

## **SOCIAL ASPECTS OF CLIMATE CHANGE IN URBAN AREAS IN LOW- AND MIDDLE-INCOME NATIONS**

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## Executive Summary

This paper discusses the implications of climate change for social welfare and development in urban areas in low- and middle-income nations, especially for those with low incomes and those who are particularly vulnerable to climate-change impacts. Hundreds of millions of urban dwellers in these nations are at risk from the direct and indirect impacts of current and likely future climate change – for instance more severe or frequent storms, floods and heat waves, constraints on fresh water and food supplies and higher risks from a range of water and food borne and vector borne diseases (especially malaria and dengue fever). But these risks are distributed very unevenly between nations, between urban areas within nations and between populations within urban areas. This is underpinned by differentials in:

- the scale and nature of hazards by site and location;
- the quality of housing, infrastructure and services;
- the extent of measures taken for disaster risk reduction (including post-disaster response);
- the capacity and preparedness of local governments to address the needs of low-income groups and work with them; and
- the social and political capital of those who face the greatest risks.

Most of the urban population most at risk from climate change have contributed very little to greenhouse gas emissions. They are also facing other deprivations to which climate change will add. Most live in urban centres that lack governance structures with the capacity to support adaptation.

The paper considers who lives and works in the locations most exposed to hazards related to the direct or indirect impacts of climate change and that lack protective infrastructure and services; also, who lacks the information, capacity and opportunities to take immediate short-term measures to limit impacts and whose homes and neighbourhoods face the greatest risks when impacts occur. High risks are concentrated within low-income populations with particularly high risks for those in many informal settlements. The paper also considers who is least able to cope with the impacts (including illness, injury, loss of property and loss of income or livelihood) or to avoid the impacts (for instance by moving to safer places, getting protective infrastructure). This includes a consideration of the particular vulnerabilities of infants and children and of risk-differentials that arise from gender relations. The paper emphasizes that vulnerabilities are not a problem if the hazards to which people are vulnerable are removed.

Later sections of the paper review measures to address climate change-related risk and vulnerability. All such measures can be pro-poor (and thus complement development) but many are in fact anti-poor and increase poverty – for instance by evicting low-income groups from ‘dangerous’ sites to free these up for profitable commercial developments. Among the measures considered are migration and mobility, which have long been important for low-income groups in increasing incomes and strengthening or diversifying asset bases; they will also be important components of low-income households’ adaptation to climate change. This discussion challenges the common perception of migration as ‘the problem’ and of climate change necessarily generating ‘floods of environmental refugees’.

The paper highlights the very strong synergies between pro-poor development and adaptation, at least for the likely climate change impacts for the next few decades. But the potential to capitalize on these synergies depends on competent, accountable local governments that are prepared to work with poor and vulnerable groups and these are rare. It is difficult to see how most city or municipal governments, as they are currently constituted, can address adaptation priorities when they have had so little success in addressing development issues – given that a significant proportion of the population in their jurisdictions live in informal settlements lacking adequate provision for infrastructure and services. The paper also questions the assumption that there are strong co-benefits for mitigation and adaptation; greenhouse gas emission levels in many urban centres in low-income nations are so low that there is not much to mitigate. While recognizing that globally the best form of adaptation is mitigation, the paper discusses the serious social consequences for urban populations in low and middle-income nations if mitigation is prioritized over adaptation (as it currently is). There is also the worry that mitigation will be promoted in ‘development projects’ for low-income groups when it is far more urgent to get middle and upper-income groups to take mitigation seriously. Finally, the paper considers the potential role of community-based adaptation in urban areas. Its potential is often over-stated; how can community-

based adaptation address the need for city-wide trunk infrastructure and services (especially flood protection and drainage), regulation and city-wide governance? But at the same time, its potential is underplayed as very few local governments and development assistance agencies recognize the competence and capacity that organizations and federations formed by slum or shack dwellers can contribute to adaptation (and development). Their capacity to work at scale and to contribute to the city-wide hazard/vulnerability mapping has also been demonstrated in many locations, where local governments work with the urban poor.

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### **Introduction**

Hundreds of millions of urban dwellers in low- and middle-income nations are at risk from the direct and indirect impacts of climate change. As the number of people living in cities and towns has grown – more than half of the world’s population now lives in urban areas – so too has the number of urban residents vulnerable to climate change.<sup>1</sup> The uneven distribution of vulnerability between and within urban areas and the way this is shaped by individual and household characteristics (including age, income-level, health-status, asset portfolio and gender) and by what governments do (and do not do) means that a better understanding of the social aspects of climate change in urban areas is highly relevant. Within the attempt to develop this understanding, there is a particular interest in the ways that climate change is exacerbating or will exacerbate the challenges already faced by low-income urban residents.

This paper considers the implications of climate change for social welfare and development in urban areas, with a specific focus on understanding the impacts of climate change on the most vulnerable populations. It moves beyond describing climate-related risks to assessing the more detailed implications for social relations, livelihoods and the provision of social and infrastructural services to low-income and other particularly vulnerable groups. The paper develops themes linked with the other research clusters – for instance with Cluster 2 (Infrastructure, Built Environment and Energy Supply) in relation to the ways in which climate-resilient infrastructure can be developed to meet the needs of the urban poor; and Cluster 3 (Role of Institutions, Governance and Urban Planning) regarding the ways in which pro-poor municipal authorities and other institutions can best address the social implications of climate change.

This paper draws on and builds on the different research projects in which its authors are engaged, including work on the vulnerability of children (Bartlett 2008a, 2008b), on the links between disasters, poverty and climate-change in urban areas in Latin America (Hardoy and Pandiella 2009); also on how migration will be affected by climate change, and the role of migration in adaptation (Tacoli forthcoming), on community-based adaptation in the Philippines (Reyos 2009, Dodman and Mitlin 2009), on municipal government responsibilities for adaptation (Satterthwaite 2008a) and on vulnerability and risk within urban centres in the Least Developed Nations.<sup>2</sup> The paper also identifies existing coping strategies relying on social networks and interactions, and looks at how these can be developed and strengthened into more proactive mechanisms for adaptation. Thus, there is an interest here in both the potentials and the limitations of adaptation by individuals, households and community-based organizations. Obviously, there is also a focus on the role of governments in adaptation, including the role of infrastructure and how the availability and price of land for housing influences vulnerability.

The impacts of the increased frequency and/or intensity of floods, storms and heat waves, water supply constraints and other changes that that climate change brings or is likely to bring are distributed unevenly within urban areas among different social groups. Location influences many impacts – for instance, storms, floods or heat waves usually hit particular parts of a city more severely than others. All impacts are influenced by the quality of housing; also by the quality and extent of provision for protective infrastructure and services, much of which is the responsibility of local government or local offices of higher levels of government. In almost all urban centres in low- and middle-income nations, there are large intra-urban differentials in the quality and extent of such provision. The unevenness in the distribution of impacts is also influenced by age and by gender, by the income levels and asset bases of

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<sup>1</sup> This is not to imply that increasing urbanization necessarily brings increasing numbers of people vulnerable to climate change; it can and should bring decreasing levels of vulnerability.

<sup>2</sup> This includes work on urban vulnerability and risk by the CLACC network, see [www.clacc.net/](http://www.clacc.net/)

individuals and households, and by their social capital. Large differentials exist within any urban population not only in the impacts but also in the potential to cope with these impacts and with recovery afterwards – and this too is influenced by age, gender and individual and household asset portfolios. Of course, it is also influenced by the speed and quality of post-disaster response from governments and international agencies. There is a particular interest here in ensuring that discussions of hazard, risk and vulnerability in relation to climate change include a consideration of the differentials among urban populations in the effectiveness of pre-disaster and post-disaster responses. Climate-change is likely to bring an ever-growing number and range of extreme-events for which complete protection is impossible (i.e. there are limits to what adaptation can protect). So adaptation is also about minimizing the impact of these events – for instance ensuring that those who live or work in particularly dangerous sites can move temporarily to safer sites and ensuring rapid responses after the event to address health impacts, provide safe, supportive temporary accommodation where needed and help to ensure that those whose homes and settlements were damaged are at the centre of plans and programmes of rebuilding and reconstruction.

Responding to the social aspects of climate change will require commitment by a variety of urban institutions, including community-based organizations, non-government organizations, local and national governments, and international agencies. The paper identifies points of intervention – from the household to the international scale – where the activities of these actors can most effectively address the challenges of climate change and support the building of more resilient urban societies.

It is also important to consider the potential positive or negative social consequences of the implementation of mitigation projects (including those funded by the Clean Development Mechanism and voluntary carbon markets) in urban areas of low- and middle-income countries. The process of applying for and managing projects of this type is very resource intensive, and the projects themselves rarely address the vulnerability of urban poor groups.

The recommendations regarding responses to these issues seek to take into account the different consequences of climate change, focusing on changes in means and changes in extremes. They take into account cities of different sizes, bearing in mind that the climate change-related risks facing small- and medium-sized urban centres have been neglected in the literature on this topic. They conceptualize urban centres as open systems, relying on complex movements of people, goods and capital within and between them and between urban and rural areas, and with the peri-urban interface as a particularly relevant nexus for both climate change impacts and social transformation. Finally, they identify commonalities and shared experiences, and the potential to define key principles that can be applied (in a contextually-specific manner) between urban centres facing similar threats.

## The social and spatial distribution of vulnerability and risk

The risks from climate change are distributed unevenly. For urban populations, this uneven distribution can be considered at different scales – for instance globally (between countries), within countries and within each urban centre. Each has relevance for understanding who is most at risk. This paper will focus primarily on the intra-urban scale, although it will also provide a brief overview of the distribution of risk in global terms. First it is important to establish just what the hazards are that contribute to these risks.

### ***The hazards in urban areas***

Table 1 summarizes a variety of possible impacts from climate change on urban areas, although of course there are large differences between different urban locations in the severity of each of these hazards or resource constraints and in the mix of impacts. At least in the next few decades, the main impacts of climate-change are likely to be increased levels of risk from existing hazards.

**Table 1: Climate Change Impacts on Urban Areas**

<b>Change in climate</b>	<b>Possible impact on urban areas</b>
<b>Changes in means</b>	
Temperature	<ul style="list-style-type: none"> <li>• increased energy demands for heating / cooling</li> <li>• worsening of air quality</li> <li>• high temperature impacts exaggerated by urban heat islands in cities</li> </ul>
Precipitation	<ul style="list-style-type: none"> <li>• increased risk of flooding</li> <li>• increased risk of landslides</li> <li>• distress migration from rural areas</li> <li>• interruption of food supply networks</li> </ul>
Sea-level rise	<ul style="list-style-type: none"> <li>• coastal flooding</li> <li>• reduced income from agriculture and tourism</li> <li>• salinization of water sources</li> </ul>
<b>Changes in extremes</b>	
Extreme rainfall / Tropical cyclones	<ul style="list-style-type: none"> <li>• more intense flooding</li> <li>• higher risk of landslides</li> <li>• disruption to livelihoods and city economies</li> <li>• damage to homes, infrastructure and businesses</li> </ul>
Drought	<ul style="list-style-type: none"> <li>• water shortages</li> <li>• higher food prices</li> <li>• disruption of hydro-electricity</li> <li>• distress migration from rural areas</li> </ul>
Heat- or cold-waves	<ul style="list-style-type: none"> <li>• short-term increase in energy demands for heating / cooling</li> <li>• health impacts for vulnerable populations</li> </ul>
Abrupt climate change	<ul style="list-style-type: none"> <li>• possible significant impacts from rapid and extreme sea-level rise</li> <li>• possible significant impacts from rapid and extreme temperature change</li> </ul>
<b>Changes in exposure</b>	
Population movements	<ul style="list-style-type: none"> <li>• movements from stressed rural habitats</li> </ul>
Biological changes	<ul style="list-style-type: none"> <li>• extended disease vector habitats</li> </ul>
Source: Adapted from Wilbanks <i>et al</i> 2007	

One of the main ways that climate-change affects urban populations is through the impacts on health – mostly from physical hazards but also from extreme temperatures, increased risk of some diseases and constraints on food availability. Urban populations in places where the current burden of climate-sensitive disease is high will be disproportionately affected, primarily the urban poor in low- and middle-income countries (Kovats and Akhtar 2008). Ill-health and injury are among the most common factors in increasing poverty, both from loss of earnings and from the additional medical expenses. Table 2 summarizes the known effects of weather and climate on urban health.

Climate change may affect the availability of drinking water to urban populations, particularly in urban centres lacking adequate water resource management. In most urban centres this is likely to have the greatest effect on household supplies in low-income areas, particularly informal settlements. These issues of water availability are compounded by the lack of space or storage facilities for water in low-income households. It is difficult, however, to establish the direct impact of climate change on access to clean water, as a variety of factors – social, political and environmental – determine availability.

**Table 2: Summary of known effects of weather and climate on urban health**

Health outcome	Known effects of weather
Heat stress	<ul style="list-style-type: none"> <li>• Deaths in older people and people with chronic disease increase with high and low temperatures</li> <li>• Heat-related illness and death due to heat waves</li> </ul>
Air pollution-related mortality and morbidity	<ul style="list-style-type: none"> <li>• Weather affects air pollutant concentrations</li> <li>• Weather affects distribution, seasonality and production of aeroallergens</li> </ul>
Health impacts of weather disasters	<ul style="list-style-type: none"> <li>• Floods, landslides and windstorms cause direct effects (deaths and injuries) and indirect effects (infectious disease, loss of food supplies, long-term psychological morbidity)</li> </ul>
Mosquito-borne diseases, tick-borne diseases (e.g. malaria, dengue)	<ul style="list-style-type: none"> <li>• Higher temperatures reduce the development time of pathogens in vectors and increase potential transmission to humans</li> <li>• Vector species require specific climatic conditions (temperature, humidity) to be sufficiently abundant to maintain transmission</li> </ul>
Water-/ food-borne diseases	<ul style="list-style-type: none"> <li>• Survival of important bacterial pathogens is related to temperature</li> <li>• Extreme rainfall can affect the transport of disease organisms into the water supply. Outbreaks of water-borne disease have been associated with contamination caused by heavy rainfall and flooding associated with inadequate sanitation</li> <li>• Increases in drought conditions may affect water availability and water quality (chemical and microbiological load) due to extreme low flows</li> </ul>

Source: Kovats and Akhtar 2008.

The vulnerability of the urban poor to floods is evident not only in the physical impacts but also as they often experience increased rates of infectious disease (including cholera, cryptosporidiosis and typhoid fever) after flood events (Kovats and Akhtar 2008). Flood-related increases in diarrhoeal disease have been reported in India and Bangladesh; the Fourth Assessment Report of the Intergovernmental Panel on Climate Change concluded that climate change will increase the burden of diarrhoeal diseases (see Confalonieri *et al* 2007). Climate change is also likely to alter the incidence and geographical range of malaria – and in many low-income and densely populated urban areas this effect is likely to be accentuated.

### ***Inter-urban differentials at the global level***

The IPCC's Fourth Assessment notes that urban centres and the infrastructure they concentrate – and the industries that are a key part of the economic base of many such centres – are often capable of considerable adaptation in order to reduce risks from the direct and indirect impacts of climate change (Wilbanks *et al* 2007). All large urban centres have had to make substantial 'adaptations' to environmental conditions, site characteristics, natural resources availability and environmental hazards to be able to function – for instance, creating stable sites for buildings, putting in place the infrastructure that all cities require and ensuring provision for water and for managing wastewater and storm and surface runoff. Successful and healthy cities are proof of the adaptive capacity of their governments, citizens and enterprises. In any well-governed city, there is already a great range of measures in place to ensure that buildings and infrastructure can withstand extreme weather events and that water supply systems can cope with variations in freshwater supplies. Good environmental and public health services should also be able to cope with any increase in other likely climate change-related health risks in the

next few decades – whether from heat waves, reduced freshwater availability, or greater risks from certain communicable diseases.

Thus, the climate change-related risks facing the population of any urban centre are a function not only of what climate change brings but of the quality of housing and the quality and extent of provision for infrastructure and services. Urban populations in high-income nations and a proportion of those in middle-income nations take for granted that a web of institutions, infrastructure, services and regulations protects them from extreme weather/floods, and will keep adapting to continue protecting them. Many measures to protect against extreme weather also meet everyday needs: healthcare services integrated with emergency services, and sewer and drainage systems serving daily requirements as well as coping with storms. The police, armed services, health services and fire services provide early warning, with details of what actions should be taken, and ensure rapid emergency responses. The costs are paid as service charges or through taxes and for most people represent a small proportion of their income. Consequently, extreme weather events in high-income nations rarely cause large loss of life or serious injury (Hurricane Katrina's impact was exceptional in this). Although such events occasionally cause serious property damage, the economic cost is reduced for most property owners by property and possessions insurance (Satterthwaite et al 2007).

