowded housing.	High risk levels from physical accidents, fires, extreme weather and infectious diseases.	High risk of household accidental fires becoming larger settlement-wide fires; conditions favouring disease transmission may cause epidemics. Housing at risk of damage or collapse from storms and earthquakes.
4. Inadequate provision of 'public' infrastructure (piped water, sanitation, drainage, roads, footpaths, etc.), which increases the health burden and often the work burden.	High levels of risk from contaminated water, inadequate sanitation, house flooding from lack of drainage.	Lack of infrastructure often the main problem underpinning flooding. Lack of roads, footpaths and drains inhibit evacuation when disaster threatens or happens.
5. Inadequate provision of basic services such as day care/schools/vocational training, health care, emergency services, public transport, communications, law enforcement.	Unnecessarily high health burden from diseases and injuries because of lack of treatment including emergency response..	Lack of health care, emergency services and disaster preparedness that should provide rapid response to disaster (and should have a role in reducing disaster risk).
6. Limited or no safety net to ensure basic consumption can be maintained when income falls; also to ensure access to housing, health care and other necessities when these can no longer be paid for (or fully paid for).	Very limited capacity to cope with stresses or shocks in everyday life, including rising prices or falling incomes, injuries and diseases.	Very limited capacity to recover from disaster – for instance to afford sufficient food and water, rebuild homes and livelihoods.

Box 4.7:
The Payatas
garbage slide
in Manila⁴⁷

When the government authorities ordered the closure of the Smokey Mountain landfill in Tondo, Manila in 1993, a large portion of the 6,000 metric tons of garbage produced daily in Metro Manila were dumped on the Payatas Estate, a contested area claimed by urban squatters, big subdivision owners and by the government. The new gargantuan garbage mountain overlooked Lupang Pangako, a site in the estate where poor urban

households had been relocated after their homes in other parts of the city had been demolished by the government. On 10th July 2000, a garbage slide affected the 15,000 residents in Lupang Pangako, leaving more than 300 people dead and missing and causing the destruction of more than 500 houses. This intensive risk disaster illustrates the causes of both extensive and intensive urban risk.

Box 4.8:
Why cities
grow in areas
exposed to
major hazards⁴⁸

1. **Economic or political reasons outweighed considerations of risk:** Most of the world's major cities are on the coast or beside major rivers because they were already important urban centres before railways, new roads and air transport changed transport systems. Most relied on river or sea ports as their main transport and communication link with other places – and, of course, river and ocean transport is still a key part of the increasingly globalized economy.
2. **The city has outgrown its original site:** While the original city site may have been safe, the city has outgrown this site and expanded onto land that is at risk, for instance onto floodplains or unstable hillsides. Many city sites that were safe and well-chosen for cities of 50,000 inhabitants (a comparatively large city 200 years ago) are not safe when the city expands to several million inhabitants.
3. **City expansion and development can create new risks:** For instance, where urban development occurs without the necessary investments in protective infrastructure, it creates a fast-growing, concentrated, impermeable surface. A lack of investment in storm and surface drains and new urban developments encroaching on important natural drains, exacerbate the risk.
4. **Dangerous sites serve low-income households well** in that they are the only places where they can find accommodation close to income-earning/livelihood opportunities. The cost of urban housing is inversely related to distance from economic opportunity (which means long and expensive commutes). Low-income households can afford only poor quality, overcrowded and often insecure housing (lacking in infrastructure and services), subject to intensive or extensive risk (e.g. sites at risk of flooding, landslides or earthquakes).
5. **Once a city has developed, it rarely disappears**, even if it experiences some disastrous flood or earthquake, because there are too many individuals, enterprises and institutions with an interest in that city's economy. Most of the world's largest cities have been successful for hundreds of years; many have experienced catastrophic disasters but were rebuilt rather than being relocated.
6. **The wealthier groups and most formal enterprises do not face serious risks** from floods and storms, due to safer locations, well-built housing, infrastructure provision and insurance.

Box 4.9:
The 2005
Mumbai
flooding⁴⁹

In July 2005 a week of incessant rainfall caused floods in several low-lying areas of Mumbai causing nearly 600 deaths, seriously affecting more than a million people, and dislocating the lives of many millions. Lifeline infrastructure and services including water, sewerage, drainage, road, rail and air transport, power and telecommunications stopped functioning across one of the world's largest cities.

The Government of Maharashtra had developed India's first urban Disaster Management Plan for Mumbai in the late 1990s, which highlighted flooding as a significant risk, pinpointed bottleneck locations in each ward, and identified vulnerable slums and settlements. However, no systematic action was taken over half a decade to mitigate the risk.