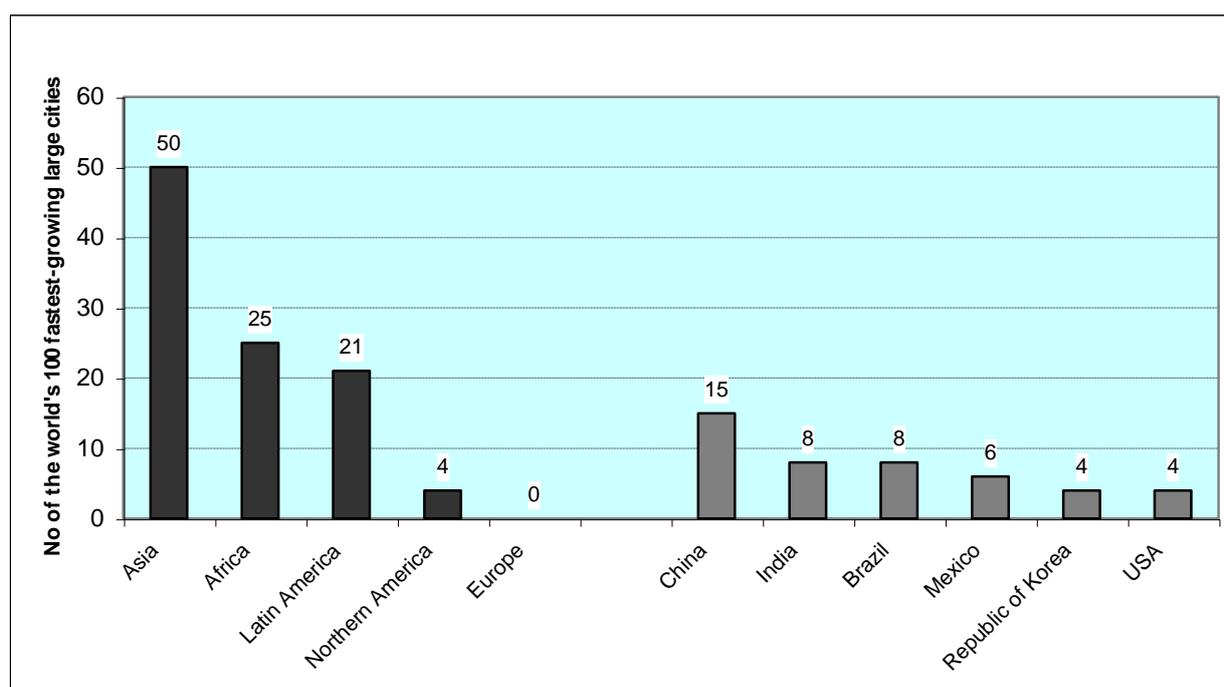
This adaptive capacity is also underpinned by the fact that most buildings conform to building regulations and health and safety regulations, and are served by piped water, sewers, all-weather roads, electricity and drains 24 hours a day. The institutions responsible for such services are expected to make them resilient to extreme weather. While private companies or non-profit institutions may provide some of the key services, the framework for provision and quality control is supplied by local government or local offices of provincial or national government. In addition, it is assumed that city planning and land-use regulation will be adjusted to any new or heightened risk that climate change may bring, encouraged and supported by changes in private-sector investments (over time shifting from high-risk areas) and changes in insurance premiums and coverage. At least for the next few decades, as the IPCC's Fourth Assessment stresses, this 'adaptive capacity' can deal with most likely impacts from climate change in the majority of urban centres in high-income countries (Wilbanks et al 2007)

Thus, a consideration of risk and vulnerability for urban centres globally has to consider first which urban centres are facing or will face the largest increase in climate-change related hazards and stresses and secondly, which urban centres have the least adaptive capacity (in terms of the quality of housing, the quality and extent of provision for infrastructure and services and the quality of local government and local governance). At a global scale, the urban centres and populations facing the largest increases in climate-change related hazards are mostly in low- and middle-income nations. So too are most of the urban centres with the least adaptive capacity and the largest deficit in adaptation. It is also worth noting that most of the urban centres facing the largest increase in climate-change related hazards and with the least adaptive capacity are also urban centres with very low levels of greenhouse gas emissions per person, both historically and currently. Thus, at a global scale, climate change is bringing, and will increasingly bring, a very large transfer of risk from high-income people and nations (who are responsible for generating most greenhouse gases and who have the greatest adaptation capacity) to low-income people and nations (who have the least responsibility for generating greenhouse gas emissions, face the largest increases in hazards and have the least adaptive capacity).

At a global scale, it is possible to point to the high levels of risk and vulnerability for particular urban centres, based on case studies or on climate-change related risk maps (for instance showing which urban centres are at greatest risk from extreme-weather events or sea level rise). But there is a limited number of detailed case studies and limited capacity to predict the likely impacts of climate change for any particular locality, including how it will change over the next few decades. At a global level, according to the IPCC's Fourth Assessment Report, the vulnerabilities of industry, infrastructure, settlements and society to climate change are generally greater in certain high-risk locations. These include coastal and riverine areas, and areas whose economies are closely linked with climate sensitive resources (Wilbanks et al 2007).

Perhaps the most relevant global trend to consider is the rapid increase in the proportion of the world's urban population and of its largest and fastest growing cities in low- and middle-income nations. Almost all the increase in the world's population over the next 20 years and beyond is likely to be in urban centres in low- and middle-income nations (UN 2008).<sup>3</sup> The scale of this growth is also worth highlighting; UN estimates suggest that the urban population in low- and middle-income nations has grown by more than 500 million since 2000. So available statistics – for instance on the 900 million urban dwellers living in slums and informal settlements in 2000 (UN-Habitat 2003a) or the 850 million to 1.1 billion urban dwellers lacking adequate sanitation in 2000 (UN-Habitat 2003b) – are likely to considerably understate the scale of the problem. Historically, most of the world's urban population and most of its largest cities have been in its wealthiest nations; today this is no longer so, although both the world's urban population and its largest cities are concentrated in the largest economies (Satterthwaite 2007). Figure 1 below illustrates that half of the world's fastest growing large cities between 1950 and 2000 were in Asia; very few were in North America and none were in Europe.

**Figure 1: The distribution of the world's fastest growing large cities, 1950-2000**



Source: Satterthwaite (2007). NB: This analysis included cities whose population exceeded 1 million inhabitants in 2000

A growing proportion of both the world's total population and its urban population also lives in the Low Elevation Coastal Zone – and this trend is particularly evident in the Least Developed Countries (McGranahan *et al* 2007). (Table 3) At present, the data only allow an analysis of the rural and urban populations settled in the zone that is within 10 metres of mean sea level – so this includes more than the population at risk from likely sea level rise in the next few decades. But this still indicates the scale of the population close to the coast and in most nations the increasing proportion of the population here.

<sup>3</sup> Although on an optimistic 'development' scenario, this may include many middle-income nations that become high-income nations. But poor economic performance may also mean a far smaller shift from rural to urban areas than anticipated in many nations (see Potts 2009).

**Table 3: Population and land area in the low-elevation coastal zone (LECZ) by region, 2000**

Region	Population and land area in LECZ				Share of population and land area in LECZ			
	Population (million)		Land ('000 km <sup>2</sup> )		Population (%)		Land (%)	
	Total	Urban	Total	Urban	Total	Urban	Total	Urban
Africa	56	31	191	15	7	12	1	7
Asia	466	238	881	113	13	18	3	12
Europe	50	40	490	56	7	8	2	7
Latin America	29	23	397	33	6	7	2	7
Australia and New Zealand	3	3	131	6	13	13	2	13
North America	24	21	553	52	8	8	3	6
Small Island States	6	4	58	5	13	13	16	13
<b>World</b>	<b>634</b>	<b>360</b>	<b>2,700</b>	<b>279</b>	<b>10</b>	<b>13</b>	<b>2</b>	<b>8</b>

Source: McGranahan *et al.* (2007)

### ***Intra-urban differentials***

The IPCC Fourth Assessment Report notes that “poor communities can be especially vulnerable, in particular those concentrated in relatively high-risk areas” (Wilbanks *et al* 2007: 359). This is true even within high-income nations well served by protective infrastructure and services, which often exhibit large differentials in the risks facing their populations. This is illustrated in Box 1, which looks at differentials in climate change vulnerability in London. Of course, this is one of the world’s wealthiest cities within a high-income nation and with the resources and capacities that underpin high adaptive capacity. It is included here in part because there are so few city-based studies that have looked at differentials in vulnerability and risk within urban populations and in part because it is a reminder that there are groups that are vulnerable to climate change impacts even in wealthy cities.

### **Box 1: Climate Change Vulnerability and Adaptation in London**

As a major global financial centre, London has a wealth of technical, financial, and human resources available to adapt to climate change. The London Climate Change Adaptation Strategy identifies the main changes that can be expected in the city’s climate, and describes the responses that are required. The main anticipated consequences of climate change are an increased risk of flooding, droughts, and uncomfortably hot weather; secondary and indirect impacts are expected to include an increased risk of winter storm damage, ground instability and movement, and periods of poor air quality in the summer.

The strategy for climate change adaptation in London is based around three key actions: prevention; preparation; and response / recovery.

Factors making people vulnerable to flood risk in London:

- personal: for example, age (the very young and very old), health status, disability, lack of proficiency in spoken English
- situational: for example, living alone or not having a support network, low income, living on the ground or lower-ground floor, not having advance warning of a flood, not having sufficient insurance cover.

These factors may operate singly or in combination to affect persons in the following ways:

- less likely to be aware of (say) the flood risk to their home
- physically more at risk from a flood if flooding occurs
- less likely to know what to do and be able to do it
- less likely to receive and use information on what to do through regular communications channels
- less likely to be able to recover independently, or access services to aid recovery

The poorest residents in London are more likely to live at tidal and fluvial flood risk, and there is a lower uptake of insurance for people in social housing or on low incomes

The effects of drought on individual access to potable water in London are likely to be minor, as there is close to universal piped-water coverage. However, several groups of people and businesses would be financially affected by more frequent implementation of 'Non-Essential Use Drought Orders'.

Various factors increase the risk of heat-related death and illness in London:

- personal: age (under 4 years or 65 and over, with those aged 85 and over experiencing the most severe effects); gender (women are more vulnerable than men for various reasons, including having a higher core body temperature, adverse effects of menopause on thermoregulation, and some social differences); pre-existing disease (e.g. heart and respiratory disease); use of certain medications and substances (including drugs and alcohol); impaired cognition (e.g. dementia).
- situational: housing (e.g. building type, condition and insulation, which floor, aspect, presence and use of air conditioning and ventilation); social factors (e.g. living alone, homeless, no support network, low income); place of work (exposed to high temperatures); level of physical activity (overexertion or inactivity).

The August 2003 heat-wave in England and Wales was associated with 2,139 excess deaths.

SOURCE: Greater London Authority 2008

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Large intra-city differentials in risk are most apparent within low and middle income countries. As Revi (2008: 219) notes in regard to urban centres in India:

“Ironically, but not surprisingly, the urban residents most vulnerable to climate change are the poor slum and squatter settlement dwellers and those who suffer from the multiple insecurities that poor governance, the lack of serious investment in the commons and a strong nexus between the political class, real estate developers and public agencies bring to cities. Through a long process of loss accumulation, they are multiply challenged by even small events that impact their livelihoods, income, property, assets and sometimes their lives. Because of systematic exclusion from the formal economy of the city – basic services and entitlements and the impossibly high entry barrier into legal land and housing markets – most poor people live in hazardous sites and are exposed to multiple environmental health risks via poor sanitation and water supply, little or no drainage and solid waste services, air and water pollution and the recurrent threat of being evicted.”

Although this analysis is drawn from an assessment of vulnerability for urban areas in India, it has relevance for most urban centres in low- and middle-income nations.

As noted above, in most urban centres, the main impacts of climate change in the next few decades are likely to be increased levels of risk from existing hazards. For poorer groups, these will include a variety of impacts, both direct impacts (such as more frequent and/or more hazardous storms and floods); less direct impacts (such as reduced availability of freshwater supplies in many cities that may reduce supplies available to poorer groups); and indirect impacts (such as climate change-related weather events or changes in temperatures that reduce agricultural production and thus increase food prices or damage poorer households' asset bases) (Dodman and Satterthwaite 2008). Within any urban centre, it is common for poorer groups to be disproportionately at risk for a variety of reasons, including:

- greater exposure to hazards (e.g. through living on flood plains or unstable slopes)
- lack of risk-reducing housing and infrastructure (e.g. poor quality housing, lack of drainage systems)
- less adaptive capacity (e.g. lacking the income or assets that allow a move to better quality housing or less dangerous sites)
- less state provision for assistance in the event of a disaster (e.g. needed emergency responses and support for rebuilding or repairing homes and livelihoods; indeed, state action may increase exposure to hazards by limiting access to safe sites for housing)

- less legal and financial protection (e.g. a lack of legal tenure for housing sites, lack of insurance and disaster-proof assets).

Note here the concern for hazards and risks that occur because adaptation has been unable to prevent them. Adaptation to climate change will only be able to reduce most risks and climate-change induced costs, not prevent them. In large part, the function of adaptation is to reduce the impact of hazards because it is not possible to reduce the actual hazards (for instance, a city cannot reduce the intensity of a cyclone but can reduce its impact through better housing and infrastructure and good disaster preparedness and response). Climate change is different in this regard from many of the environmental hazards present in urban areas in low- and middle-income nations because there is no possibility of local action reducing or removing the hazard. Thus, a key part of adaptation is disaster-preparedness and disaster-response. This is an issue that is generally not well integrated into discussions of adaptation.

Much urban expansion has involved the occupation of floodplains or mountain slopes, or other zones ill-suited to settlement such as areas prone to flooding or affected by seasonal storms, sea surges or other weather-related risks (Hardoy et al 1992, 2001). These sites are primarily occupied by low-income households, because all other 'safer' sites are beyond their means. In most cases, the poor lack formal tenure, and face not only environmental risks but also the risk of eviction. Houses are frequently built with inadequate materials, and so provide very inadequate protection against storms, fires, extreme temperatures and damp. Attention to reducing the risks faced by much of the urban population from extreme weather (unrelated to climate change) has long been lacking; this lack of attention puts many people at high risk from the likely impacts of climate change. High levels of risk are particularly evident for those who not only inhabit dangerous sites, but also lack the resources and options to modify conditions to lessen their vulnerability.

The growing proportion of the world's urban population living in the Low Elevation Coastal Zone was noted above; case studies of particular coastal cities show that most of those most at risk are low-income groups (see Awuor et al 2008 for Mombasa, Revi 2008 for cities in India, Alam and Rabbani 2007 for Dhaka and Dossou and Glehouenou-Dossou 2007 for Cotonou; also Satterthwaite et al 2007 for a review of city case studies).<sup>4</sup>

In the absence of a strong information base for each locality on the impacts that climate change is likely to bring over time, the experience of groups that have been most affected by extreme weather events in the past, and more generally by climate variability, provides a basis for identifying those likely to be at risk from these in the future (see Awuor et al 2008). However, even here available data are limited. Despite that fact that the combination of hazards and vulnerability generates environmental risks that are part of everyday life for large sections of the urban population, the number of deaths, serious injuries and loss of assets from these is not known. There are some data on the number of deaths and injuries for events registered as disasters, but this is known to be only a small proportion of all those killed or injured and/or who lost homes and assets. In part this is because the criteria for what constitutes a 'disaster' means that only large disasters are registered in official records – for instance only if at least 10 people died and/or at least 100 were reported as affected. Most of the deaths, serious injuries and loss of or damage to property caused by extreme weather goes unrecorded globally and within most nations and cities (ISDR forthcoming).

Even within the same geographical location, the impacts of climate change will not affect urban residents in the same way. The assessment of vulnerability – and the ways in which it is socially distributed – can perhaps best be addressed through looking at six key questions (Hardoy and Pandiella 2009):

- i) Who lives or works in the locations most exposed to hazards related to the direct or indirect impacts of climate change (such as on sites at risk of flooding or landslides)?
- ii) Who lives or works in locations lacking the infrastructure that reduces risk (e.g. drains that reduce flood risk)?

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<sup>4</sup> See also Bicknell et al 2009 that brings together the city case studies published in *Environment and Urbanization* between 2007 and 2009

- iii) Who lacks information, capacity and opportunities to take immediate short-term measures to limit impacts (e.g. to move family and assets before a disaster event)?
- iv) Whose homes and neighbourhoods face the greatest risks when impacts occur (e.g. because of poorer quality buildings that provide less protection for inhabitants and their physical assets)?
- v) Who is least able to cope with the impacts (including illness, injury, loss of property, loss of income)?
- vi) Who is least able to avoid impacts (e.g. by building better homes, agitating for improved infrastructure, or moving to a safer place)?

The first question is on where hazards occur; the rest relate to different aspects of exposure to hazards and vulnerability to hazards. Below, each of these questions is followed by a short section considering how vulnerability is related to age, gender, household/neighbourhood assets and migration. (Age and gender are then more comprehensively considered in subsequent sections.)

*Where do hazards occur – and who lives or works in the locations most exposed to hazards related to the direct or indirect impacts of climate change?*

In urban areas, when legal land sites available for housing are scarce and/or unaffordable for low-income groups, the choices for location are limited. Individuals and households make choices that reflect their constraints, priorities and trade-offs – for instance, with regard to location/accessibility, availability, type of ownership (private or state owned), security (the likelihood of eviction), possibilities of service provision and regularization, and cost. Low-income populations often settle on land with high levels of hazard and little or no protective infrastructure, because this is the only land available to them. This is a process that has been going on for decades in most cities, so now a very considerable proportion of the population live on sites at risk from landslides, floods or extreme-winds. Box 2 gives some examples from Latin America.

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#### **Box 2: Who lives in hazardous locations; examples from Latin American cities**

**Rio de Janeiro:** An estimated 1.1 million people live in the *favelas* of Rio de Janeiro that sprawl over the slopes of the Tijuca mountain range. Housing conditions here have improved over time, with better quality building materials and public services such as electricity, water and sewers. In many places, however, the paving of sidewalks has increased runoff in the rainy season to the point where water is ankle or knee-deep between houses. Water runs down from the mountain through cemented or quasi-natural watercourses, flooding lowlands. The accumulation of uncollected wastes also blocks drains and surface runoff. More intense or prolonged rains will increase risks in the area (De Sherbinin et al 2007).

**Quito:** This is another city where hazards and vulnerability combine to create risk. It is at the foot of the Pichincha volcano, on very steep slopes. Its population has increased four-fold over the last 30 years and a combination of problems (economic crisis, debt, population growing far faster than government can keep up, a lack of planning) has led to legal and illegal occupation of slopes. The costs of providing services and infrastructure to these areas are very high, especially for illegal settlements. The lack of sewers and drainage systems increases the risk of floods, while the lack of proper waste collection systems results in waste accumulation in ravines and gorges, which clogs natural water flow and contributes to floods and landslides (Zeballos Moreno 1996).

**Caracas:** The metropolitan district of Caracas has suffered from recurrent disasters. Much of the city is built on slopes, with many gorges that lead to the main city river, the Guaire. In recent decades, the population in low-income neighbourhoods (*zonas de ranchos*) increased far more rapidly than the total population, resulting in far higher population densities (Cilento Sarli, 2007). As the city has expanded, land has become more impermeable, increasing water runoff. Without planning, low-income neighbourhoods have occupied unstable land and gorges and, together with their accumulated waste, they act as barriers to water runoff (Mata and Nobre 2006). In December 1999, Venezuela experienced a one in 100-year rainfall with massive landslides and floods that killed hundreds of people. The rainfall was unusual in its intensity, the time of year and in that it was not produced by either a hurricane or a tropical cyclone. The death toll among people settled on slopes and on low-lying lands was very high (ibid). The metropolitan area of Caracas occupies a valley measuring approximately 30 kilometres east to west and five kilometres north to south. Although it is a relatively small area, coordination between

different administrative units (municipalities) has proved difficult. Several efforts are underway but there are difficulties in translating a theoretical model of risk management into practice (Jiménez 2006).

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The south of South America is the world's region with highest increase in annual precipitation during the 20<sup>th</sup> century (Giorgi 2003) affecting the hydrological balance in the region, especially in the Rio de la Plata basin. There is agreement amongst most scholars of the region that increased precipitation and floods, and changes in wind and precipitation patterns, are associated with climate change and will increase the risks faced by large sections of the region's population. Many urban centres here including cities such as Buenos Aires, Santa Fe and Rosario are already experiencing the effects. These cities, like so many others, were founded on the margins of major rivers on high land, but as they grew, so settlements occupied low lands and flood plains.

Buenos Aires has had a significant increase in annual rainfall over recent decades, and increasing numbers of intense rainfall events (for example, more than 100 millimetres in 24 hours) (Rebagliati 2003). Applying the DesInventar methodology that includes disasters that do not get included in official disaster records, between 1990 and 1998, 24 flood events occurred, affecting neighbourhoods of different income levels (Herzer and Clichevsky 2001). Other data indicate that between 1985 and January 2003, 35 flood events affected the metropolitan region (Rebagliati 2003). The areas most at risk are the low-lying lands of the lower basins of the rivers Reconquista and Matanza-Riachuelo and these lands have high concentrations of informal settlements (Re and Menéndez 2007). Also at risk are the city areas crossed by local streams that drain to the Rio de la Plata. Historically these areas also were inundated and therefore settled by low-income population. Later most of these streams were channeled and covered; the area was upgraded and a middle income population moved in. However, due to a lack of completion and expansion of infrastructure works and maintenance, floods are again a recurrent problem. Not many in depth studies have looked at flood events from the perspective of those most affected (Gentile and González 2001). But the location of informal settlements within the metropolitan area historically has been on disadvantaged lands, including low-lying coastal lands. Also, a study of vulnerability and risk management in the consolidated neighbourhoods of La Boca (located in low lying land at the mouth of the Riachuelo river) and others such as Paternal, Villa Crespo, and Palermo (located in the lower basin of the Maldonado river) show that the first is characterized by low – income population, while the other neighbourhoods have middle income residents, though with low income areas (ibid).

Intense rains in January 2006 affected several areas in Bolivia, including the city of Viacha, where the Río Pallina overflowed – a result of heavy rains combined with the dumping of city waste into the watercourse and a lack of cleaning and maintenance. Settlements on the periphery of Viacha have expanded spontaneously and regularization and basic services come after residents have settled; most houses do not have approved plans or legal tenure. Those most affected by the rains were low-income groups, with the disaster occurring at the same time as an economic and political crisis, making it very difficult to implement the needed actions in time. Residents recall former floods in 1985 and 1995, when sewage overflowed onto the streets and damp crept into house foundations, but none were as heavy as the 2006 floods. Demands on local government have been constant.<sup>(5)</sup>

The problem of flooding in many African cities is also worsening. In Accra, Ghana, heavy rains have been starting earlier in the year than usual, and floods frequently disrupt economic activities such as small-scale commerce, petty trading, and artisanal trades, thus affecting the ability to buy food or pay bills. In Kampala, Uganda, the construction of unregulated shelters has reduced the infiltration of rainfall and increased runoff, thereby compounding any increase in rainfall caused by climate change. Residents of low-lying coastal settlements in Lagos, Nigeria, report that flooding has become more frequent; while residents of Maputo, Mozambique also argue that flooding has become worse since 1980 (Douglas *et al* 2008). In Mombasa, Kenya, it is estimated that about 17 percent of the city's land area will be submerged with a sea-level rise of only 0.3 metres, and large additional areas may be rendered uninhabitable as a

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<sup>5</sup> “Rehabilitación urbana en Viacha, La Paz, Bolivia”, accessed 4 December 2007 at <http://www.hic-net.org/document.asp?PID=238>.

result of flooding or water logging, or will become agriculturally unsuitable due to salt stress. This will particularly affect residents of peri-urban areas where agriculture is practised (Awuor *et al* 2008).

*Who lives or works in locations lacking the infrastructure that reduces risk?*

Perhaps two of the best documented aspects of urban development in low- and middle-income nations are first the very large deficit in provision for infrastructure and services and secondly how this deficit is concentrated in informal or illegal settlements. Thus, many of the urban neighbourhoods most at risk from extreme weather are made even more vulnerable by the lack of infrastructure and services, and often by physical changes to the site or its surrounds.

Rather than attempting to summarize a very large literature on this, one case will be given, to highlight impacts that arise from a combination of a lack of attention to infrastructure, increased occupation on hazardous sites and increased climate-related hazards - the case of flooding in the city of Santa Fe in Argentina. This city with around half a million inhabitants has increasingly expanded onto the Río Salado floodplain. To defend itself from floods, it had to create embankments and dykes. A flood in 2003 displaced 139,886 persons (1/3 of the city population) and 27,928 households were affected (Natenzon 2006). Official statistics indicate there were 23 deaths, although local sources suggest there were at least 100 more than this. There were also 180 cases of leptospirosis and 200 cases of hepatitis. Economic losses were estimated at approximately US\$ 1 billion (CEPAL 2003) although actual losses were much larger than this but were hard to measure (for example, work and school days lost and the impossibility of carrying out informal activities to generate income). Among the factors contributing to the flood were increased and more intense rainfall and deforestation and land use changes around the city – but the flood caught the city authorities completely unprepared, even though the Instituto Nacional del Agua (INA) was monitoring water flows and had informed city and provincial government (Asociación Civil Canoa nd). More floods in 2006–2007 also caught the government unprepared: there were several deaths, tens of thousands of people had to be evacuated, highways and roads were flooded and bridges brought down. Again, one-third of the city became a shallow lake – the same part of the city that was hit by the 2003 flood. City authorities recognized that in the last 50 years there had been no official urban land policies and people had settled where and how they could, prioritizing proximity to work places or social networks. But the lack of policies is also a way of doing politics.

The devastating floods experienced by Santa Fe described above were due in part to incomplete or unmaintained infrastructure. Also, where land use has not been regulated, nobody enforced recommendations for avoiding the occupation of low-lying areas. A member of a local foundation complained that local authorities favour the settlement of at-risk areas by bringing piped water and electricity to the neighbourhoods “where they have their loyal voters” (Valente 2007). Infrastructure to defend certain city areas was meant to be in place shortly after 1998 but was never completed because of a lack of resources; and the construction of road infrastructure, such as the highway connecting the city with Rosario, created barriers to water runoff. Five years previously, studies had pointed to the need to double the size of the highway’s bridges. The pumps and drainage systems installed to evacuate water in protected areas did not work because of vandalism and lack of maintenance (Natenzon 2006). Here, as in most cities, the vulnerability of large sections of the population to extreme weather is related not only to obvious economic and social factors but also to a complex mix of political factors that include a long tradition of clientelism that inhibits accountability and transparency (and excludes many groups), a lack of trust among much of the population in government institutions and civil servants and elected local politicians with a focus on the short term. “It is hard to gain votes by pointing out that a disaster did not happen” (Christoplos *et al* 2001).

Besides the fact that basic services and infrastructure such as piped water and sanitation and proper waste collection and disposal decrease health risks, when they are in place, excess water drains more easily, cesspits do not overflow and wastes do not clog drains. In Latin America, sanitation has improved; however in 2004, 125 million people (14 per cent of the urban population) still lacked a basic sanitation system (Noticias de Latinoamérica 2007) and a significantly higher proportion lacked good quality provision for sanitation and drainage (UN Habitat 2003b). The deficits in provision for water, sanitation

and drainage are much larger in Africa and Asia and affect a much higher proportion of their urban populations (ibid).

*Who lacks information, capacity and opportunity to take immediate short-term measures to limit impacts?*

The devastation caused in so many low-income settlements by extreme weather is not necessarily a matter of a lack of knowledge or capacities on the part of their residents, although this may be the case for some new arrivals. Residents of informal settlements are often reluctant to move away from their homes in response to an approaching storm or likelihood of a flood, even when advised to do so – for instance, for fear of losing valuables to looters, uncertainty about provisioning for their needs in the places they move to and the worry of not being allowed back if their house and settlement are damaged. There are also uncertainties about what the weather forecast actually implies for each home and household, so decisions are made in the context of stress and considerable uncertainty.

These uncertainties are not necessarily removed by official mechanisms to inform the population on how to prepare and react in cases of disaster. In the case of the floods in Santa Fe, the accuracy of the information was in doubt. In addition, the lack of appropriate information and official evacuation mechanisms stopped many from evacuating promptly. The sense of insecurity for those living in informal settlements and the knowledge that looting usually accompanies flooding made many stay to protect their homes and assets (as also documented in other places). There is also the worry that they will not be allowed to return to their homes or settlement or that they will be relocated to other city areas far away from social and family networks, work and schools.

In the case of a low-income community (EL Zanjón) on the banks of the Matanza Riachuelo River in Buenos Aires, the lack of advance warning has long hindered them from taking appropriate action before floods arrive. In 2004, the neighbourhood was flooded and local inhabitants reported that they never knew in advance when the floods were coming even though there was official information regarding precipitation, tides and water levels (Simms and Reid 2006).

There are also examples of low-income populations that lack the knowledge to cope with risk. For example, in Brazil, new migrant populations from the arid northeast, with no personal experience of mudslides, arrive in Rio de Janeiro and settle on hillsides. As they clear these areas for their homes, they remove the protective vegetation cover despite government efforts to protect these areas. The lack of personal knowledge of local risk and of appropriate building techniques hinders safer practices – although many other factors also contribute, including the prevalence of crime and violence that inhibit social cohesion. Over the last 15 years, there have been large public programmes to improve conditions in the *favelas*, including investment in basic infrastructure, health and education for half a million poor residents (De Sherbinin et al 2007).

*Whose homes and neighbourhoods face greatest risks when impacts occur?*

Studies of disaster impacts from extreme weather in urban areas suggest that most of those who are killed or seriously injured and most of those that lose most or all their assets are from low-income groups (Satterthwaite et al 2007, ISDR 2009). Indeed, many disasters only impact the inhabitants of particular informal settlements.

In informal settlements, houses are usually built incrementally over a number of years, with diverse materials and often without following accepted techniques for safe housing. These houses rarely comply with official safety standards and there are no controls in place. Most buildings are used intensively – with high levels of overcrowding and a mix of living and working spaces. This is often combined with a lack of maintenance and with environmental conditions (e.g. humidity from proximity to river edges and coastal areas) that cause rapid deterioration. Houses are not as solid or as insulated as they should be and are often built on inadequate foundations (many on landfill or unstable land). For instance, most informal housing begins as a single storey structure, often using many temporary materials and with little attention given to foundations; over time it is common for this to develop into more consolidated structures with

more than one storey – but it is difficult to ‘retrofit’ the foundations and structural elements needed for safe multi-storey dwellings.

It is also difficult within informal settlements to get the needed coordination between all those living there for needed site-wide measures. In the suburbs of Buenos Aires, in low-lying lands, each resident contracts trucks to bring solid waste to their piece of land and later compact it as best they can. There is no coordination between neighbours, so plots end up on different levels; when it rains, some are flooded more than others. The natural drainage of the larger site is modified without incorporating the needed drainage infrastructure. Families often end up with water in their houses for up to a day when heavy (but not exceptional) rains occur. Houses built on stilts are rare in Buenos Aires – although there are examples, mostly in traditional low-income coastal areas. Most relatively new low-income settlements have not incorporated such measures, although building two-storey houses would allow valuable assets to be moved to the higher floor. However, this cannot always be done because of the costs and skills necessary to build two-storey houses.

Most low-income groups live in housing without air-conditioning or adequate insulation, and during heat waves, the very young, the elderly and people in poor health are particularly at risk (Bartlett 2008a). Here, attention is needed both to the spatial distribution of those most at risk and the spatial distribution of homes facing the highest temperatures and the least possibilities of temperature control. In most cities, a proportion of the low-income population live in tenements or cheap boarding houses in central districts with very high densities and these are often part of ‘heat-islands.’ “The ‘urban heat island’ effect is caused by day time heat being retained by the fabric of the buildings and by a reduction in cooling vegetation ..... In tropical cities, the mean monthly urban heat island intensities can reach 10°C by the end of the night, especially during the dry season” (Kovats and Akhtar 2008:165).

In northern Mexico, heat waves have been correlated with increases in mortality rates; in Buenos Aires, 10 per cent of summer deaths are associated with heat stress; and records show increases in the incidence of diarrhoea in Peru (Mata and Nobre 2006). Cold spells are also becoming more frequent in some locations, and without proper heating and housing insulation they are also difficult to cope with. In July 2007, it snowed in Buenos Aires for the first time in almost 100 years. There are no available data, however, on death tolls and health impacts related to unusual and extreme temperatures.

The expansion of the range of dengue, malaria and other communicable diseases is related to changes in temperature and precipitation. No studies that we know of specifically associate disease risks and vulnerability to climate change. However, we can assume that low-income groups will be most at risk as they live and work in homes and neighbourhoods where public health measures to eliminate disease vectors are absent or ineffective.

#### *Who is least able to cope with impacts?*

The increased health risks noted above become all the more serious if those who get sick (or injured by extreme events) have to rely on overtaxed and often ineffective health care systems, and lose school and work days to health problems that should have been prevented. Here the speed and effectiveness of post-disaster response has such relevance for helping the groups affected to cope with the impacts – for instance in making immediate provision for safe locations for those who have been displaced, in rapid and effective treatment for those who are injured and in supporting those who have been displaced to plan and implement their own individual, household and community recovery (Reyos 2009). For most disasters, all the above depends on local capacities because they do not attract the attention of international agencies (ISDR 2009).

Obviously, those with the lowest paying jobs in the informal economy face particular difficulties in coping. Most of those who work in the informal economy lack health insurance to cover income lost to illness, injury or death. Income lost to illness or injury or the accidental death of an income-earner remains one of the most common causes of impoverishment; so too are the additional costs imposed on households with sick or injured members from health care and medicines (see for instance Pryer 1993, 2003).

The vulnerability of low-income individuals or households to virtually all stresses and shocks, including those that are climate-related, is influenced not only by income-levels but also by the scale and nature of the assets they possess or can draw on. The asset-portfolios of individuals, households and communities are a key determinant of their adaptive capacity both to reduce risk and to cope with and adapt to increased risk levels (Moser and Satterthwaite 2008). Here, assets “are not simply resources that people use to build livelihoods: they give them the capability to be and act” (Bebbington 1999, page 2029). This is a point to which this paper returns in the final sections.

The factors influencing who is least able to cope with climate-change related impacts can be divided into **personal** or **situational**. Personal factors are related to the characteristics of the individual who may be affected. Age is perhaps the most important of these – and will be discussed in detail below. Existing health problems and disabilities, including mental difficulties resulting in impaired cognition, can also reduce the capacity of people to respond in emergencies. Situational factors may include housing (the type of building and its condition) and the work environment. People in certain occupations are particularly vulnerable to heat stress, including those involved in heavy manual labour such as rickshaw-pullers (Begum and Sen 2005). However, a broad range of social factors also affect vulnerability, with people living alone or with limited family or social networks facing more difficulties in coping with shocks and stresses, including those related to climate change. Among the groups that have particularly high levels of vulnerability to some or most aspects of climate change are children, women and migrants; separate sections later in this paper consider why this is so. Low-income groups in general, women, children and the elderly seldom have much influence in regard to what is done for disaster preparedness or responses.

*Who is least able to adapt to avoid impacts?*

The large differentials between locations within and around most cities in the scale and nature of climate-related hazards and in the quality of housing, infrastructure and services means that where you live or work influences your level of risk. This means that households and enterprises can ‘buy’ their way out of risk by choosing safer sites and sites with good quality buildings and infrastructure. ‘Good governance’ should be able to greatly diminish these spatial differences in risk, for instance by ensuring that low-income groups can find accommodation in safe sites with good infrastructure.

So in large part, adaptation capacity relates to being in or moving to low-risk locations. Most larger companies and corporations can move from a city-site or city if climate-change risks increase. It is possible to envisage a trend in new investments by larger companies and corporations away from cities and city-sites most at risk from floods, storms and sea-level rise that will hardly affect their operations. They have long been adept at shifting production to locations where profits are maximized and it is easy for them to factor in risks from climate change. But it is difficult to conceive of how many of the largest successful coastal cities most at risk from storms and sea level rise will manage. Cities such as Mumbai, Shanghai and Dhaka are very vulnerable to sea-level rise. All are very large (each has well over 10 million inhabitants), all have had considerable economic success in the last few decades, all have great importance to their nations’ economies and cultures, all concentrate very large investments and economic interests. Many other cities that have great economic importance for their nation face similar problems – for instance Alexandria, Dar es Salaam and many cities on the coast of West Africa. Most residents and smaller businesses have far less possibilities of moving – and face far more serious losses if the value of their properties decline. Many low-income households have their livelihoods and assets tied to particular cities or city sites. Meanwhile, the movement out of larger companies and corporations also threatens the city’s economic base and the livelihoods of those who worked for these companies or provided goods and services to them or their workforces (Satterthwaite et al 2007).

In many cities, middle- and high-income groups also settle in some neighbourhoods in risk areas near rivers or coastal areas or on slopes, but they have a choice and the assets (capital, contacts, power etc.) to reinforce their house structures, get protective infrastructure, and lobby for policies and actions that protect their homes and neighbourhoods; their homes and possessions are also often protected by insurance (although if hazard-levels increase, insurance premiums will go up or may not be available).

## **Age and Vulnerability<sup>6</sup>**

Children, especially young children, are in a stage of rapid development and are less well equipped on many fronts to deal with deprivation and stress. Their more rapid metabolisms, immature organs and nervous systems, developing cognition, limited experience and behavioural characteristics are all at issue here. Their exposure to various risks is also more likely than with adults to have long-term repercussions. Almost all the disproportionate implications for children are intensified by poverty and the difficult choices low-income households make as they adapt to more challenging conditions. Events that might have little or no effect on children in high-income countries and communities can have critical implications for children in poverty.

Urban children are generally better off than their rural counterparts, but this is not true for the hundreds of millions living in urban poverty. Without adequate planning and good governance, poor urban areas can be among the world's most life-threatening environments (Hardoy et al 1990, Van den Poel et al 2007). In some informal settlements, a quarter of all children still die before the age of five. Nor does the "urban advantage" come into play in terms of education and life opportunities for most of those in poverty. In many urban areas, the risks children face are likely to be intensified by climate change.

Although children are disproportionately at risk on many fronts, it is a mistake to think of them only as victims in the face of climate change. With adequate support and protection, children can also be extraordinarily resilient in the face of stresses and shocks. Moreover, there is ample documentation on the benefits of having children and young people active, informed and involved in responding to the challenges in their lives, not only for their own learning and development but also for the energy, resourcefulness and knowledge that they can bring to local issues.