Effective mechanisms for disaster management operations were found to be missing; the Disaster

Management Plan existed only on paper. Short-term development gains had been prioritized at the cost of the city's sustainability. Key development norms were bypassed with results that included rapid urbanization, a constant modification of building norms, the narrowing and congestion of the Mithi River by development, and the construction of informal settlements adjacent to the river. Additionally land reclamation continues to denude the city's mangroves, mudflats and creeks, which make up its natural drainage systems.

A strong political framework for long-term urban infrastructure development and risk reduction will need to be constructed in Mumbai. A culture of risk mitigation and emergency preparedness must be built, involving communities, the private sector, civil society, state and national governments.

transport, and the collapse of hospitals, schools and public administration buildings. However, housing destruction and mortality are usually concentrated in the same poor areas that manifest extensive risk. Similarly, the interruption or collapse of economic activities has a greater impact on the economy of the urban poor than on wealthier households with economic reserves.

4.2.2 Disaster impacts and poverty outcomes

The losses experienced by poor urban households, as manifestations of extensive and intensive risks, feed back into poverty. Housing is usually the principal economic asset of poor urban households, providing not only shelter and personal security, but also often their livelihood. Its damage or loss, together with essential domestic possessions, therefore, places enormous strain on household economies, given the high monetary cost of replacing lost assets, relative to low and irregular incomes, and the absence of insurance or safety nets.

Studies that measure the impact of intensive risk manifestations⁵⁰ normally focus on the macroeconomic impacts and aggregate losses, making it difficult to identify the impact on the urban poor. The apparently low economic value of lost assets in informal settlements is a reflection of the deficits in housing, infrastructure and services and understates the impact on poor households. In addition, many losses are qualitative and hard to measure – for instance work and school days lost and disruptions to informal income-earning activities⁵¹. The empirical evidence of disaster impacts on urban areas presented in Chapter 3, however, showed a resulting increase in poverty (for example in Trinidad, Bolivia) or reductions in expenditure (as in Iran).

Within poor urban areas, women are often particularly vulnerable as a result of a range of gender-related inequalities, affecting access to income, land tenure and services. A higher proportion of women's income is often generated from home-based activities, with the result that they are most affected when houses and neighbourhoods are damaged and destroyed. Existing gender inequalities are also frequently

manifested in differential access to the resources and services available to support recovery and reconstruction. It is rare for women's and children's needs and priorities to be addressed adequately in the provision of temporary post-disaster settlement, for example, ensuring that health needs are met and protection given against domestic and sexual violence. In general, their needs are not adequately factored into post-disaster recovery and reconstruction planning.

4.2.3 The urbanization of risk in rural economies

Extensive disaster risk is not only a characteristic of large cities but also expands centrifugally within countries, mirroring patterns of territorial occupation and economic and urban development. Such patterns in turn reflect broader global economic change: for example, intensive agricultural development for export markets; the demand for biofuels or for drugs such as cocaine and heroine; the expansion of the agricultural frontier, through the construction of roads and settlements in previously sparsely populated areas; the decentralization of manufacturing to areas with low labour costs; and coastal and island tourist development.

While these processes manifest differently in each country, their outcomes often include increased migration from rural areas, attracted by income and livelihood opportunities, improved markets for surrounding rural areas, and the rapid growth of small and medium-sized urban centres. Such outcomes transform the risks faced by people in rural economies while configuring new risks in small and medium urban centres.

Transformed rural livelihoods

In rural economies, the opening of new urban markets may improve the viability of rural livelihoods, increase household incomes and contribute to a reduction in both vulnerability and poverty, through better and easier opportunities to sell agricultural products or to engage in non-agricultural work. Seasonal or permanent migration to urban areas by household members helps to diversify the livelihoods of rural households and remittances now provide an important source of income in many rural areas,

Box 4.10:
Changing
livelihood
practices:
urbanizing rural
economies
in Africa⁵²

In many countries, farmers have ceased to grow traditional export crops and commercial staple foods in rural areas remote from roads and urban markets, and instead, diversification into non-farm activities and migration to urban areas have become important livelihood strategies⁵³. In sub-Saharan Africa linkages between family members in urban and rural areas are traditionally very strong and represent a strategy to spread resources in a risk-prone environment.

Economic hardship in urban areas, however, affects such linkages. In Senegal and Zimbabwe, for example, economic downturns forced urban residents to decrease financial support to rural-based relatives, negatively affecting the remittance economy on which so many of the rural poor depend. In Botswana and South Africa, however, urban dwellers' investment in livestock and housing in home rural areas is a safety net and has continued despite growing uncertainty in the urban centres. Economic crisis may also be encouraging urban to rural movement, especially among retrenched formal sector workers, but the evidence for this remains anecdotal⁵⁴.

as described in Box 4.10. Worldwide remittance flows are estimated to have exceeded US\$ 318 billion in 2007, of which developing countries received US\$ 240 billion. The true size, including unrecorded flows through formal and informal channels, is believed to be significantly larger⁵⁵. The risks associated with vulnerable rural livelihoods, highlighted in Section 4.1, are rarely found to the same degree in rural areas that are integrated into a strong urban network.