There is not enough hard knowledge about the implications of climate change for children to present a comprehensive picture. Even where more general impacts are projected, figures are seldom disaggregated by age. But it is possible to extrapolate from existing knowledge in related areas: work on environmental health in urban areas, disaster responses, household coping strategies, the effects on children of urban poverty, children's resilience, and the beneficial effects of their participation in various efforts all contribute to a picture of the implications of disasters as well as more gradual changes, and the adaptations likely to be made.

However, various events associated with climate change have clear impacts on child health and survival:

- *Mortality in extreme events:* In low-income and many middle-income countries, the loss of life is shown repeatedly to be disproportionately high among children, women and the elderly, especially among the poor during such extreme events as flooding, high winds and landslides. A study of flood-related mortalities in Nepal, for instance, found that the death rate for children aged two to nine was more than double that of adults; and pre-school girls were five times more likely to die than adult men. The risk for poor households was six times that of higher-income households (Pradhan et al 2007).
- *Water and sanitation-related illnesses:* Children under five are the main victims (80 per cent globally) of sanitation-related illnesses (diarrhoeal disease primarily) (Murray and Lopez 1996) because of their less developed immunity and because their play behaviour can bring them into contact with pathogens. This also results in higher levels of malnutrition and increased vulnerability to other illnesses, with effects on overall development. Droughts, heavy or prolonged rains, flooding and conditions after disasters all intensify the risks, which are already very high in poor urban areas; so too may climate-change related constraints on fresh water supplies in many urban centres.
- *Malaria and other tropical diseases:* Warmer average temperatures are expanding the areas where many tropical diseases can occur, with children most often the victims. In many locations, the most

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<sup>6</sup> This draws directly from Bartlett 2008b

serious threat is malaria. Up to 50 per cent of the world's population is now considered to be at risk. In Africa, 65 per cent of mortality is among children under five (Breman et al 2004). Malaria also increases the severity of other diseases, more than doubling overall mortality for young children.

- *Heat stress:* Young children, along with the elderly, are at highest risk from heat stress. Research in São Paulo found that for every degree increase above 20°C, there was a 2.6 per cent increase in overall mortality in children under 15 (same as for those over 65.) (Gouveia et al 2003). Risks for younger children are higher. Those in poor urban areas may be at highest risk because of the “urban heat-island” effect, high levels of congestion and little open space and vegetation (Kovats and Akhtar 2008)
- *Malnutrition:* Malnutrition results from food shortages (for instance as a result of reduced rainfall, other changes affecting agriculture, interruptions in supplies during sudden acute events) and is also closely tied to unsanitary conditions and to children's general state of health. If children are already undernourished, they are less likely to withstand the stress of an extreme event. Malnutrition increases vulnerability on every front and can result in long-term physical and mental stunting.
- *Injury:* After extreme events, injury rates go up. Children, because of their size and developmental immaturity, are particularly susceptible and are more likely to experience serious and long-term effects (from burns, broken bones, head injuries, for example) because of their size and physiological immaturity (Berger and Mohan 1996).
- *Quality of care:* As conditions become more challenging to health, so do the burdens faced by caregivers. These problems are seldom faced one at a time – risk factors generally exist in clusters. Overstretched and exhausted caregivers are more likely to leave children unsupervised and to cut corners in all the chores that are necessary for healthy living.

For some children in some places, the added challenges brought by climate change could contribute to an erosion of both their mental capacity and their opportunities for learning and growth. Abundant research relates lower cognitive capacity and performance to under nutrition, intestinal parasites, diarrhoeal diseases, malaria, maternal health and nutrition during pregnancy, as well as maternal stress during and after pregnancy. Learning is also dependent on supportive social and physical environments and the opportunities to master new skills. When supportive environments break down, so do opportunities for engagement in purposeful goal-directed activities. Disaster can also result in the interruption of formal schooling for months at a time, and children are more likely to be withdrawn from school when households face shocks.

Levels of psychological vulnerability and resilience depend on children's health and internal strengths as well as household dynamics and levels of social support. Children who have experienced success and approval in their lives are more likely to adapt well than those who have suffered rejection and failure. Poverty and social status can play an important role in this regard. But without question, the losses, hardships and uncertainties surrounding stressful events can have high costs for children. Increased levels of irritability, withdrawal and family conflict are not unusual after disasters. Even gradually worsening conditions can contribute to mental health problems, which are closely tied to unpredictability, uncertainty and general insecurity. High stress for adults can have serious implications for children, contributing to higher levels of neglect. Increased rates of child abuse have long been associated with such factors as parental depression, increased poverty, loss of property or a breakdown in social support.

Displacement and life in emergency or transitional housing have been noted in many contexts to lead to an erosion of the social controls that normally regulate behaviour within households and communities. Overcrowding, chaotic conditions, lack of privacy and the collapse of regular routines can contribute to anger, frustration and violence. Adolescent girls especially report sexual harassment and abuse. The synergistic and cumulative effects of such physical and social stressors can affect children's development on all fronts. As the numbers of displaced people grow, these dysfunctional environments are likely to become the setting within which more and more children spend their early years. Children's capacity to cope well in these difficult situations has been related to their own active engagement, opportunities for problem solving and for interaction with peers, and the presence of at least one consistently supportive adult in their lives.

Even less extreme events can create havoc in families' lives, deepening the level of poverty. When times are hard, children can become an asset that is drawn on to maintain the stability of the household. Children may be pulled from school to work or take care of siblings. Some children may be considered more "expendable" than others. Many of Bombay's young prostitutes are from poor rural villages in Nepal, where inadequate crop yields lead families to sacrifice one child so others may survive.

### ***Gender and vulnerability***

In most urban centres, there are large differences between women and men in regard to their exposure to climate-related hazards, and their capacity to avoid, cope with or adapt to them. It usually falls to women and often to older girls to cope with all the increased risks and vulnerabilities facing children. Within low-income populations, women often have particular risks and vulnerabilities related to gender relations – because of the tasks they undertake and the responsibilities they bear, the discrimination they face in accessing jobs (which also means lower incomes), resources (for instance property titles or control of income or expenditure within households) and services, and their generally lower status within many households and communities,

One indicator pointing to the higher burdens and stresses faced by women is the evidence globally of the higher incidence of mental health problems among women, especially poor women in low income countries (WHO 2001). This evidence is not specifically related to climate change, but many of the risk factors for such common mental problems as anxiety, depression, insomnia and irritability are likely to be exacerbated by some of the effects of climate change. There is growing evidence, for instance, both from high- and low-income countries, of significant associations for women between food insecurity and anxiety and depression (Heflin et al 2005; Hadley and Patil 2007). More generally, these common mental health problems are considered to be related to unpredictability, uncertainty and general insecurity (Patel et al 1999, WHO 2001). These factors are undoubtedly intensified by many of the effects of climate change. Women also speak of the punishing workloads they face in the context of poverty and adversity, and the resulting fatigue, anxiety and "problems of the mind" that characterize their days. They describe headaches, unhappiness, disturbed sleep patterns and just "thinking too much" as undermining their capacity to cope adequately with their lives and their children (Aidoo and Harpham 2001; Avotri and Waters 1999). Mental health problems obviously also affect men; yet the particular gender-related burdens faced by women may increase their vulnerability to climate-related shocks and stresses.

These stresses and vulnerabilities often become most evident after events that destroy or damage homes and neighbourhoods.. When homes are destroyed or damaged, this often affects women's incomes more than men's as they undertake income-earning activities from home and so lose the income when the house or the equipment they used is lost. As noted above, where women take most responsibility for children, they are more constrained in their capacity to move rapidly – for instance to avoid flood waters. Women generally spend more time in and around the home because they have most of the child rearing and house management tasks and/or work from home; in some societies, women are constrained by social norms from being able to leave the home. Where homes and settlements are at particular risk from climate shocks, these factors all act to increase the level of risk faced by women. This helps to explain why many climate-disasters have mortality rates among women significantly higher than for men. Although the Indian Ocean Tsunami was not related to climate change, its impacts illustrate differentials in vulnerability; in India, Indonesia and Sri Lanka, Oxfam America found mortality in women was between three and four times that of men (Renton and Palmer 2005).

For populations that have to move – either temporarily or permanently – it is rare for women's needs and priorities to be addressed or even considered in the temporary or resettlement accommodation. There are also case studies showing the particular disadvantages and risks that women face after disasters – and, within this, instances of the particular problems faced by women-headed households and widows (Enarson, 2004). Within the chaos of temporary camps and even of more permanent resettlement, little attention is paid to housing, settlement forms and services that address the personal safety of girls and women, with higher risk of gender-based violence, abuse and maltreatment associated with household stress and/or displacement (Bartlett 2008a, 2008b). Child-rearing and domestic responsibilities can

become even more onerous and time consuming in this context, with greater difficulties, for instance, in getting food, fuel and water,.. At the same time women “struggle in the fast-closing post-disaster ‘window of opportunity’ for personal security, land rights, secure housing, employment, job training, decision-making power, mobility, autonomy, and a voice in the reconstruction process” (Enarson and Meyreles 2004, page 69).

Equally problematic is the failure to recognize women’s individual and collective capacities for recovery and reconstruction as community leaders, neighbourhood networkers, producers, gardeners, rainwater harvesters, and monitors of flood prone rivers. This means that their resources, capacities, assets and hard-won knowledge about how to make life safer and live with risk are all ignored. Examples show that supporting women’s involvement in reconstruction and in rebuilding their livelihoods not only benefits women but also their communities (Enarson 2004).

## **The Social Implications of Responses to Climate Change**

Not only will climate change have differential impacts within society but so too will responses to it – both mitigation and adaptation. Mitigation refers to interventions intended to reduce greenhouse gas emissions and enhance greenhouse gas sinks – in other words, to reduce and eventually stop global warming (and rising GHG gas concentrations in the atmosphere). Adaptation involves responding to actual or expected climate change to reduce harmful impacts – or managing the unavoidable consequences of this process. In effect, mitigation is reducing the hazards, adaptation is reducing vulnerability to the hazards.

Climate change practitioners have begun to recognise the potential for co-benefits between mitigation and adaptation activities (Wilbanks and Sathaye 2007, Klein *et al* 2007) – indeed, the IPCC’s 2007 (Fourth) Assessment concluded that creating synergies between adaptation and mitigation can increase the cost-effectiveness of actions and make them more attractive to stakeholders, including potential funding agencies (Klein *et al* 2007). But most of this synergy is in wealthier nations; in most urban areas in low-income nations, there is not much to mitigate because greenhouse gas emissions are so low. Similarly, there has been some interest in the concept of ‘high value adaptations’ – adaptations that have the potential to provide benefits across many risks, and that can meet a variety of needs in a complementary and cost-effective manner (City of Melbourne 2008). To date, however, the linkages have tended to be seen as facilitating economic and efficiency advantages – rather than explicitly generating social co-benefits. There are a few examples of initiatives seeking to demonstrate co-benefits – for instance a waste-to-compost project in Bangladesh where methane emissions are reduced through the process of composting, which also generates new employment opportunities in urban areas; whilst the compost meets adaptation needs through soil improvement in drought-prone areas (Ayers and Huq 2008). But this initiative does not directly address the high-risks faced but by so much of Bangladesh’s population and a pressure from funders for co-benefit initiatives may well not address the most pressing adaptation needs.

The following sections examine the social and political implications of mitigation and the potential social consequences of adaptation, both formal and informal. Mitigation and adaptation both incur costs – but both also have the potential to provide a broader suite of benefits in both the short- and the long-term. Yet mitigation and adaptation projects also need to be assessed critically to examine the consequences that these may have for different social groups. There are few specific examples of these assessments – largely because there have been only a limited number of projects of this type in cities in low- and middle-income countries. But investments in flood protection often serve only a portion of the city’s population and businesses – as is the case in such investments to date in Dhaka (Alam and Rabbani 2007). There are many examples of ‘environmental’ projects in cities that have served only the narrow interests of wealthier groups, or that have included an active anti-poor political agenda. Indeed, while many traditional approaches to improve urban environmental health (e.g. subsidising public water, sewers and conventional solid waste collection) can undermine sustainability, some of the new approaches promoted by those concerned primarily with ecological sustainability (e.g. demand management applied to water when much of the population lack piped supplies) can undermine the

health of the urban poor (McGranahan and Satterthwaite 2000). David Harvey (1996: 182) states the case somewhat bluntly: “A cynical observer might be tempted to conclude that discussion of the environmental issue is nothing more than a covert way of introducing particular social and political projects by raising the specter of an ecological crisis or of legitimizing solutions by appeal to the authority of nature-imposed necessity”. An extreme example of this is Operation Murambatsvina in Zimbabwe, characterized by government officials as a ‘clean up’ to reduce the spread of infectious diseases; yet this was actually one of the largest and most violent examples of forcible slum clearance driven by political motives (Tibaijuka 2005). The large-scale evictions in Delhi in recent years have in part been justified on environmental grounds, as low-income groups and their informal settlements are accused of pollution they did not create, but these primarily serve middle-class interests and increase poverty (Bhan 2009). In Surabaya, the city government has been seeking to clear long-established low-income settlements along the riverside by claiming that they are responsible for polluting the river and filling it with waste (which in turn increases flooding) even though the inhabitants of these settlements make little contribution to these problems (PWS and Sauter, forthcoming).

Urban policies have a key role in both adaptation and mitigation, particularly as urban areas concentrate more than half the world’s population and more than 90 percent of the value of economic activities.<sup>7</sup> Although many estimates of the contribution of cities to global anthropogenic greenhouse gas emissions over-state their responsibility and under-state the contribution of smaller urban centres and rural areas (Satterthwaite 2008b, Dodman 2009), the extent of the population living in cities and the concentration of production and of populations with high-consumption lifestyles in cities means that they have a key role to play in the reduction of greenhouse gas emissions. (Although so too do urban centres too small to be cities and rural areas, especially those that concentrate high-income groups). Good land-use and transportation planning can contribute to reducing urban carbon footprints, and can de-link economic success from high greenhouse gas emissions. Urban authorities also have a key role in developing and enforcing appropriate building standards and regulations that can encourage energy efficient buildings and reduce emissions from industry, commerce, and services.

### ***The Social and Political Implications of Mitigation***

As part of a broader, long-term policy of responding to climate change, there is obviously a role for mitigation in all city development strategies. But for most urban centres in low- and middle-income nations, a focus on building the capacity of individuals, households, community organizations and local governments to respond to climate change through adaptation is a much higher priority. For most urban centres in low- and middle-income nations, an emphasis on mitigation is not only unfair – given that these urban centres and their residents have made minimal contributions to greenhouse gas emissions – but also ineffective (because there is not much to mitigate).

Effective responses to climate change require both adaptation and mitigation. Mitigation can be considered the most important contribution to adaptation, because if it is successful on a global scale, it can greatly reduce the need for adaptation in almost all localities. This would be particularly valuable to the many cities, smaller urban centres and rural areas in low-income nations that have so little adaptation capacity, however much funding the international system might make available to them. The difficulties in building adaptive capacity in many of the urban centres most at risk from climate change (especially for low-income groups) adds greatly to the urgency of achieving global agreements that rapidly reduce total greenhouse gas emissions and avoid ‘dangerous’ climate change. But greenhouse gas emission reduction of the scale and speed needed to avoid this is very unlikely, in large part because this necessitates substantial constraints on high-consumption lifestyles in high-income nations and with the main benefits being less increase in risk levels for low-income groups in low- and middle-income nations.

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<sup>7</sup> Industry and services account for 97 percent of industry and services (Satterthwaite 2007) and most industries and service enterprises are in urban areas

The anticipated increase in the urban population in low- and middle-income nations over the coming decades (which will accommodate most of the global growth in population) means that greenhouse gas reduction measures will need to be adopted here too, if dangerous levels of climate change are to be avoided. Successful mitigation globally depends on ensuring that the development of urban centres in low- and middle-income nations do not mirror the resource-hungry and carbon-intensive development pathways of urban centres elsewhere.

However, there are two areas in which mitigation might have serious social consequences for urban populations in low- and middle-income nations: first, if mitigation detracts attention from adaptation; and secondly, if mitigation measures have damaging impacts on sections of the urban population (for instance through the eviction of urban poor groups from 'unsafe' sites). In particular, authorities in some of the larger cities in middle-income cities appear to place a particularly high priority on mitigation as their response to climate change – at least partially in response to highly publicised global initiatives that appear to generate positive publicity and provide an entry point into an elite group of cities.

There is some recognition that climate change mitigation efforts may have disproportionately negative impacts on some of the groups that are most vulnerable to climate change impacts. The Overseas Development Institute notes that “for the world’s poor, policies to mitigate climate change may, in the short term, have as much impact as climate change itself” – particularly in the areas of green growth strategies, environmental labelling policies, biofuel production policies and forest carbon policies (Prowse and Peskett 2008: 1). An increasing emphasis in high-income nations on imported goods meeting externally-audited environmental standards may hugely disadvantage many small producers from low-income nations.

Mayors and city officials around the world dream of transforming ‘their city’ into a ‘world class city’. In this, they are often much influenced by ‘successful’ cities that they have visited or read about, such as Dubai, Singapore or Shanghai. This often leads to city government support for projects, programmes, and partnerships with powerful private-sector interests that have very large carbon footprints (in their construction and functioning) and also do little or nothing to address the key needs of low-income urban residents (including addressing the infrastructure deficit). In many cases, city governments view the poor, their settlements, and their income-generating activities as ‘the problem’ (even as these same people are central to the city’s economy and their settlements and livelihoods have very small carbon footprints). This situation is often exacerbated by strong middle class interests that push city and municipal governments towards positions that are anti-poor, anti-vendors, anti-street, anti-pedestrian, and anti-mixed use (Hasan 2005).

Singapore has long served as an example that captures the imagination of politicians and developers. But this is without any recognition of what has actually underpinned Singapore’s development - one of the fastest growing economies in the world over a long period, a very small population, almost entirely urban, and so no rapid rural-urban migration boosting the city’s population growth, and much of the land in public ownership. More recently, Shanghai and Dubai have increasingly been used as examples to which cities should aspire, but these are hardly models of participatory democracy and again, these are within nations that have enjoyed very rapid growth over decades. If ‘city development’ so often involves massive evictions of low-income groups (see Hasan 2005, du Plessis 2005, Bhan 2009), it is likely that official responses to mitigation (and adaptation) may also be similarly anti-poor.

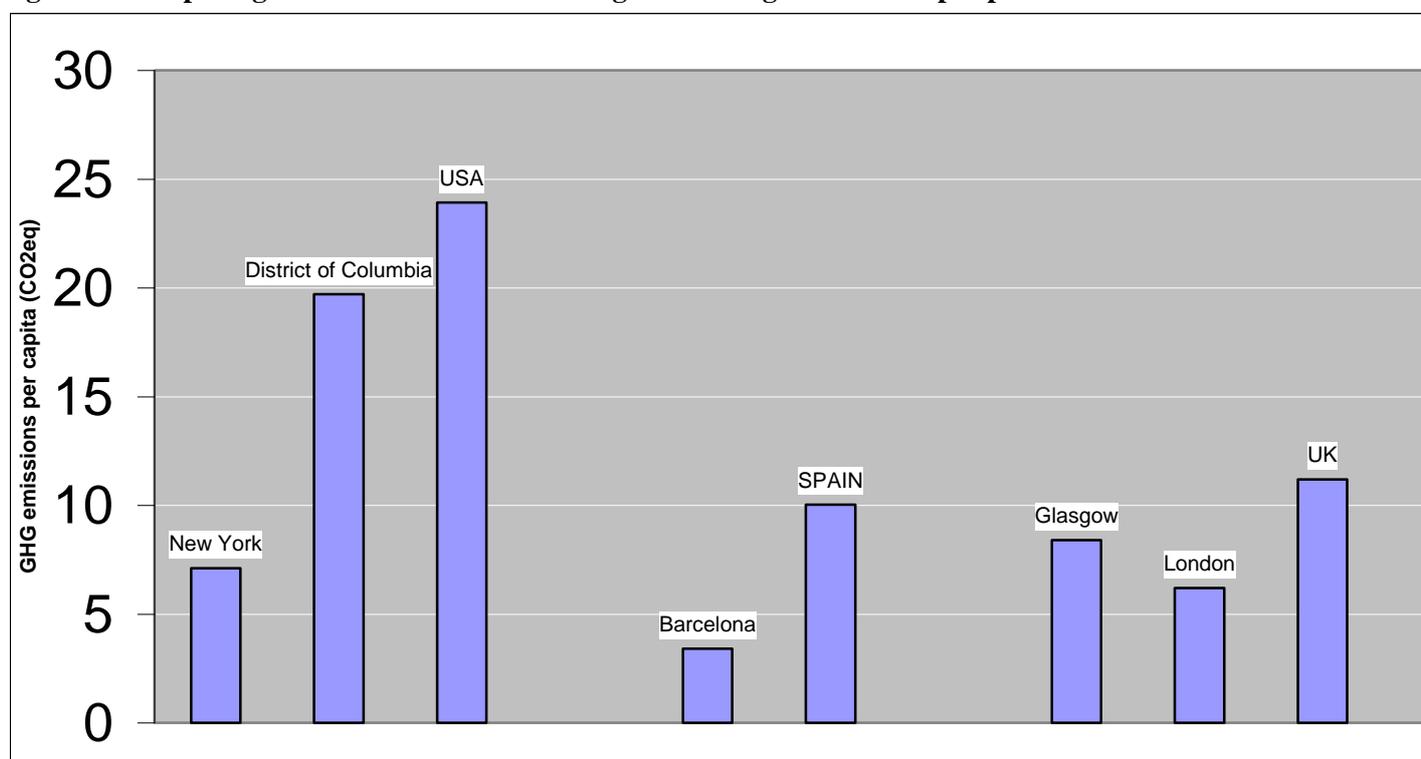
Many urban authorities in high-income nations have, quite rightly, made significant statements and efforts in relation to the reduction of greenhouse gas emissions. Although international relations approaches to addressing climate change, such as those overseen by the United Nations Framework Convention on Climate Change (UNFCCC), have tended to treat the nation state as a single unit, many cities have been successful at pursuing mitigation goals separate and apart from those committed to at a national scale (Bulkeley and Betsill 2004). In New York City, Mayor Michael Bloomberg has made a commitment to reduce the city’s emissions by 30 percent below 2005 levels by 2030 (PlaNYC 2007), despite the expected increase in population of almost a million people in the same period. London has set a target of achieving a 60 percent reduction from 2000 levels by 2050 (Mayor of London 2007). Some similar efforts can also be seen in low- and middle-income nations: for example, the Mayor of

Makati City (in Metro-Manila, Philippines), Jejomar Binay, announced the intention of his city to reduce its greenhouse gas emissions by 20 percent by 2010.<sup>8</sup>

However, for most low-income nations and many middle-income nations, greenhouse gas emissions are so low that there is not much to mitigate. Many low-income nations have emissions per capita that are less than 1/200<sup>th</sup> that of the United States and Canada.<sup>9</sup> In 2004, per capita carbon dioxide emissions were around 20 tonnes in the United States and Canada, between 10 and 6 tonnes in most European nations – and less than 0.25 tonnes for many nations in sub-Saharan Africa and Asia. Several sub-Saharan African nations have per capita emissions of less than 0.1 tonnes. These nations' per capita figures are also far below the targets for the world average sought for 2030 or 2050 to slow and then stop the increase in carbon dioxide concentrations in the atmosphere. The 100 'Most Vulnerable Countries' (composed of the Least Developed Countries, Small Island Developing States, and Africa) that are home to well over one billion people account for less than five percent of total global emissions (Huq and Ayers 2007).

There is much less data available on GHG emissions per capita for cities. The limited data available show that cities tend to have per capita emissions well below their national averages (see Figure 2) – but there is little data on cities in low- and middle-income nations. Per capita emissions (CO<sub>2</sub>eq) in São Paulo were calculated at 1.5 tonnes per capita in 2003 (Secretaria Municipal do Verde e do Meio Ambiente de São Paulo 2005), while those in the Municipality of Thane, India, were calculated at 1.2 tonnes per year in 2007 (Jantre 2008). These can be compared with national figures of 8.2 tonnes of CO<sub>2</sub>eq per capita in Brazil and 1.33 tonnes of CO<sub>2</sub>eq per capita in India.<sup>10</sup>

**Figure 2: Comparing cities and their nations for greenhouse gas emissions per person**



Source: Dodman 2009. NB Care should be taken in comparing figures for the cities in different nations, due to differences in methodologies for counting and assigning greenhouse gas emissions.

<sup>8</sup> *Manila Bulletin* 8/10/08

<sup>9</sup> The figures on per capita carbon dioxide emissions are drawn from World Development Indicators On-line; <https://publications.worldbank.org/e-commerce/>

<sup>10</sup> national figures 1994, accessed from [http://unstats.un.org/unsd/environment/air\\_greenhouse\\_emissions.htm](http://unstats.un.org/unsd/environment/air_greenhouse_emissions.htm)

In many urban centres and countries, a focus on mitigation so often promoted by northern-based initiatives may serve to divert attention from the more immediate issues of adaptation, and particularly how climate change is likely to affect the urban and rural poor. It is also easier for international agencies to promote mitigation than to promote the much needed but messy, complex process of pro-poor adaptation.

The enthusiasm for promoting mitigation in cities in low- and middle-income nations suggests a need to develop GHG emission inventories for cities. But there are social implications to consider as cities become classified and ranked by their GHG emissions and per capita emissions. Allocating to cities the GHG emissions arising from production within their borders puts cities producing energy intensive goods at a disadvantage. So a city that was a centre for the production of (say) windmills, photovoltaic panels and hydrogen-powered buses would have the greenhouse gas emissions that go into their fabrication counted as the responsibility of that city but the city would not get credited with the GHG emissions reduced by the use of its products in other locations. Meanwhile, a city with a high concentration of people with high-consumption lifestyles would have its GHG emissions kept down if most of the goods used in the city that have large carbon footprints are imported. In addition, if a city's performance in GHG emissions or in emissions reduction becomes important in, for instance, attracting investment or obtaining concessional finance, there are so many ways in which figures can be tweaked – for instance by the choice of city boundaries (e.g. excluding wealthy low-density suburbs with very high private automobile ownership and use) or by how particular emissions sources are treated (do cities get allocated the emissions generated by the transport used by commuters who live outside the city or the emissions from airplanes that refuel in that city's airport or the emissions from distant power stations when much of the electricity they generate is used within the city?) More generally, a focus in city-based GHG emissions may encourage a focus on mitigation when for most urban centres in low- and middle-income nations, a much higher priority should be given to adaptation.

Some mitigation may be made to work in favour of the urban poor or to include benefits for them. Shifts in power generation to reduce carbon emissions may also reduce air pollution – especially if these involve a shift from coal and oil-fired power stations with little or no pollution control. Improving and extending public transport and measures to encourage walking and bicycling may also contribute to better air quality and also better meet the mobility needs of low-income urban residents. The TransMilenio public transport system in Bogotá, Colombia has been successful at meeting the needs of the 80 percent of the city's population that is dependent on public transportation, including the 53 percent who are defined as living in poverty (Héron 2006). But obviously, all improvements in public transport serve particular groups and locations better than others and often many of the urban poor get little or no benefit because their neighbourhoods are not served or the fares are too high. A low-income neighbourhood in Montevideo even got named 'barrio nicol' because it had no bus service ('ni colectivo).

It may be that 'slum' and squatter upgrading or new house initiatives that serve low-income groups can also incorporate equipment and design features that limit carbon emissions – as in a housing project in Kuvasa, South Africa where low-cost housing was provided with energy efficient lighting, solar water heaters, and ceiling insulation – while being funded through carbon financing.<sup>11</sup> But care is needed to make sure that what is provided actually meets inhabitants' needs. The past record on this is not so good – for instance the enthusiasm for pushing 'energy efficient stoves' onto low-income households 'to reduce deforestation' that did not work or that failed to meet their needs (see Sarin 1991 for example). And in terms of mitigation effectiveness, it is the middle and upper-income groups that need to use energy efficient lighting, solar water heaters and house designs that minimize the need for heating and cooling, more than the low-income groups, since they are greater energy consumers.

### ***Adaptation; responses and social implications***

Initiatives to adapt to environmental change (including those to which climate change contributes) are undertaken by many actors and at many levels – from large formal government and international agency

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<sup>11</sup> see [www.ssnafrika.org](http://www.ssnafrika.org)

funded efforts to the small risk management decisions made at the household level. These measures affect not only environmental and economic realities; they also have social consequences, and sometimes these may be unexpected or unintended. When the social aspects are taken into consideration, it can provide a different perspective on their practicality or success. For instance, many climate change adaptation strategies advocated by government or donors may actually have unintended negative consequences for the poor. Conversely, a strategy that is most often frowned on by policy makers, i.e. migration, can actually be a constructive way for households to adapt to changing realities

### ***Formal responses; the unintended consequences***

To date, considerations for adaptation have been driven by a discourse of urgency – because of the scale of the potential challenges, and the rapidity with which change may take place. However, a failure to fully consider the outcomes of some of the actions that are being taken or considered to promote adaptation can end up penalizing those who will be (or are already) hardest hit by climate change.

One example of this is the consequences of developing and enforcing more rigorous building and infrastructure standards. Such standards serve an important purpose in ensuring that houses, commercial buildings and infrastructure are safe and provide an adequate standard of protection from weather and other factors. However, a large proportion of the houses in urban areas in low and middle-income countries and most new housing that is constructed do not meet existing standards – and in many cases the problem is not with the houses themselves but with regulations that fail to reflect what is possible locally. One aspect of this is the absence of regulations to deal with the process of incremental construction that is at the core of the strategies adopted by a high proportion of low-income urban residents to obtain housing. There are examples of building-standard changes that have been made in response to dialogues between city authorities and representative organizations of the urban poor (Muller and Mitlin 2007, Manda 2007) but these are exceptions (and were not done in response to climate change but in order to lower prices).

It is very easy to recommend more rigorous building standards as a means of protecting urban residents from the more frequent and more intense extreme weather events anticipated under climate change. However, the likely consequence of this will be to make an even greater proportion of homes and commercial buildings fall outside of the regulations, and to reduce the potential for low-income urban residents to obtain ‘legal’ housing by increasing their costs. Innovative work by architects associated with the Philippines Action for Community Shelter Initiatives has shown how a more flexible approach to structural building standards can lower the costs of housing by up to thirty percent while maintaining an acceptable level of safety, and increasing the ability of urban poor groups to access appropriate housing. One way of achieving this shift is for governments and low-income groups to agree on ‘experimental areas’ in which new standards can be tested for their appropriateness and cost. Some new technologies – such as the use of Interlocking Compressed Earth Blocks (ICEBs) – show the potential for structurally sound buildings that use locally available materials at lower cost, but building regulations may not reflect these local realities or new technologies (Dodman and Mitlin 2009).

A second area is related to the consequences of identifying land as ‘vulnerable’ or at risk. The process of mapping hazards and labelling particular land sites as “at risk” can be contentious and may bring disadvantages to particular low-income settlements. In Khulna, Bangladesh, the presentation of risk maps led to heated discussions as to the particular outcomes of this labelling process. Land-owners were worried that the value of their land would be affected if it was seen to be at risk. Land classified as being at risk from climate change may also lead to calls for the removal of low-income groups from areas in which they have settled for many years. Wealthy landowners, local authorities, and more affluent urban residents may use ‘vulnerability’ as an excuse for displacing low-income groups and getting access to the land they currently occupy. The urban authorities in Nairobi, Kenya have identified land adjacent to river banks as being at risk from climate change and are using this as a motive for removing low-income residents from this location. The paper noted earlier how the city government in Surabaya had tried to evict those living in long-established low-income settlements along the riverside by claiming that they were responsible for polluting the river and causing floods by filling it with waste.

In any expanding urban area, the occupation of dangerous land sites by the urban poor will continue, unless there are safer, affordable alternatives that are also well located in regard to income-earning opportunities. Households in two flood-prone squatter settlements in Dhaka, for instance, were asked to consider the incentives that would encourage them to relocate to safer locations. Despite the extent and difficulty of their experience coping with floods, many residents felt that relocation was simply not feasible without considerable incentives – including free land, grants and long-term employment opportunities (Rashid et al 2004). So measures to increase the supply and reduce the cost of safe and well-located legal land and housing are an important part of facilitating climate change adaptation for the urban poor. The absence of this for many urban residents is a reflection of a broader set of social, political and economic forces that have been in operation for decades – if not longer. Identifying existing land or housing as ‘dangerous’ should be the first step in providing appropriate alternatives, but this should be developed in consultation with those who are at risk, rather than in further displacing this already vulnerable group. There are some good experiences in the Philippines with urban poor organizations (supported by the Philippines Homeless People’s Federation) working with local governments to identify and acquire land sites to rehouse those who lost their homes from disasters that also allow them to rebuild on safe sites (see Reyos 2009). But it would have been better to identify the sites at risk before the disaster and if possible make these sites safe or if this is not possible, support those who live there to move to safer locations.

### *Informal responses*

Of course, individuals and households who live in settlements at risk from storms or floods take measures to reduce the adverse impacts. These include measures to protect their homes and possessions and measures to reduce their exposure to the hazards – for instance moving temporarily to safer sites. Understanding and supporting these individual and household responses to increase their effectiveness are an important part of climate change adaptation. A study of low-income households’ adaptation to flooding in Indore (India) found well-developed temporary and permanent adaptations to flooding including raising plinth levels, using materials and furniture that resist flooding (for instance heavy beds that did not float) and ensuring that shelving and electric wiring are high up on the walls, above expected flood levels. The inhabitants had contingency plans for evacuation if needed – for instance, first the movement of valuables, the elderly, children and animals to higher ground (Stephens, Patnaik and Lewin 1996). But the success of these adaptation measures depends on the residents’ capacity to anticipate flooding and climate change will often change the timing and the volume and speed of floodwaters.

Discussions with those living in informal settlements in a range of cities in Africa found similar responses (as illustrated in the quotes below) and also many residents commenting on the increased unpredictability of flooding (Douglas et al 2008).

*“When we see very dark clouds up the hills, we expect heavy rains to come. So we get ourselves prepared by transferring our valuable things on our very high beds which are reached by climbing ladders. Also children who sleep on the floor are transferred to the high beds.”* Mrs Fatu Turay, Kroo Bay community, Freetown, Sierra Leone (quoted in Douglas et al 2008).

*“As soon as the clouds gather I move with my family to Nima to spend the night there. When the rain starts falling abruptly we turn off the electricity meter in the house. We climb on top of our wardrobes and stay awake till morning .... Our furniture has been custom made to help keep our things dry from the water .... These measures are adaptive strategies as old as I can recollect”* One woman in Alajo, Accra (quoted in Douglas et al 2008).

Of course, the adaptations noted above are pragmatic responses to environmental hazards taken within individual or household considerations influenced by social, economic and political issues. Survival needs and economic priorities often conflict with environmental risk reduction. It is often access to income-earning opportunities that is the main influence on the use of the most environmentally hazardous sites since this is the basis for survival. This also means a large potential for measures to address such environmental hazards impacting on livelihoods or income-levels. The inhabitants of the settlements that so often get flooded in Indore mentioned above want to stay there because the central

location means they are close to jobs and markets for the goods they produce and close to health services and schools; most of the inhabitants also have strong family, kinship and community ties with other local inhabitants. The housing is also very cheap (Stephens, Patnaik and Lewin 1996). Similarly, the pavement-dwellers in Mumbai and the waste-pickers living around the Payatas garbage dump in Manila, along with thousands of other communities at risk, are there because of the access to income-earning opportunities these provide.

Some measures taken by the poor to manage risk enhance short term security, but with longer term social and economic costs. Anticipating and managing risk seldom presents simple choices, especially for those with inadequate incomes. Actions taken by households to limit their exposure to risk can result in substantial losses in income and security, with long term implications. Dercon points out that in research on risk management and household coping mechanisms, more emphasis has been placed on short term implications, ignoring the longer term consequences for the deepening of poverty. Often, as Dercon explains, “... *the best that poor people can do is to make choices that perpetuate poverty via choosing low return, low risk portfolios of activities and assets*”(Dercon 2007 page 18) Research on this topic, he says, has been especially limited in urban areas. The social implications of these decisions must also be considered. For instance, removing children from school in order to adapt to changing economic realities (for instance avoiding the cost of keeping children at school and getting the contribution that children can make to household income) has obvious long term implications for the potential and productivity of those children, and for the larger society.

In a range of African cities surveyed, when flooding occurs, there are ad hoc individual short-term efforts to survive and to protect property – for instance making barriers to water entry at the doorsteps or ditches to drain water away, making outlets at the rear of the house so water coming out flowed out quickly. Sometimes people share protective storage or accommodation on higher ground. Spontaneous community action to unblock drainage channels is relatively rare. So there is limited collective effort and no significant intervention from local government.