Urbanization, however, may also have negative effects on surrounding rural areas. Towns and cities often displace their environmental burdens and risks to rural hinterlands, including pollution, waste and over-extraction of water resources. Migration to urban areas may increase the risk of HIV/AIDS transmission. Household decomposition and depopulation lead to the breakdown of traditional rural coping and risk management mechanisms. At the same time, urbanization often radically restructures social and gender relations, meaning that potential changes in risk affect men and women, the old and young, the wealthy and the poor in different ways. Evidence from Thailand and the Philippines,

for example, suggests that more and more migrants are moving alone, either temporarily or permanently, and leaving their families behind due to increasing livelihood pressures. In India, there has been a rapid increase in the number of female headed households as men migrate to cities in search of employment⁵⁶. Surveys by the Development Bank of South Africa show that three out of four rural respondents (76%) wanted to remain in their area, despite high levels of poverty. That so many migrate to cities underlines the fact that they move only when they have the means, and see a clear advantage to doing so, in the context of the information and contacts they have available.

Emerging disaster risk in small and medium urban centres

The economies of most small urban centres are linked to the provision of goods and services for local agricultural, fishing or forestry enterprises. Rapid growth both in economic activity and population occurs through the exploitation of new economic opportunities in sectors such as tourism, agro-industry, decentralized manufacturing and illegal drugs, often enhanced by improved communications through the construction of new roads and airports. Already, far more people live in small and medium urban centres in low- and middle-income countries than in mega-cities. In these countries, urban areas with fewer than 500,000 inhabitants account for 22.1% of the population, compared to only 6.6% in large cities with over 5 million inhabitants. However, not all small urban centres are growing rapidly. Isolated towns serving stagnating rural economies may be declining, while at the other extreme urban population growth rates of 20% a year or more have been recorded, for example in the coca growing regions of the Andes⁵⁷. Economically dynamic small and medium urban centres attract migrants not only from surrounding rural areas but also from other cities and regions, due to the promise of potentially lucrative income-generating activities.

Almost all small and at least some medium urban centres, have weak and poorly resourced local governments, large backlogs in provision of infrastructure, little investment capacity and

limited technical capacity and knowledge in managing urban development in general and disaster risk in particular. Informal settlements in small urban centres are likely to be poorer and even less well served by infrastructure and services than their counterparts in large cities. While land constraints may be less apparent, many informal settlements exist around small urban centres in hazard exposed locations, due to rapid and haphazard growth, an absence of urban

planning policies and instruments, and a lack of awareness of local hazard patterns by arriving migrants. Housing is also likely to be more vulnerable. This reflects not only the fact that households may be poorer than in large cities: the adaptation of traditional rural building typologies to the realities of urban economies often produces new structural vulnerabilities, as households have to buy materials and labour on the market and have to adapt to a reduced plot size⁵⁸.

Additionally, as Box 4.11 shows, infrastructure and services provided by and for the poor, in both urban and rural areas, often do not meet even minimum safety standards.

The environmental transformation of surrounding rural areas through deforestation, mineral extraction, and the construction of roads and other infrastructure, often dramatically increases the incidence of hazards, such as floods, flash floods and landslides. The processes through which disaster risk evolves in such contexts are far from linear. Risk arises over time through a concatenation of a large number of different individual and collective decisions often involving land speculation, settlement by the poor of some areas and their eviction from others, the mismanagement of environmental resources and many others, in an overall context of weak local governance. The case of Pereira in Colombia (Box 4.12) illustrates these processes in all their dimensions.

Box 4.11:
Poorly constructed schools kill pupils during earthquakes⁵⁹

Experiences in the recent past have highlighted the urgent need to increase attention to the threat of earthquakes and other natural hazards that expose students to hazards in schools. The 7.9 magnitude earthquake in Sichuan, China in 2008 caused damage to more than 10,000 school buildings and almost 7,000 schools were completely destroyed. UNICEF estimates that millions of school children were affected; 9,000 children and teachers died. Unfortunately this is not the first such loss. In October 2005, the earthquake in Kashmir was yet another cruel reminder of how vulnerable the region's schools actually are. In Pakistan over 8,000 out of 9,000 schools were either destroyed or damaged beyond repair by the earthquake. Over 17,000 school-age children died in the collapsed schools, approximately 23% of the total deaths in the earthquake, and over 20,000 more suffered serious injury. Over 80% of schools in Pakistan are unprotected from similar risks⁶⁰.

Box 4.12:
Risk accumulation in Pereira, Colombia⁶¹

The earthquakes of 1995 and 1999 caused significant destruction and damage to housing built on former landfills in the Egoya and other watersheds in the city of Pereira, where there are high levels of seismic hazard. While this area represents only 7% of the urbanized area of Pereira, it concentrated 43% of the damages in the 1999 earthquake. This manifest disaster risk, however, had been gradually constructed over 65 years, through multiple decisions by a wide range of stakeholders, none of whom were aware of the risk accumulation process. Due to high levels of contamination, the river Egoya had been channelled into a culvert. Given the shortage of landfills, the area had then been levelled with garbage and rubble, permitting its urbanization. In

parallel, traditional lightweight construction in bamboo and mud in the watershed was gradually replaced by more vulnerable brick housing. Most of these changes were justified at the time for other reasons: the river was made into a culvert for environmental health reasons; the city required land for urban expansion; building in brick rather than bamboo was a sign of modernity. By the time of the 1995 and 1999 earthquakes, the area's residents had forgotten this history and were unaware of the seismic risk or even that the river Egoya and the landfill had existed. Subsequently, the municipality of Pereira carried out a study of seismic microzoning, prohibiting rebuilding in the most hazard prone areas, meaning that at least legally the risk cannot be rebuilt.

4.3 Ecosystem decline

People receive substantial benefits or services from ecosystems, categorized as provisioning services (such as food and fibre), cultural services (such as a sense of place or tourism), and regulating services (such as climate moderation or flood reduction). Most ecosystems have been intentionally or unintentionally modified to increase the supply of certain categories of services, and institutions have been developed to govern access to, and use of, these services. However, because ecosystems produce many services simultaneously, an increase in the supply of one service, such as food, can frequently lead to declines in other services, such as flood protection.

The Millennium Assessment found that the supply of approximately 60% (15 of 24) of the ecosystem services evaluated were in decline (Table 4.3), while consumption of over 80% of the services was found to be increasing. In other words, the flow of most ecosystem services is increasing at the same time as the total stock is decreasing. In particular, the Millennium Assessment identified that while people have modified ecosystems to increase the supply of food and fibre, these modifications have

unintentionally led to the decline of regulating ecosystem services, including those responsible for reducing people’s exposure to hazards, such as fires and floods. An increase in landslide hazard on deforested slopes and of storm surges in areas where mangroves have been destroyed, are other examples of how an increase in provisioning ecosystem services may decrease regulating ecosystem services. While such changes in the distribution of ecosystem services often benefit specific economic interests, the costs are frequently borne by poor urban and rural households.

Changes in the supply of ecosystem services may also increase livelihood vulnerability, particularly when livelihoods depend on common pool resources. As Box 4.13 highlights, the destruction of mangroves not only reduces protection against coastal erosion and storm surges but negatively affects artisanal coastal fisheries and the communities that depend on them.

The Fourth Global Environment Outlook⁶³ highlighted the declining capacity of many ecosystems to provide regulating services, including the regulation of flood, drought,

Table 4.3:
Use and supply of ecosystem services⁶²

Source: Millennium Assessment, 2005

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

ES = ecosystem service. Numeric sign shows change in use. Colour shows change in supply: green= increasing supply, red = decreasing supply, yellow = supply more or less stable

**Box 4.13:
Mangroves
in Myepon,
Myanmar**

Myepon is located in the coastal state of Arakan, where many of Myanmar's mangrove forests are found. Several large areas of mangrove were cleared for agriculture and other uses (e.g. paddy fields and salt pans) between 1979 and 2000. The large areas of grey and tan that appear in the previously deep green areas in Figure 4.3 show where the mangroves have been cleared. Mangrove ecosystems occur at the transition between marine and terrestrial ecosystems and provide important services to both. They provide nursery and breeding areas for many marine species and are essential

for maintaining healthy fisheries. They are also a prime habitat for migratory birds, amphibians and many terrestrial species. In terms of their regulating services, mangroves play a vital role in protecting coastlines from storm surges, flooding and erosion.

Mangroves are under pressure throughout much of coastal South Asia where they are being cleared for agriculture, aquaculture and urbanization. Protection of mangroves, as part of overall coastal zone management, will become increasingly important.

**Figure 4.3:
Destruction
of mangroves
and coastal
vegetation in
Myepon (Arakan,
Myanmar),
comparison
between 1979
and 2000**

Source: United Nations Environment Programme (UNEP), 2005



landslide and other weather-related hazards, as well as to support the livelihoods of poor households through provisioning services. Key examples of ecosystem decline include the decrease in supply of tropical forest ecosystem services, land degradation in the form of soil erosion, nutrient depletion, salinity, the disruption of biological cycles, and increasing water scarcity.