When faced with a flood risk, residents of marginalized but risky areas have only a limited set of adaptation options. But they need help at the local community level to improve their options for emergency action and evacuation. They need help at the municipal level to improve drainage, to regulate developments upstream and elsewhere that increase flooding in their communities, and to give them greater security of tenure so that they can invest in making their homes more flood resistant. They need help at the national level; particularly to ensure that their needs are included in national disaster reduction plans and that these and other impacts of climate change are included in poverty reduction strategies. They also need international help to see that funding for adaptation to climate change is directed towards their problems (Douglas et al 2008)

Thus many measures that could be considered as “autonomous adaptation” to climate change taken by households are creative and resourceful responses to difficult conditions undertaken with minimal resources. But these also have the limitation that they cannot address most deficiencies in community infrastructure and services (which may be the main reason they are at risk). These need a collective response, either in terms of local populations developing a collective voice for negotiations with government for infrastructure and services or in terms of working together to address these deficiencies (although generally in successful adaptation initiatives, there is a combination of these). This is discussed in more detail in a later section on community-based adaptation.

There is also the issue of what autonomous adaptation cannot do. A high proportion of the urban poor in most cities rent accommodation and have little scope (or motivation) for improving the structure in which they live. A large proportion of those that do ‘own’ their home are discouraged from investing in improvements because of insecure or uncertain land tenure. And all low-income groups face obvious limitations in their capacity to invest in better housing.

Much risk-reduction depends on better community-wide infrastructure. A case study of 15 disaster-prone “slum” communities in El Salvador shows the difficulties of getting appropriate risk-reduction action at neighbourhood level. Households recognized the serious risk of flooding and landslides and took

measures to lower risks. But various factors limited the effectiveness of community-wide measures, including the individualistic nature of households' investments, the lack of representative community organizations and the lack of support from government agencies, with most residents viewing local and national governments as unhelpful or even as a hindrance to their efforts (Wamsler 2007). Of course, the motivation to form and sustain representative resident organizations in informal settlements is much reduced if there is little or no possibility of getting local governments or utilities to respond to their demands. In addition, many informal settlements have diverse populations with diverse interests that make it difficult to get broad-based community organizations. And, of course, many local governments see such community organizations as a political threat that they seek to contain in ways that limits the powers and effectiveness of these organizations.

### ***Mobility and Migration***

There is a need to understand migration as one in a range of strategies that individuals and households can use to adapt to climate change.<sup>12</sup> Rural to urban migration is often seen as 'a problem' by national and local governments and by development specialists. For instance, a review of the Poverty Reduction Strategy Papers in Africa showed how migration is seen as putting pressure on urban areas, promoting the spread of crime and HIV/AIDS, stimulating land degradation and reinforcing both urban and rural poverty (Black et al., 2006). Many governments implement policies to try to slow rural to urban migration, yet most such measures have had little effect and often result in increasing hardships for the urban and rural poor. These negative perceptions of rural to urban migration go against the evidence that most such migration is the logical response by households to changing patterns of economic opportunity; for almost all nations, the scale of net rural to urban migration tracks the scale of the increase in the proportion of GDP generated by industry and services (most industries and service enterprises are in urban areas) and the scale of the increase in the proportion of the labour force working in industry and services (Satterthwaite 2007). Indeed, rural to urban migration is an essential part of any prosperous economy – and there is no high-income nation that is not predominantly urban and no successful economy that has not urbanized. In addition, remittance flows back to their families from those who migrate are an important part of rural households' incomes and capacities to invest. Migrants are so often blamed for urban population growth (when natural increase and reclassification often contribute more to this than net in-migration) and for expanding illegal settlements (even though in many instances this expansion is mostly from long-time city residents).

This negative perception of migrants is now firmly embedded in the discussions of climate change. Instead of seeing most migration as individual and household adaptations to changing circumstances, it is seen in terms of a failure or inability to adapt that leads to 'floods of environmental refugees'. There are predictions that by 2050 there will be as many as 200 million 'environmental refugees' – people forced to move by environmental degradation caused by climate change (Myers 2005, Stern 2006). These figures are also used to scare those in high-income nations, the implication being that most of these environmental refugees will try to move there.

This is not to suggest that climate change will not have very serious impacts on the lives and livelihoods of large sections of the rural (and urban) population, especially if global emissions are not reduced. But in this context, migration, mobility and income-diversification must be recognized as ways in which rural households adapt to changing circumstances to reduce their vulnerability to climate shocks and stresses (and other shocks and stresses). Migration is important for development. In many cases, mobility not only increases resilience but also enables individuals and households to expand and diversify their asset bases. So policies that support and accommodate mobility and migration are an important part of adaptation (and an important part of development).

In many nations, the data available on migration flows is limited, especially in relation to internal migration, including the scale and nature of temporary and circular migration (which census data so often fails to capture). There are some studies that look at migration in response to environmental change and

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<sup>12</sup> This section is drawn primarily from Tacoli, forthcoming

these can help inform a discussion of migration and climate change. Research in northern Mali in the late 1990s found that up to 80 percent of households interviewed had at least one migrant member, but this high level of mobility was related to economic opportunities and the need to diversify income sources, rather than the direct consequence of desertification and land degradation (GRAD (Groupe Recherche Actions pour le Développement), 2001). Recent research in Burkina Faso suggests that a decrease in rainfall increases rural-rural temporary migration; on the other hand, migration to urban centres and abroad (which entails higher costs for those who move) is more likely to take place after normal rainfall periods and is influenced by migrants' education, the existence of social networks and access to transport and road networks (Henry et al, 2004). In Nepal, land degradation and environmental deterioration lead mainly to local movements, although the better educated tend to move to urban centres further away (Massey et al, 2007).

So research on contexts that offer similarities with the predicted impacts of climate change such as those noted above and those on the impact of extreme weather disasters suggests that environmental degradation does not inevitably result in migration. Where it does, it is likely that movement is predominantly short-term, as in the case of extreme weather events and natural disasters, and short-distance, as in the case of drought and land degradation. In the case of rising sea levels, much less can be inferred from past experience and the number of people forced to move will depend on their adaptation initiatives and on those undertaken by governments. The significance of non-environmental factors in migration, the uncertainty on the extent of changes in rainfall patterns and cyclone/hurricane frequency and strength as a consequence of climate change, and the fact that predictions only go as far as the next 50 years, are serious limitations for any realistic long-term assessment of the link between climate change and migration.

For slow-onset climate change that has negative impacts on agriculture (including rising average temperatures and reduced water availability), income diversification and short distance circular migration are likely to be common responses – and this will often have an urban component - for instance the movement of one or more family member to an urban area or temporary or seasonal work in urban areas. This kind of income diversification is likely to be an important element of climate change adaptation. It has proved very important for reducing rural poverty in many places. In China, a survey by the Ministry of Agriculture suggested in 2004 that non-farm incomes and internal transfers from migrants to urban centres were about to overtake earnings from agriculture in rural household budgets (Deshingkar, 2006). In India, remittances account for about one-third of the annual incomes of poor and landless rural households (ibid). Earnings from non-farm activities are also substantial, and estimated to account for between 30 and 50 percent of rural household income in Africa, reaching as much as 80-90 percent in Southern Africa (Ellis, 1998), about 60 percent in Asia (ibid) and around 40 percent in Latin America (Reardon et al., 2001)

Migrants' financial responsibilities towards their rural relatives are often overlooked. Remittances from urban household members and earnings from non-farm activities also have a major role in financing innovation and intensification of farming in Africa (Tiffen, 2003) and in Asia (Hoang et al., 2005; Hoang et al., 2008). Income diversification provides the capital needed to invest in agricultural production – inputs, infrastructure, and sometimes waged labour. It also provides the safety net that enables farmers to take the risks inherent in changing long-held practices. As such, it is an essential element of agricultural adaptation to climate change. The extent of temporary, circular and seasonal migration and its contribution to rural households' income diversification is not generally recognized, although it is well documented in various studies (Guest 1998 for Thailand, Deshingkar 2006 for India, Hoang et al for Vietnam's Red River Delta, Zhu 2003 for China). In addition, many urban residents invest in rural property or keep rural assets (often managed by family members) as a safety net and rural safety nets were critical for many urban residents in Africa during the 1990s and facilitated urban to rural migration (Potts and Mutambirwa 1998).

Where climate change is causing environmental stress for rural livelihoods, it will be one among a number of other factors in determining migration duration, direction and composition and these other factors (socio-economic, political and cultural) need to be integrated into adaptation policies. Agricultural adaptation initiatives should not assume that they ought to reduce out-migration, and

especially rural-urban migration; indeed successful rural development often supports rapid urban development locally (as it generates demand for goods and services from farmers and rural households) and may even encourage rural-urban migration (Beauchemin and Bocquier, 2004; Deshingkar, 2004; Henry, Schoumaker, and Beauchemin, 2004; Hoang, Dinh, and Nguyen, 2008; Massey, Axinn, and Ghimire, 2007). Thus, agricultural and rural development and the specific climate change adaptation actions that these need should not be linked to the reduction of migration.

There is also the potential role in adaptation of smaller urban centres. In most nations, a significant proportion of the urban population lives in urban centres with less than 20,000 inhabitants. Small urban centres in agricultural areas can have especially important roles in the livelihoods of the poorest rural groups, often landless and without the means to migrate to larger cities, by providing access to non-farm activities that require limited skills and capital (Hoang et al., 2008). They also have an important role in the provision of basic services such as health and education to their own population and that of the surrounding rural area, and this is likely to become increasingly important with both slow-onset climate change and the increase in frequency and intensity of extreme events. But little attention has been given to strengthening the competence, capacity and accountability of local governments in small urban centres, even though this would bring strong developmental advantages and increase adaptive capacity.

However, a failure to support rural populations to adapt will help produce crisis-driven population movements which make those forced to move very vulnerable. This is not the planned movement of an individual or a household to an urban centre helped by knowledge and contacts in that urban centre. A considerable proportion of the urban poor in some African, Latin American and Asian nations are refugees, fleeing wars and conflicts (including guerrillas and drug warfare) and disasters. Most of these crisis-driven movements may be unrelated to climate events but they show how much these destroy livelihoods and create vulnerable populations. A high proportion of these people move to urban areas, leaving behind homes, social networks, family ties and assets. It can take a long time to insert themselves into local communities (who may resent them as they compete for income-sources) and to build ties and participate in community organizations that can push for changes and negotiate with government and utilities for neighbourhood improvements. Ironically, it will be a failure of governments and international agencies to support the poorer and more vulnerable households to adapt (including that achieved by migration and mobility) and the failure of high-income nations to agree to the needed reductions in greenhouse gas emissions that will produce the crisis-driven migration that they currently fear.

### Addressing vulnerability and risk: the role of institutions, governance, and urban planning

It is impossible to conceive of an effective climate-change adaptation programme for any urban centre without a competent, capable local government that is able and willing to work with the inhabitants of the settlements most at risk – which in most nations means working with the residents of informal/illegal settlements. Adaptation has to be locally driven because hazards, risks and vulnerabilities are so shaped by local contexts. And the possibilities for their reduction are so shaped by the competence and capacity of local organizations and good use of local resources. In most instances, this will also require representative organizations formed by the residents of the informal/illegal settlements and other groups particularly at risk to ensure that local government responses address their priorities and work to support the resources and capacities they can contribute. So local government has to provide the framework and policies that encourage and support the contributions of individuals and households and of a range of other local organizations including community-based organizations, non-governmental organizations (NGOs) and private enterprises. It also has to provide the needed local coordination for the actions and policies of different agencies from higher levels of government. The sections below focus on the roles of local governments and of community based organizations in adaptation. But these are both the groups that official development assistance agencies have most difficulties working with. Such agencies were set up to work with and fund national governments. No national government will want donor agencies to develop funding and support programmes for local governments outside of their control. Indeed, this would often include support to local governments from different political parties or orientations to those

in national government. Or, even worse from their perspective would be funding channels to support the organizations formed by the residents of informal or illegal settlements. Even if national governments can tolerate new funding channels for these two key local actors, the official development assistance agencies lack the staff and structure to allow them to support the needed long-term, locally driven ‘development+adaptation’ processes in thousands of different urban centres (Satterthwaite et al 2009). In many ways, the challenge of getting an international institutional framework capable of supporting locally-driven pro-poor adaptation is greater than the challenge of getting needed funding for it.

## Local government responses

Within most local governments in low- and middle-income nations, there is generally little institutional capacity to address climate-related risks; and also a lack of accountability to citizens in their jurisdictions and little or no scope for citizen participation. This is even the case in cities in relatively prosperous middle-income nations – as illustrated by the earlier case study of Santa Fe. The lack of attention to the effects of extreme weather for large sections of the urban population compounds the risks they face from the likely impacts of climate change, including storms and flooding. Climate change contributes another level of stress to already vulnerable cities and populations, adding to the inadequacies in water and sanitation coverage, solid and liquid waste collection and treatment and pollution control – and of course adding to poverty and unemployment, lack of participation and inadequate governance structures (including corruption)

Thus, adaptation in urban centres that addresses the needs of low-income groups, and more generally the needs of vulnerable groups, is not possible without more knowledgeable, accountable, better resourced and technically competent local authorities that are willing and able to work well with the groups most at risk. Table 4 is a reminder of all the areas in which city or municipal government has important roles in reducing climate-related hazards or their impacts – in the built environment, in infrastructure and in services. They should also have key roles in adaptation that reduces impacts (including measures for pre-disaster damage limitation) and that helps with recovery after any disaster.

This is a point that has resonance far beyond the specific context of climate change: well-governed towns and cities have populations and economies that are resilient to a broader range of shocks and stresses. This includes the extreme weather and other events that can bring disasters that should have been avoided or whose impact could be much reduced. Well-governed urban centres also have above average performance on most indicators of health and quality of life. The most recent IPCC assessment emphasizes the adaptation capacity within well-governed urban centres (Wilbanks et al 2007) - and well-governed urban centres should be able to protect their inhabitants from floods and storms and ensure a high quality of life by ensuring provision for infrastructure, services, public space, and by establishing a planning/land use management framework. They should be able to understand the very location-specific, place-specific local needs for this – through strong local information, careful consultation and accountable political and administrative systems. Planning, land use management and building and land use standards should ensure that sufficient land is available for housing (including low-cost housing) without urban expansion taking place over land that is dangerous or needed for city or region flood protection. This kind of adaptation strategy is something easily stated but almost always difficult politically. Well-governed urban centres can also incorporate measures to support mitigation into most of the policies mentioned above. Various cities in Latin America have also demonstrated a capacity to combine poverty reduction with policies that support city prosperity and with environmental improvements that benefit middle and upper income groups as well as low income groups (see for instance Menegat 2002, Velasquez 1998 and Almansi 2009).

Local governments will often need to depend on cooperation with other local governments and/or support from higher levels of government to reduce climate-related hazards. For instance, urban centres facing floods from nearby rivers may depend on actions ‘up-river’ to reduce the volume and speed of peak flows. Local governments units within large metropolitan areas often face difficulties coordinating their responses to hazard reduction, especially where they are from different political parties or where

their jurisdictions contain a concentration of middle and upper income groups reluctant to contribute to addressing wider city problems. Yet such coordination is often far more effective.

**There are very substantial synergies between successful adaptation to climate change and successful local development, including poverty reduction** (Bicknell et al 2009). Reductions in poverty, including improvements in housing and living conditions and in provision for infrastructure and services, are central to adaptation. Successful, well-governed cities greatly reduce climate-related risks for low-income populations; unsuccessful, badly governed cities do not and may greatly increase such risks. One of the key predictors for resilience at the level of the individual, household and community is access to safe, secure housing with the necessary infrastructure and services. Oddly enough, the importance of safe, secure, adequate quality housing for adaptation is hardly discussed in the four IPCC assessments, despite its obvious importance in regard to protection from climate-related hazards – as well as being central to the health and often the income-earning possibilities and asset bases of low-income households. Perhaps the IPCC saw housing not as a government responsibility but as something provided by the market – forgetting the key role for government in providing the policies, regulations and infrastructure that are required in meeting housing needs and demands.

It is not surprising that most city governments and most ministries and agencies at higher levels of government in low- and middle-income countries have given little attention to climate change adaptation within their urban policies and investments. Even where city governments are competent, representative and accountable to poorer groups, they generally have more immediate pressing issues, including large backlogs in provision for infrastructure and services and much of their population living in poor quality housing. They are also under pressure to improve education, health care and security, and are looking for ways to expand employment and attract new investment. By contrast, climate-change related risks are uncertain and perceived as being in the future (see for instance Roberts 2008).

**Unless adaptation to climate change is seen to support and enhance the achievement of development goals, it will remain marginal within most government plans and investments.** Perhaps as importantly, the need for adaptation highlights the importance of strong, locally driven development that delivers for poorer groups and is accountable to them. The extreme vulnerability of large sections of the urban population to many aspects of climate change reveals the deficiencies in ‘development’, and unless these deficiencies are addressed, there is no real basis for adaptation. It is very difficult to conceive of how to get pro-poor and effective adaptation in nations with weak, ineffective and unaccountable local governments, especially where there are also civil conflicts and no economic or political stability. Many of the nations or cities most at risk from climate change lack the political and institutional base to address adaptation. It is also difficult to see how existing international institutions as they are currently configured can respond to the need for pro-poor adaptation. International funding for adaptation is still far from adequate (Ayers 2009) but understanding how to make effective use of international funding to support the locally determined, locally driven needed adaptation that serves and works with those most at risk is even further off.

**Table 4: The role of urban authorities in the four aspects of adaptation**

<b>Role for city / municipal government</b>	<b>Adaptation to avoid impacts</b>	<b>Pre-disaster damage limitation</b>	<b>Immediate post-disaster response</b>	<b>Rebuilding</b>
<b>Built environment</b>				
Building codes	High		High*	High
Land use regulations and property registration	High	Some		High
Public building construction and maintenance	High	Some		High
Urban planning (including zoning and development controls)	High		High*	High

<b>Infrastructure</b>				
Piped water including treatment	High	Some	High	High
Sanitation	High	Some	High	High
Drainage	High	High**	High	High
Roads, bridges, pavements	High		High	High
Electricity	High	Some?	High	High
Solid waste disposal facilities	High	Some		High
Waste water treatment	High			High
<b>Services</b>				
Fire-protection	High	Some	High	Some
Public order / police / early warning	Medium	High	High	Some
Solid waste collection	High	High**	High	High
Schools	Medium	Medium		
Health care / public health / environmental health / ambulances	Medium	Medium	High	High
Public transport	Medium	High	High	High
Social welfare (includes provision for child care and old-age care)	Medium	High	High	High
Disaster response (over and above those listed above)			High	High

\* Obviously it is important that these do not inhibit rapid responses

\*\* Clearing / de-silting drains and ensuring collection of solid wastes has particular importance just prior to extreme rainfall; many cities face serious flooding from extreme rainfall that is expected (for instance the monsoon rains) and this is often caused or exacerbated by the failure to keep storm and surface drains in good order.