Between 1995 and 2005, the global forest area shrank at an annual rate of 0.2%. However, this global figure hides critical regional differences. It is estimated that over the last 15 years approximately 50,000 km² of primary

forest were lost per year, while the area of planted or semi-natural forest has increased by 30,000 km² ⁶⁴. The loss of primary forest was greatest in Latin America and the Caribbean, Asia and the Pacific, and Africa. Given that forests play a key role in the protection and regulation of soil as well as water catchments, their decline in many countries in these regions may be contributing to the intensification of flooding and drought cycles, as well as landslides due to the deforestation of steep slopes.

In addition, forests play a key role in sustaining rural livelihoods. A recent synthesis of data from 17 countries found that 22% of

Figure 4.4:
Deforestation
in Iguazú
(Argentina, Brazil
and Paraguay),
comparison
between 1973
and 2003

Source: UNEP, 2005



rural household income in forested regions comes from harvesting wild food, firewood, fodder and medicinal plants, generating a much higher proportion of income for poor rather than wealthy households.

Poor rural households in developing countries also suffer disproportionately from land degradation. The direct effects include losses of soil organic content, nutrients, and water storage and regulation, which in turn lead to a loss of productive capacity and wildlife habitat, as well as increases in salinity. The Fourth Global Environment Outlook report⁶⁶ indicates a considerable increase in land degradation between 1981 and 2003, characterized by an

absolute decline in net primary productivity or biomass production across 12% of the global land area, with an absolute decrease in rain-water efficiency affecting 29% of the global land area.

Approximately 15% of the global population of 1 billion people live in the affected areas. The impact of land degradation on rural livelihoods is greater in those areas where livelihoods are already characterized by poverty and vulnerability, such as in sub-Saharan Africa. In the low input–low output agricultural systems common to poor rural areas in such regions, nutrient inputs to the soil are almost always less than the outputs, due to reduced fallow periods and insufficient use of inorganic fertilizer, which may be only 5% of the levels applied in developed countries. Land degradation is, therefore, both a cause and an effect of rural poverty and vulnerability. In sub-Saharan Africa, for example, it is estimated that land degradation is responsible for an annual loss of 3% of agriculture's contribution to the region's GDP.

Water management also affects the provision of ecosystem services in ways that modify levels of disaster risk. For example, the increasing demand on rivers for irrigation, as well as extraction of water for industrial and domestic use, reduces the sedimentation that reaches the coast. This can affect downstream agricultural

Box 4.14:
Rural livelihoods
and ecosystem
services⁶⁵

In the Makanya catchment in Tanzania, people's livelihoods are marked by a lack of infrastructure, public services and market access, and are subject to a semi-arid climate with frequent drought episodes. During the 2005–2006 drought, 85% of households earned 42% of their income from local provisioning ecosystem services, in the form of fibre, wood products, wild fruits and fodder. This income was as important as the proportion provided by non-agricultural sources, such as remittances and short-term wage labour.

yields and fish productivity, damage the health of coastal wetlands, and increase coastal flood hazard levels. Excessive groundwater extraction is leading to a potentially irreversible degradation

of aquifers, again with compound effects on rural livelihoods. Coastal and inland wetlands have a critical influence on both livelihoods and the regulation of flood and drought (see Box 4.15).

**Box 4.15:
The Mississippi
wetlands⁶⁷**

The drainage of approximately 4,800 km² of wetlands in the Mississippi Delta in the United States of America was one of the underlying factors behind the scale of the flooding associated with Hurricane Katrina. Many areas formerly above sea level were below sea level at the time of Katrina, due to wetland drainage, while the capacity of the wetlands to dissipate storm surge and absorb flood waters had diminished. The forested riparian

wetlands adjacent to the Mississippi River during pre-settlement times had the capacity to store about 60 days of river discharge. Today, the few remaining wetlands have a reduced storage capacity of less than 12 days discharge, implying an 80% reduction of flood storage capacity. This loss of wetlands also contributed substantially to the severity and damage experienced in the 1993 flood in the Mississippi Basin.

4.4 Global climate change

Global climate change represents environmental inequity in a most pervasive form, since it is driven by historical levels of emissions that have brought enormous benefits to affluent individuals and societies, yet most of the resulting burdens fall on poorer individuals and societies. A large number of global reports already published or in preparation have described in detail the current and projected changes in climatic factors and the likely impacts⁶⁸.

As highlighted by the empirical evidence presented in Chapters 2 and 3, disaster risk associated with weather-related hazards is disproportionately concentrated in developing countries and within these countries in poorer sectors of the population. Climate change will act on this uneven and asymmetric distribution of risk and therefore further magnify the disproportionate social and economic impacts of disaster loss on the rural and urban poor.

The Fourth Assessment Report of the IPCC states that the Earth's climate system has been undergoing warming over the last 50 years. Mean temperatures are likely to increase, mean precipitation will fluctuate, and mean sea level will rise. By the decade 2090–2099, global average surface temperature is predicted to be

1.1–6.4°C higher than the 1990–1998 average. Sea levels are predicted to rise 18–59 cm by the same decade⁶⁹. The IPCC indicates that any increase in mean global surface temperature of more than 2°C above pre-industrial levels, or 1.5°C above 1990 levels, would lead to a dangerous degree of climate change. The IPCC has developed a set of six scenarios identifying plausible emissions pathways for the rest of this century. None of the IPCC scenarios points to a future below the 2°C threshold. The possibility is real that a change of 3°C or more will occur, leading to ecosystem collapse, drastic sea level rise, severe water insecurity and other catastrophic outcomes on a global scale.

Changes in climate can decrease the resilience of households and communities, while at the same time increasing hazard. Some of the projected impacts of climate change in Africa, Asia and Latin America are shown in Table 4.4.

In general the IPCC has predicted decreasing agricultural yields in warmer environments due to heat stress, aggravated by increased insect outbreaks and wildfires; increased soil erosion and land degradation due to extreme precipitation events; greater livestock deaths caused by an increase in the area affected

Table 4.4: Projected impacts of climate change in Africa, Asia and Latin America ⁷⁰	Africa	By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change. Yields from rain-fed agriculture could be reduced by up to 50% in some countries. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition.
	Asia	By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease. Coastal areas, especially heavily populated mega-delta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some mega-deltas, flooding from the rivers.
	Latin America	By 2050, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savannah in eastern Amazonia. Semi-arid vegetation will tend to be replaced by arid-land vegetation. Productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security. In temperate zones, soybean yields are projected to increase. Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.

by drought; and increased stresses in water availability and quality.

The implications are severe. The 2007 Human Development Report⁷¹ estimated that, at the global level, aggregate agricultural output potential will be relatively unaffected by climate change; however this masks significant regional variations. By the 2080s, agricultural potential could increase by 8% in developed countries, primarily as a result of longer growing seasons. In contrast, in developing countries it would fall by 9% with sub-Saharan Africa projected to experience the greatest fall.

Yields from rain-fed agriculture in Southern Africa could be reduced by up to 50% between 2000 and 2020 according to the IPCC. The size of arid and semi-arid areas is projected by the Hadley Centre to increase by 60–90 million hectares. In Malawi for example, the production potential for maize is expected to fall by over 10% due to reduced water availability. Maize is the source of 75% of calorie consumption, so this will aggravate the country's already extreme vulnerability to existing hazard levels. In a normal year, two-thirds of households in Malawi are unable to produce enough maize to cover household needs, and declining soil fertility has reduced maize productivity from 2 tonnes per hectare to 0.8 tonnes over the last 20 years.

As described in Section 4.1, the livelihoods of the rural poor often rely heavily on climate sensitive sectors. Climate change will therefore

translate into decreased resilience, particularly in areas such as sub-Saharan Africa. Apart from reduced agricultural productivity, resilience will also be affected by direct health impacts from water-borne diseases and malnutrition and indirect impacts for parents who must tend to sick children and the elderly.

Rising sea levels also pose a challenge by increasing hazards in low-lying coastal areas. As was discussed in Chapter 2, the population living in coastal areas has grown faster than the overall increase in global population. GDP growth has also been faster in coastal regions. Currently 10% of the world's total population (over 600 million people) and 13% of its urban population (over 360 million people) live on the 2% of the world's land area that is less than 10 metres above sea level, known as the Low Elevation Coastal Zone (LECZ)⁷². In Asia, 18% of the urban population lives in the LECZ; in small island states this is 16%; in Africa, 12%; and in Latin America, 7%.

There are evident risks associated with increased flooding and storm surges exacerbated by sea level rise in cities such as Dhaka, Mumbai and Shanghai, large sections of which are only 1–5 metres above sea level. Box 4.16 illustrates the kind of impacts that can be expected in a number of cities in Africa. Apart from those mentioned, others such as Abidjan, Banjul, Port Harcourt and Mombassa are at high risk⁷³.

The impacts of climate change in rural and urban areas are intimately linked. As the

Box 4.16:
Impacts of sea level rise in urban areas in Africa

Alexandria, Egypt: An assessment of the vulnerability of the most important economic and historic centres along the Mediterranean coast (the cities of Alexandria, Rosetta and Port-Said) suggests that, for a sea level rise of 50 cm, over 2 million people will have to abandon their homes; 214,000 jobs would be lost, and the cost in land and property value and tourism income lost would be over US\$ 35 billion. Alexandria alone has more than 3 million inhabitants. However, it is not really possible to put a monetary value on the loss of the world-famous historic, cultural and archaeological sites⁷⁴.