Source: Satterthwaite 2008a

Of course, there are also many developmental interventions that have the potential to increase the resilience of low-income groups to climate change related stresses and shocks; indeed, almost any intervention that reduces poverty is likely to increase resilience and also to reduce the need for livelihoods and homes that bring high risk levels.

### ***Community-based responses***

For community-based adaptation, there is a danger that its relevance will be both overstated and underplayed at the same time. It will be overstated because community-based organization and actions cannot provide the citywide infrastructure and service provision and city-wide and city-region management that is central to adaptation. Many of the risks and vulnerabilities that low-income groups face are from deficiencies or inadequacies in infrastructure provision that they alone cannot address. For instance, they may be able to help construct or improve drainage (see the scale of what is possible in this in urban areas of Pakistan in Hasan 2006) and collect solid waste within their settlement (Anand 1999) but this needs a larger drainage and solid waste collection system into which to feed. Or investments and actions are needed 'upstream' from them – for instance, to reduce the volume and speed of floodwaters.

Low-income individuals and their families also face considerable structural adversity that constrains their capacity to act. They have to manage with very limited incomes and monetary assets in a social and economic context that is, in urban centres, dominated by money with commodified markets for labour and goods and services. As discussed earlier, there are often many constraints on the possibilities of organizing collective responses. In addition, those in power generally look down on low-income groups; even within democratic local governments, they are often seen as no more than vote banks. One of the consequences of this is that low-income citizens are not expected to be proactive citizens in part because they are judged to be less able than others in a multitude of ways. This has often been seen in climate change approaches toward this group, even as it is widely recognized that they will suffer from climate

change due to a combination of lack of finance to protect themselves against adversity related to climate change, and lack of state action to address their needs and interests.

But the relevance of community-based adaptation is also underplayed in that the policies and practices of governments and international agencies do not recognize the capacity of community-based organizations to contribute to adaptation or, if they do, they lack the institutional means to support them. Low-income urban residents can effect many risk-reducing measures, individually or collectively, while well-organized, representative community organizations are important for representing their interests to local governments and external funders. Also important is the possibility for these local organizations to form broader coalitions (or federations) to undertake work on a larger scale, and also to influence local and international views on effective adaptation and international strategies for adaptation financing. The national federations formed by slum and shack dwellers or homeless groups that are now active in at least fifteen nations and emerging in many others<sup>13</sup> have demonstrated a capacity not only to work at scale to improve housing conditions and basic infrastructure and services for their members – but also to form effective partnerships with local governments (Patel and Mitlin 2004, d’Cruz and Satterthwaite 2005, Mitlin 2008). These are the kinds of partnerships that can address deficits in infrastructure and services in ways that do address the needs of the most vulnerable groups and that are thus also central to climate change adaptation. These urban poor federations have also demonstrated their capacity to contribute to risk-reduction frameworks, especially in undertaking city-wide surveys of informal settlements and in detailed enumerations and mapping that provides the information base needed for upgrading (ibid, Weru 2004, Reyos 2009). Some federations have demonstrated a capacity to work with local authorities in resettling those living on high-risk sites (Patel et al 2002).

There is also the key role of community-based organizations in post-disaster work, especially for those who were most affected, and this is so often forgotten. Although the Indian Ocean Tsunami was not caused by climate change, the deficiencies in the post-disaster response despite (or perhaps in part because of) massive international funding show deficiencies that need to be understood and addressed, to ensure better responses in the future (ACHR 2005, 2006). For instance, the survivors from this Tsunami in Banda Aceh were swamped by so much unregulated, uncoordinated aid (over 500 international organizations each with their own priorities, agendas and funds that needed to be spent quickly) that it undermined their social structures. Support for housing and infrastructure should have been entry points for helping the survivors get some control back of their lives including rebuilding homes and villages and strengthening their own social cohesion and self-determination. But the funding went to contractors with the construction seen as ends in themselves – and with no coordination (some households got two or more new houses or boats, others got none). The survivors also had to fight against a national government that wanted to create a 2 km construction free zone in which most of their homes and villages were located. So much funding was available at first (even paying people to attend meetings and clean their homes) that it undermined attempts to develop livelihoods and any role for community organizations. But then the funders withdrew, leaving communities with no source of income and no social cohesion. Despite the billions of dollars spent, poverty had not been addressed. To address these issues, 23 villages have been working together with the support of a small Indonesian NGO (Uplink Banda Aceh) to develop their own plans and priorities and to oppose the initiatives that threaten their homes and livelihoods (Uplink Banda Aceh and Sauter, forthcoming). This is not an isolated case; indeed it is rare for those who are most impacted by disasters to be allowed central roles in designing and implementing responses (ACHR 2005, 2006). Addressing this needs collective organization formed by those who survive. The Philippines Homeless People’s Federation has been active in working with the victims of disasters and their local governments in developing responses that include upgrading and where needed resettlement on safer sites (Reyos 2009).

Table 5 below gives examples of the kinds of asset-based actions that households and community based organizations can take to build resilience to extreme weather and the ways in which this can be supported by local, regional and national governments

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<sup>13</sup> see the website of Slum/Shack Dwellers International (SDI), [www.sdinet.org/](http://www.sdinet.org/)

**Table 5: Examples of asset-based actions at different levels to build resilience to extreme weather**

Areas of intervention	Asset-based actions		
	Household and neighbourhood	Municipal/city	Regional or national
Protection	Household and community-based actions to improve housing and infrastructure  Community-based negotiation for safer sites in locations that serve low-income households  Community-based measures to build disaster-proof assets (e.g. savings groups) or protect assets (e.g. insurance)	Work with low-income communities to support slum and squatter upgrading informed by hazard mapping and vulnerability analysis  Support increased supply and reduced costs of safe sites for housing	Government frameworks to support household, neighbourhood and municipal action; risk reduction investments and actions that are needed beyond urban boundaries
Pre-disaster damage limitation	Community-based disaster preparedness and response plans including ensuring early warning systems reach everyone, measures to protect houses, safe evacuation sites identified if needed and provision to help those less able to move quickly	Early warning systems that reach and serve groups most at risk, preparation of safe sites with services, organization for transport to safe sites, protecting evacuated areas from looting	National weather systems capable of providing early warning; support for community and municipal actions
Immediate post-disaster response	Support for immediate household and community responses to reduce risks in affected areas, support the recovery of assets and develop and implement responses	Encourage and support active engagement of survivors in decisions and responses; draw on resources, skills and social capital of local communities; rapid restoration of infrastructure and services	Funding and institutional support for community and municipal responses
Rebuilding	Support for households and community organizations to get back to their homes and communities and plan for rebuilding with greater resilience; support for recovering the household and local economy.	Ensure reconstruction process supports household and community actions including addressing priorities of women, children and youth; build or rebuild infrastructure to more resilient standards	Funding and institutional support for household, community and municipal action; address deficiencies in regional infrastructure

Source: Moser and Satterthwaite 2009

## Conclusions

How can governments and international agencies reduce the large and growing levels of risks being imposed by climate change on large sections of the urban (and rural) population in low- and middle-income nations? Most of those at risk have livelihoods and lifestyles that contribute very little to greenhouse gas emissions. Although there is a long history of richer groups reducing the environmental problems they face by transferring these to other people and other locations, climate change represents the largest and potentially the most catastrophic of these transfers.

For low- and most middle-income nations, clearly the priority is adaptation that addresses current and near-future risks and vulnerabilities, and the two key actors are local governments and the populations most at risk (and their organizations). Yet these are both groups that official development assistance agencies have difficulties working with. Development assistance agencies were set up to work with national governments and they lack the structure and staff to support the needed long-term local engagement with many localities. Most of the climate change risks evident in urban centres are related to development deficits – poor quality housing, inadequacies in provision for infrastructure and services and a failure of land-management to ensure that low-income households can find or build homes on safe sites. These are often underpinned by governments that refuse to address the needs of those living in

informal settlements. This will not be addressed by new ‘adaptation funds’ that only support ‘adaptation to climate change’. In effect, climate change adaptation in urban areas is not possible without building adaptation into development and without reducing the ‘development deficit’ in (for instance) provision for infrastructure and services (which may also be called the adaptation deficit). Climate change adaptation also requires more knowledgeable, accountable, better resourced and technically competent local authorities that are willing and able to work well with the groups most at risk. But the political and institutional means to achieve this are not easily conceived in most nations, especially on the time-scale needed for effective adaptation. In addition, even where local governments are more competent and accountable, unless adaptation to climate change is seen to support and enhance the achievement of development goals, it will remain marginal within most government plans and investments.

At a global scale, mitigation can be considered the most important contribution to adaptation, especially for all the cities, smaller urban centres and rural areas in low-income nations that have high risks and so little adaptation capacity. The difficulties in building local adaptive capacity, and the limits in external funders’ knowledge of how to do so, adds greatly to the urgency of achieving global agreements that rapidly reduce total greenhouse gas emissions and avoid ‘dangerous’ climate change. But greenhouse gas emission reduction at the scale and speed needed to avoid this is unlikely, in large part because this necessitates substantial constraints on high-consumption lifestyles in high-income and increasingly in middle-income nations.

At national level, adaptation needs to be seen as a development issue, not an environmental issue; it also needs to be understood as an issue needing locally-driven development. Considering the issues raised above about local development, adaptation will require national frameworks and funding provisions to strengthen the capacity of local governments to act and to work with low-income group and other groups at risk. This is easily said but not easily acted on.

In many urban centres in low-income nations, a focus on mitigation, often promoted by northern-based initiatives, may serve to divert attention from the more pressing issues of building adaptive capacity, in full recognition of how climate change is likely to affect the urban and rural poor. It is also easier for international agencies to promote mitigation than to promote the much needed but messy, complex locally rooted process of pro-poor adaptation. It is strange to see ‘mitigation’ being included in projects that are meant to benefit low-income groups, when mitigation should be focusing on reducing emissions from middle- and upper-income groups.

Many of the inaccurate stereotypes imposed on the urban poor in discussions of development are being transferred to the climate change discourse. Instead of seeing migration and mobility as ways in which the poor adapt to changing circumstances (including climate change), the discourse is of “floods of environmental refugees”. Instead of seeing the informal homes and neighbourhoods that house so much of the urban population as evidence of the capacity and ingenuity of low-income groups, and as a contribution to city development, these are usually seen as ‘the problem’. Similar anti-poor attitudes are evident in government policies on the informal economy. Disasters usually have the greatest impact on low-income groups – and after disasters, at best, the survivors are seen as ‘victims’ in need of ‘emergency relief,’ under-playing the knowledge, resources and capacities they can bring to recovery and rebuilding. More generally, rural-urban migration is seen as ‘the problem’ yet this is overwhelmingly a rational response by individuals and households to the concentration of economic opportunity in particular urban locations. Urbanization is a necessary part of a stronger, more resilient economy; it is also not in opposition to rural development as urban to rural remittances, urban demand for higher value foodstuffs and urban support for off-farm and non-farm work support rural prosperity. Yet many national and local governments see urbanization as a problem – when the problem is their failure to change their governance structures to support it. The same is true for many official development assistance agencies who have long failed to understand the role of urbanization in development and failed to recognize the scale and depth of urban poverty.

## References

- ACHR/Asian Coalition for Housing Rights(2005), *Tsunami; How Asia's Precarious Coastal Settlements are Coping after the Tsunami*, Housing by People in Asia 16, ACHR, Bangkok, 52 pages.
- ACHR/Asian Coalition for Housing Rights(2006), *Tsunami Update*, ACHR, Bangkok, 16 pages.
- Afsar R. (2003), "Internal migration and the development nexus: the case of Bangladesh", Presented at: Migration, Development and Pro-Poor Policies in Asia, Dhaka, Bangladesh, 22-24 June 2003.
- Alam, Mozaharul and MD. Golam Rabbani (2007), "Vulnerabilities and responses to climate change for Dhaka", *Environment and Urbanization*, Vol. 19, No. 1, pages 81-97.
- Aidoo, Magna and Trudy Harpham (2001) "The explanatory models of mental health amongst low-income women and health care practitioners in Lusaka, Zambia", *Health Policy and Planning* Vol. 16, No. 2, pages 206-213.
- Almansi, Florencia (2009), "Rosario's development; interview with Miguel Lifschitz, mayor of Rosario, Argentina", *Environment and Urbanization*, Vol. 21, No. 1.
- Anand, P.B. (1999), "Waste management in Madras Revisited", *Environment and Urbanization* Vol.11, No. 2, pages 161-176.
- Asociación Civil Canoa, accessible at <http://www.canoa.org.ar/DDHH02.html>.
- Avotri, Joyce Yaa and Vivienne Walters (1999) "'You just look at our work and see if you have any freedom on earth': Ghanaian women's accounts of their work and their health", *Social Science and Medicine* Vol. 48, pages 1123-1133;
- Awuor C, Orindi V, Adwera A (2008). 'Climate change and coastal cities: the case of Mombasa, Kenya' *Environment and Urbanization* Vol 20, No 1, pages 231-242.
- Ayers, Jessica (2009), "International Funding to Support Urban Adaptation to climate change", *Environment and Urbanization* Vol. 21, No. 1.
- Ayers J, Huq S (2008). 'The Value of Linking Mitigation and Adaptation: a case study of Bangladesh' *Environmental Management*. Published online October 2008.
- Bartlett, Sheridan (2008a). *Climate change and urban children: impacts and implications for adaptation in low- and middle-income countries*. International Institute for Environment and Development, London, Human Settlements Discussion Paper Series, Climate Change and Cities 2. August 2008.
- Bartlett, Sheridan (2008b), "Climate change and urban children: Implications for adaptation in low and middle income countries", *Environment and Urbanization* Vol. 20, No. 2, pages 501-520.
- Beauchemin, Cris and Philippe Bocquier (2004), "Migration and urbanization in Francophone West Africa: An overview of the recent empirical evidence", *Urban Studies*, Vol. 41, No. 11, pages 2245-2272.
- Bebbington, Anthony (1999) "Capitals and capabilities: a framework for analysing peasant viability, rural livelihoods and poverty", *World Development* Vol. 27, pages 2021-2044.
- Begum, Sharifa and Binayak Sen (2005), "Pulling rickshaws in the city of Dhaka: a way out of poverty?", *Environment and Urbanization*, Vol. 17, No. 2.
- Berger LR and D Mohan (1996) *Injury Control: a Global View*, Oxford University Press, New Delhi.
- Bhan, Gautam (2009), "This is no longer the city I once knew; Evictions, the urban poor and the right to the city in Millennial Delhi", *Environment and Urbanization* Vol. 21, No. 1.
- Bicknell, Jane, David Dodman and David Satterthwaite (editors) (2009), *Adapting Cities to Climate Change: Understanding and Addressing the Development Challenges*, Earthscan, London.
- Black, R., J. Crush, S. Peberdy, S. Ammassari, L. McLean Hilken, S. Mouillesseux, C. Pooley and R. Rajkotia (2006), *Migration and Development in Africa: An Overview*, Migration and Development Series, Southern African Migration Project, Cape Town, South Africa, and Kingston, Ontario.
- Breman, J, MS Alilio, A Mills (2004) "Conquering the intolerable burden of malaria: what's new, what's needed: a summary", *American Journal of Tropical. Medicine and. Hygiene*, Vol. 71 (2 suppl), pages 1-15
- Bulkeley H, Betsill M (2003). *Cities and Climate Change: urban sustainability and global environmental governance*. London, Routledge.
- Castles, Stephen (2002) *Environmental Change and Forced Migration: Making Sense of the Debate*, UNHCR, Geneva
- CEPAL (2003), cited in Natenzon (2006)
- Chen, N. P. Valente and H. Zlotnick (1998), "What do we know about recent trends in urbanization?", in Richard E. Bilborrow (editor), *Migration, Urbanization and Development: New Directions and Issues*, United Nations Population Fund, New York, pages 59-88.
- Christoplos, Ian, John Mitchell and Anna Liljelund (2001), "Re-framing Risk: The Changing Context of Disaster Mitigation and Preparedness", *Disasters*, Vol. 25, No 3, pages 185-198.
- Cilento Sarli, Alfredo (2007), "La vulnerabilidad urbana de Caracas", accessible at <http://168.96.200.17/ar/libros/venezuela/rvecs/3.2002/sarli.doc>.