Lagos, Nigeria: With a total population of around 10 million inhabitants⁷⁵, Lagos has very inadequate provision for basic infrastructure to cope with flooding. 'Normal' rainfall brings flooding to many areas of the city, largely as a result of the inadequate provision of sewers, drains and wastewater management. Any increase in the intensity of storms and storm surges is likely to increase such problems; much of the land in and around Lagos is less than 2 metres above sea level. In many areas, roads have been built without complementary gutters for rainwater. Where a drainage system exists, it is often not properly constructed and maintained. The lack of solid waste collection compounds the problem as waste blocks gutters and drains. In addition, many buildings have been erected in ways that block storm-water routes. Little attention is given to clearing the drains in advance of periods of the year when rain is expected. Many low-income settlements are built in areas at high risk of flooding (many on stilts), largely because safer sites are too expensive⁷⁶.

Cotonou, Benin: Cotonou is Benin's largest urban centre, its main port and a key part of the national economy; it has around 700,000 inhabitants. The continued advance of the sea, coastal erosion and the rise in sea level, exacerbated by human activity on the coast, have medium- and long-term consequences that are already threatening vulnerable communities and disrupting the least-protected sensitive ecosystems. Some roads, beaches and buildings have already been destroyed by the coastline's regression in the last ten years⁷⁷. In addition, provision for drainage is inadequate; the city has no sewer system and only a small proportion of solid wastes are collected; in addition, most of the population lives in informal settlements⁷⁸.

sustainability of rural livelihoods declines and disaster risk increases, it is possible that increased rural to urban migration may occur. In countries such as India, where the urban population is projected to grow by approximately 500 million over the next 50 years anyway, increased drought and flooding in the very densely populated Indo-Gangetic and Brahmaputra basins and in the coastal plains, may precipitate waves of migration that Indian cities are not well placed to absorb. Already major metropolitan areas such as Delhi, Mumbai-Pune and Kolkata are suffering from water stress, breakdown of environmental services and other risks, which can only increase under the influence of climate change⁷⁹.

Existing patterns of extensive risks, for example flooding and landslides, affecting urban informal settlements may intensify due to more severe and frequent extreme precipitation events and increases in the population and assets exposed, as a result of migration from rural areas. New patterns of risk may also emerge as a result of changes in the geographic distribution of weather-related hazards. In addition, climate change will lead to decreasing resilience, which is likely to disproportionately affect poorer countries and communities. Climate change is therefore also a driver of increasing poverty.

However, it is not inevitable that climate change leads to increasing disaster risk. As Chapter 3 illustrated, the rapid increase in the number of extensive floods reported in urban areas in Latin American countries is driven by factors such as the growth of informal settlements in low-lying areas and a chronic underinvestment in the construction and maintenance of drainage infrastructure by both city and national governments. These factors in turn reflect deficiencies in urban and local governance. Increases in the number or severity of extreme precipitation events, due to climate change, will lead to more urban poor households being more affected by more floods. But the changing climate is not responsible for the growth of informal settlements in flood prone areas nor for the lack of investment in urban infrastructure such as drainage. This finding has been reiterated in recent research on the impact of ENSO in the Americas⁸⁰.

In rural areas more frequent and extreme droughts as well as changes in mean temperatures and precipitation levels will cause further stress to already vulnerable livelihoods. The risk levels faced by rural households will increase as both the number and intensity of hazard events and livelihood vulnerability increase. But again, the changing climate cannot be blamed for risk factors such as chronic rural poverty, lack of market access, HIV/AIDS and the absence of social safety nets. If these factors were addressed, climate change would not necessarily lead to worsening risk for the rural poor.

It is important therefore to differentiate between climate change per se and the disaster risks associated with climate change. To reduce the latter, it is necessary to address the underlying drivers that configure risk in the first place. If these drivers are not addressed disaster risk will continue to increase even if climate change is successfully mitigated. Conversely if the drivers can be addressed not only will disaster risk be reduced but also the impacts of climate change. Addressing the underlying risk drivers, therefore, is key not only to disaster risk reduction but also to climate change adaptation. This conclusion has very important policy implications that will be examined in Chapters 5, 6 and 7.

Endnotes

- 1 Ravallion, 2008
- 2 The expression 'least developed countries' is used here as defined by UN-OHRLLS, 2007
- 3 FAO, 2006
- 4 FAO, 2008a
- 5 Bird, et al., 2002
- 6 Information on the 2005 Niger Food Crisis, personal contribution from Mohammed Abchir, UNDP/BCPR, Geneva. November 2008.
- 7 Sánchez-Montero, 2008
- 8 BBC, 8th November, 2008. Niger food crisis timeline. <http://news.bbc.co.uk/2/hi/africa/4699643.stm>
- 9 ESCAP Poverty and Development Division, 2008
- 10 UNDESA, 2008
- 11 In parts of the Peruvian Andes for example, households have traditionally farmed numerous small parcels of land in different altitudinal ranges and ecological niches in order to minimize risk to natural hazards and to increase the diversification of production.
- 12 Dercon and Christiaensen, 2007
- 13 Elbers and Gunning, 2007
- 14 Loewenson and Whiteside, 2001
- 15 Devereux, 2007
- 16 Moser, 1998
- 17 Orindi, et al., 2007
- 18 Devereux, 2007
- 19 FAO, 2008b
- 20 UNDESA, 2008
- 21 Selvaraju, et al., 2006
- 22 Selvaraju, et al., 2006
- 23 Planning Commission, Government of India, 2008
- 24 UNICEF, 1995
- 25 IDS, 2006
- 26 Information on earthquake impacts in rural Kashmir. Personal contribution from Zubair Murshed, UNDP Pakistan, October 2008.
- 27 Government of the Union of Myanmar, et al., 2008, DMH Myanmar/ADPC, 2008 and personal communication from Kamal Kishore, UNDP/BCPR Geneva. November 2008.
- 28 Satterthwaite, 2007a
- 29 UNDESA Population Division, 2008
- 30 This estimate is based on the US\$1 per day poverty line; World Bank, 2007. The World Bank has not released updated figures for the US\$ 1.25 per day poverty line, proposed as of February 2009.
- 31 Sabates-Wheeler, et al., 2008
- 32 Satterthwaite, 2007a; 2007b
- 33 Satterthwaite, et al., 2007
- 34 Satterthwaite, 2004
- 35 Ravallion, et al., 2007 suggest a lower figure.
- 36 UN-HABITAT, 2003a
- 37 UN-HABITAT, 2003b
- 38 UN-HABITAT, 1996
- 39 APHRC, 2002

- 40 Chambers, 1995; Satterthwaite, 1997
- 41 Bartlett, 2008
- 42 This does not mean with no official influence, since there may be widespread government collusion in informal land developments.
- 43 Bull-Kamanga, et al., 2003
- 44 Hardoy et al., 2001
- 45 OSSO, 2008
- 46 Material compiled by Silvia de los Rios, CIDAP (Centro de Información, Documentación y Asesoría Popular), Lima, Peru on the basis of reports by Defensa Civil y Servicios Educativos El Agustino, a local NGO
- 47 Information on the Payatas Garbage Slide in Manila. Personal contribution from Sanny Jegillos, UNDP Regional Centre, Bangkok, November 2008.
- 48 Dodman, et al., 2008
- 49 Revi, 2005
- 50 ECLAC, 2003
- 51 Hardoy and Pandiella, 2008; Sheridan, 2008
- 52 Sabates-Wheeler, et al., 2008
- 53 Bryceson, 1999
- 54 Tacoli, 2002
- 55 Ratha and Xu, 2008
- 56 Sabates-Wheeler, et al., 2008, Section 3.2
- 57 Maskrey et al., 1991
- 58 For example, research by Monzon (1990) indicated that the traditional thickness of earth walls in informal settlement housing was greatly reduced to cope with small plots and the high cost of labour, greatly increasing the structural vulnerability of the houses.
- 59 Information compiled by Andrew Maskrey for this Report.
- 60 UNISDR, 2006
- 61 Bedoya and Narvaez, 2004
- 62 Millennium Ecosystem Assessment, 2005
- 63 UNEP, 2007
- 64 Dent, 2007
- 65 Duraipappah, et al., 2008
- 66 UNEP, 2007
- 67 Duraipappah, et al., 2008
- 68 IPCC, 2007a; Stern, 2006; UNDP, 2007; Sperling and Szekely, 2005; World Bank, 2008c
- 69 IPCC, 2007b
- 70 IPCC, 2007a
- 71 UNDP, 2007
- 72 Satterthwaite, et al., 2007a; 2007b
- 73 Satterthwaite, et al., 2007a; 2007b
- 74 El-Raey, 1997
- 75 Many sources suggest that Lagos has a much larger population than this, but these may overstate its population. The preliminary census data for 2006 suggest that Lagos State in which the city is located had 9 million inhabitants. The 1991 census suggested that the Lagos urban agglomeration had around 5 million inhabitants. The movement of the federal capital to Abuja will also have removed one of the key drivers of Lagos's growth.
- 76 AllAfrica cited in Action Aid, 2006; Aina, 1995; Aina, et al., 1994; Iwugo, et al., 2003; Okude and Taiwo, 2006; Nwafor, 1986
- 77 Dossou and Glehouenou-Dossou, 2007
- 78 Houinsou, 1998
- 79 Revi, 2008
- 80 Wilches-Chaux, 2007; Lavell and Brenes, 2008