- City of Melbourne (2008), *Towards a City of Melbourne Climate Change Adaptation Strategy: a risk assessment and action plan discussion paper*, Maunsell Australia, July 2008.
- Confalonieri U, Menne B, Akhtar R, Ebi K, Hauengue M, Kovats R, Revich B, Woodward A (2007). 'Human Health' in Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.
- D'Cruz, Celine and David Satterthwaite (2005), *Building Homes, changing official approaches: The work of Urban Poor Federations and their contributions to meeting the Millennium Development Goals in urban areas*, Poverty Reduction in Urban Areas Series, Working Paper 16, IIED, London, 80 pages.
- De Sherbinin, Alex, Andrew Schiller and Alex Pulsipher (2007), "The vulnerability of global cities to climate hazards", *Environment and Urbanization* Vol 19, No 1, April, pages 39–64.
- Dercon, Stefan (2007) *Fate and Fear: Risk and its Consequences in Africa*, Global Poverty Research Group, GPRC-WPS-074.
- Deshingkar, P. (2004), "Improved Livelihoods in Improved Watersheds: Can Migration Be Mitigated?", Presented at: ICAR-IWMI-ICRISAT International Workshop on Watershed Management Challenges, 3-4 November 2004, New Delhi.
- Deshingkar, Priya (2005) Maximising the benefits of internal migration, paper presented at the Regional Conference on Migration and Development in Asia, Lanzhou, China
- Deshingkar, P. (2006), "Internal Migration, Poverty and Development in Asia", In *Asia 2015: Promoting Growth, Ending Poverty*, London, 6-7 March 2006.
- Deshingkar, P., M. Deshpande, S. Kumar, A. Paradkar, L. Rao and P. Sharma (2009), *Governance for Local Development in Small Towns: Addressing the Challenges and Opportunities of Increasing Migration and Mobility in India*, Rural-Urban Working Paper 17, IIED, London.
- Dodman D (2009). 'Blaming cities for climate change? An analysis of urban greenhouse gas emissions inventories' *Environment and Urbanization* Vol. 21, No. 1: in press.
- Dodman, D and D Mitlin (2009). 'Victims to Victors, Disasters to Opportunities: Community Driven Responses to Climate Change in the Philippines' Paper prepared for World Bank Urban Symposium, Marseille, June 2009.
- Dodman D and D Satterthwaite (2008). 'Institutional Capacity, Climate Change Adaptation and the Urban Poor' *IDS Bulletin* Vol. 39, No. 4, pages 67-74.
- Domínguez Aguilar, Mauricio and Ana García de Fuentes (2007), "Barriers to achieving the water and sanitation-related Millennium Development Goals in Cancún, Mexico at the beginning of the twenty-first century", *Environment and Urbanization* Vol 19, No 1, April, pages 243–260.
- Dossou, Krystel and Bernadette Glehouenou-Dossou (2007), "The vulnerability to climate change of Cotonou (Benin): the rise in sea level", *Environment and Urbanization* Vol. 19, No. 1, pages 65-79.
- Douglas I, Alam K, Maghenda M, McDonnell Y, McLean L, Campbell J (2008). 'Unjust waters: climate change, flooding and the urban poor in Africa' *Environment and Urbanization* Vol. 20, No. 1, pages 187-205.
- du Plessis, Jean (2005), "The growing problem of forced evictions and the crucial importance of community-based, locally appropriate alternatives", *Environment and Urbanization* Vol. 17, No. 1, pages 123-134.
- Ellis, F. (1998), Livelihood diversification and sustainable rural livelihoods, in *Sustainable Rural Livelihoods: What Contribution Can We Make?*, Diana Carney (editor), DFID, London.
- Enarson, Elaine (2004), Gender Matters: Talking Points on Gender Equality and Disaster Risk Reduction, 22 pages.
- Enarson, Elaine and Lourdes Meyreles (2004), "International perspectives on gender and disaster; differences and possibilities", *International Journal of Sociology and Social Policy* Vol. 24, Issue 10/11, pages 49-93.
- Gentile E. and S. González (2001) *Vulnerabilidad y gestión del riesgo por inundaciones en la ciudad de Buenos Aires: la cultura técnica de la imprevisión*, in Primer Encuentro: Adaptación de la Ciudad de Buenos Aires y el Area Metropolitana de Buenos Aires al Cambio Climático. Defensoría del Pueblo Adjunta de la Ciudad de Buenos Aires, 14 – 15 November.
- Giorgi F (2003), "Variability and trends of sub-continental scale surface climate in the twentieth century. Part I: Observations". *Climate Dynamics* Vol. 18, pages 675 – 691.
- Gouveia, Nelson, Shakoor Hajat and Ben Armstrong (2003) "Socioeconomic differentials in the temperature–mortality relationship in São Paulo, Brazil", *International Journal of Epidemiology* Vol. 32, pages 390–397
- GRAD (Groupe Recherche Actions pour le Développement) (2001), *Potentialités et conflits dans les zones péri-urbaines: le cas de Mopti au Mali*, Rural-Urban Working Paper 6, IIED, London.
- Greater London Authority (2008). *The London Climate Change Adaptation Strategy*. Greater London Authority, 2008.
- Guest, P. (1998), "Assessing the consequences of internal migration: methodological issues and a case study on Thailand based on longitudinal survey data" in *Migration, Urbanization and Development: New Directions and Issues*, Richard Bilborrow (editor), UNFPA, New York.

- Hadley, C and CL Patil (2007) “Seasonal changes in household food insecurity and symptoms of anxiety and depression”, *American Journal of Physical Anthropology* Nov 28 [Epub ahead of print]
- Hardoy, Jorge E., Sandy Cairncross and David Satterthwaite (Editors) (1990), *The Poor Die Young: Housing and Health in Third World Cities*, Earthscan Publications, London, 309 pages.
- Hardoy, Jorge E, Diana Mitlin and David Satterthwaite (1992), *Environmental Problems in Third World Cities*, Earthscan Publications, London, 302 pages.
- Hardoy, Jorge E, Diana Mitlin and David Satterthwaite (2001), *Environmental Problems in an Urbanizing World: Finding Solutions for Cities in Africa, Asia and Latin America*, Earthscan Publications, London, 448 pages.
- Hardoy, Jorgelina and Gustavo Pandiella (2009), "Urban poverty and vulnerability to climate change in Latin America", *Environment and Urbanization* Vol. 21, No. 1.
- Harvey D (1996), *Justice, Nature and the Geography of Difference*, Blackwell, Oxford.
- Hasan A (2005). ‘The political and institutional blockages to good governance: the case of the Lyari expressway in Karachi’ *Environment and Urbanization* Vol. 17, No. 2, pages 127-141.
- Hasan, Arif (2006), "Orangi Pilot Project; the expansion of work beyond Orangi and the mapping of informal settlements and infrastructure", *Environment and Urbanization* Vol. 18, No. 2, pages 451-480.
- Hasan, A. and M. Raza (2009), *Migration and Small Towns in Pakistan*, Rural-Urban Working Paper 15, IIED, London.
- Heflin CM, K Siefert and DR Williams (2005) “Food insufficiency and women's mental health: findings from a 3-year panel of welfare recipients”, *Social Science and Medicine* Vol. 61, No. 9, pages 1971-1982;
- Henry, S., B. Schoumaker and C. Beauchemin (2004), “The Impact of Rainfall on the First Out-Migration: A Multi-level Event-History Analysis in Burkina Faso”, *Population and Environment*, Vol. 25, No. 5, pages 423-460.
- Héron D (2006) *The TransMilenio Public Transportation System (Bogotá, Colombia)*. UNITAR/VEOLIA Environnement / UN-Habitat. Available online: <http://www.sustainable-development.veolia.com/library/en/standalone/others/1767,Transmilenio-Bogota-ANG.pdf> [accessed 31/3/09].
- Herzer, Hilda and Nora Clichevsky (2001), “Perspectiva histórica: las inundaciones en Buenos Aires”, in Alcira Kreimer et al. (editors), *Inundaciones en el Area Metropolitana de Buenos Aires*, World Bank, Washington DC.
- Hoang, X. T., T. T. P. Dinh and T. H. Nguyen (2008), *Urbanization, fruit production and rural livelihood transformations in the Mekong Delta*, Rural-Urban Interactions Working Paper 14, IIED, London.
- Hoang, X., N. Dang and C. Tacoli (2005), *Livelihood diversification and rural-urban linkages in Vietnam's Red River Delta*, Rural-Urban Working Paper No 11, IIED, London.
- Huq S, and J Ayers (2007). *Critical list: the 100 nations most vulnerable to climate change*. International Institute for Environment and Development, London, Sustainable Development Opinion, December 2007.
- ISDR (forthcoming), *2009 Global Assessment Report on Disaster Risk Reduction*, Earthscan, London.
- Jantre N (2008). *Local Government on the way towards COP 15*. Presentation at UCLG / ICLEI Local Government Climate Sessions, UNFCCC COP 14, Poznan, December 2008.
- Jiménez, Virginia (2006), “Taller vivencial de intercambio de experiencias municipales en reducción de riesgos”, Report within the framework of Proyecto RLA/51467 Fortalecimiento Regional y Reducción de Riesgos en Ciudades Mayores de la Comunidad Andina, 9–12 November, Caracas, Venezuela.
- Klein R, Huq S, Denton F, Downing T, Richels R, Robinson J, Toth F (2007). ‘Inter-relationships between adaptation and mitigation’ in Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, pages 745-777.
- Kovats S, and R. Akhtar R (2008). ‘Climate, climate change and human health in Asian cities’ *Environment and Urbanization* 20(1): 165-175.
- Manda, Mtafu A Zeleza (2007), "Mchenga - urban poor housing fund in Malawi", *Environment and Urbanization* Vol. 19, No. 2, pages 337-359.
- Massey, D., W. Axinn and D. Ghimire (2007), *Environmental Change and Out-Migration: Evidence from Nepal*, Population Studies Center Research Report 07-615, Institute for Social Research, University of Michigan, Ann Arbor.
- Mata, J L and Carlos Nobre (2006), “Impacts, vulnerability and adaptation to climate change in Latin America”, Background Paper presented at Regional Workshop on Latin American Adaptation, UNFCCC, 18–20 April, Lima, Peru.
- Mayor of London (2007), *Action Today to Protect Tomorrow: The Mayor's Climate Change Action Plan*, Greater London Authority.
- McGranahan G, Balk D, Anderson B (2007). ‘The Rising Tide: assessing the risks of climate change and human settlements in low elevation coastal zones’ *Environment and Urbanization* 19(1): 17-37.

- McGranahan G, Satterthwaite D (2000). 'Environmental Health or Ecological Sustainability? Reconciling the Brown and Green Agendas in Urban Development' in Pugh C (ed) *Sustainable Cities in Developing Countries*. London, Earthscan, pages 73-90.
- Mejia, Fanny Y (2000), "Construyendo una ciudad mas saludable y sostenible ambientalmente. Estrategia municipal para la superación de condiciones de vulnerabilidad del distrito central, capital de Honduras", Seminar on El Impacto de los Desastres Naturales en Areas Urbanas y en la Salud Publica Urbana en Centro America y el Caribe, ASIES, Guatemala.
- Menegat, Rualdo (2002), "Participatory democracy and sustainable development: integrated urban environmental management in Porto Alegre, Brazil", *Environment and Urbanization*, Vol. 14 No. 2, pages 181-206..
- Mitlin, Diana (2008), "With and beyond the state; co-production as a route to political influence, power and transformation for grassroots organizations", *Environment and Urbanization* Vol. 20, No. 2, pages 339-360.
- Montgomery, Mark R, Richard Stren, Barney Cohen and Holly E. Reed (editors) (2003), *Cities Transformed; Demographic Change and its Implications in the Developing World*, The National Academy Press (North America)/Earthscan (Europe), Washington DC, 518 pages.
- Moser, Caroline and David Satterthwaite (2008), *Towards Pro-poor Adaptation to Climate Change in the Urban Centres of Low and Middle-Income Countries*, Climate Change and Cities Discussion Paper 3, IIED, London, 39 pages.
- Moser, Caroline and David Satterthwaite (2009), "Towards pro-poor adaptation to climate change in the urban centres of low- and middle-income countries", In Robin Mearns, Andy Norton and Edward Cameron (editors), *People, Vulnerability and Climate: Understanding the Social Dimensions of Climate Change*, World Bank, forthcoming.
- Muller, Anna and Diana Mitlin (2007), "Securing inclusion: strategies for community empowerment and state redistribution ", *Environment and Urbanization* Vol. 19, No. 2, pages 425-439.
- Murray, C J and A D Lopez (1996), *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries and Risk Factors in 1990 and Projected to 2020*, Harvard University Press, Boston.
- Myers, N. (2005), Environmental refugees: an emerging security issue, Presented at: 13th Economic Forum, Prague, 23-27 May 2005.
- Natenzon, Claudia (2006), "Inundaciones catastróficas, vulnerabilidad social y adaptación en un caso argentino actual. Cambio climático, elevación del nivel medio del mar y sus implicancias", Paper submitted to EMF Workshop IX: Climate Change Impact and Integrated Assessment, July 28–August 7, Snowmass, Colorado.
- Noticias de Latinoamérica (2007), *Boletín de Agua y Saneamiento* No 20, July 2007.
- Patel, Sheela, Celine d'Cruz and Sundar Burra (2002), "Beyond evictions in a global city: people-managed resettlement in Mumbai", *Environment and Urbanization* Vol. 14, No. 1, pages 159-172.
- Patel, Sheela and Diana Mitlin (2004), "Grassroots-driven development: The Alliance of SPARC, the National Slum Dwellers Federation and Mahila Milan", in Diana Mitlin and David Satterthwaite (editors), *Empowering Squatter Citizen; Local Government, Civil Society and Urban Poverty Reduction*, Earthscan Publications, London, pages 216-241.
- Patel, V, R Araya, M de Lima, A Ludermir and C Todd (1999) "Women, poverty and common mental disorders in four restructuring societies", *Social Science and Medicine* Vol. 49, pages 1461-1471
- PlaNYC (2007). *Inventory of New York City greenhouse gas emissions*. Mayor's Office of Operations, New York City
- Potts, Deborah (2009), "The slowing of sub-Saharan Africa's urbanization: evidence and implications for urban livelihoods", *Environment and Urbanization*, Vol. 21, No. 1.
- Potts, D. and C. Mutambirwa (1998), "Basics are now a luxury": perceptions of structural adjustment's impact on rural and urban areas in Zimbabwe, *Environment and Urbanization*, Vol 10, No 1, pages 55-75.
- Pradhan, Elizabeth Kimbrough, Keith P. West, Joanne Katz, Steven C. LeClerq, Subarna K. Khattry, and Sharada Ram Shrestha (2007) "Risk of flood-related mortality in Nepal", *Disasters* Vol. 31, No 1, pages 57-70.
- Prowse M, Peskett L (2008). *Mitigating climate change: what impact on the poor?* Overseas Development Institute, London, Opinion 97, April 2008.
- Pryer, Jane (1993), "The impact of adult ill-health on household income and nutrition in Khulna, Bangladesh", *Environment and Urbanization*, Vol. 5, No. 2, October, pages 35-49.
- Pryer, Jane A. (2003), *Poverty and Vulnerability in Dhaka Slums; the Urban Livelihoods Study*, Ashgate, Aldershot, 203 pages.
- PWS and Sauter, G (forthcoming) *Renovation not relocation; the work of Paguyuban Warga Strenkali (PWS) in Surabaya*, IIED Gatekeeper Series, 2009.
- Rashid, Harun, Len Hunt and Wolfgang Haider (2004) "Urban flood problems in Dhaka, Bangladesh: slum residents' choices for relocation to flood-free areas", [Environmental Management](#) Vol. 40, No. 1, pages 95-104.

- Re, Mariano and Ángel Menéndez (2007), “Impacto del cambio climático en las costas del río de la Plata”, in *Revista Internacional de Desastres Naturales, Accidentes e Infraestructura Civil* Vol 7, No 1, April, Universidad de Puerto Rico, Recinto Universitario de Mayagüez, Puerto Rico, [www.uprm.edu/civil/revistadesastres/Vol7Num1/2%20Re%20y%20Menendez.pdf](http://www.uprm.edu/civil/revistadesastres/Vol7Num1/2%20Re%20y%20Menendez.pdf)
- Rearson, T., J. Berdegúe and G. Escobar (2001), “Rural non farm employment and incomes in Latin America: overview and policy implications”, *World Development* Vol 29, No. 3.
- Rebagliati, Ricardo (2003), “Plan director de ordenamiento hidráulico y proyecto ejecutivo para el arroyo Maldonado del gobierno de la ciudad de Buenos Aires”, *Contactar, Ciudades Saludables* No 11, accessible at [www.revistacontactar.com.ar/plan\\_director\\_nro11.htm](http://www.revistacontactar.com.ar/plan_director_nro11.htm).
- Renton, Alex and Robin Palmer (2005), *A Place to Stay, a Place to Live; Challenges in Providing Shelter in India, Indonesia and Sri Lanka after the Tsunami*, Oxfam Briefing Note, Oxfam International, Washington DC, 14 pages.
- Revi A (2008). ‘Climate change risk: an adaptation and mitigation agenda for Indian cities’ *Environment and Urbanization* Vol. 20, No. 1, pages 207-229.
- Reyos, Jason (2009), *Community-driven Disaster Intervention: Experiences of the Homeless People's Federation in the Philippines*, HPFP, PACSII and IIED, Manila and London, 70 pages.
- Roberts, D (2008), ‘Thinking globally, acting locally – institutionalizing climate change at the local government level in Durban, South Africa’, *Environment and Urbanization* Vol. 20, No. 2, October, pages 521–538.
- Rogner, H, Zhou D, Bradley R, Crabbé O, Edenhofer O, Hare B, Kuijpers L, Yamaguchi M (2007), “Introduction”, in Metz B, Davidson O, Bosch P, Dave D and Meyer L (eds.), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate*, Cambridge University Press, Cambridge.
- Sarin, Madhu (1991), “Improved stoves, women and domestic energy”, *Environment and Urbanization* Vol. 3, No. 2, pages 51-56.
- Satterthwaite, David (2007). *The transition to a predominantly urban world and its underpinnings*. International Institute for Environment and Development, London, Human Settlements Discussion Paper Series, Urban Change 4. September.
- Satterthwaite, David (2008a), *Climate Change and Urbanization: Effects and Implications for Urban Governance*, Paper presented at the United Nations Expert Meeting on Population Distribution, Urbanization, Internal Migration and Development, Population Division, United Nations Secretariat, New York, 27 pages.
- Satterthwaite D (2008b). ‘Cities’ contribution to global warming: notes on the allocation of greenhouse gas emissions’ *Environment and Urbanization* Vol. 20, No. 2, pages 539-549.
- Satterthwaite, David, David Dodman and Jane Bicknell (2009), “Conclusions; Local Development+Adaptation”, in Jane Bicknell, David Dodman and David Satterthwaite (editors), *Adapting Cities to Climate Change*, Earthscan Publications, London.
- Satterthwaite, David, Saleemul Huq, Mark Pelling, Hannah Reid and Patricia Lankao-Romero (2007), *Adapting to Climate Change in Urban Areas: The possibilities and constraints in low- and middle-income nations*, IIED Working paper, IIED, London, 120 pages.
- Secretaria Municipal do Verde e do Meio Ambiente de São Paulo (SVMA) (2005). *Inventário de Emissões de Efeito Estufa do Município de São Paulo*, Centro de Estudos Integrados sobre Meio Ambiente e Mudanças Climáticas (Centro Clima) da Coordenação dos Programas de Pós-graduação de Engenharia (COPPE) da Universidade Federal do Rio de Janeiro (UFRJ).
- Simms, Andrew and Hannah Reid (2006), “Up in smoke? Latin America and the Caribbean. The threat from climate change to the environment and human development”, Third Report from the working group on climate change and development, New Economic Foundation, page 15,
- Stephens, Carolyn, Rajesh Patnaik and Simon Lewin (1996) *This is My Beautiful Home: Risk Perceptions towards Flooding and Environment in Low-income Urban Communities: A Case Study in Indore, India*, London School of Hygiene and Tropical Medicine, London, 51 pages.
- Stern Review Team (2006), *What is the Economics of Climate Change?*, HM Treasury, London.
- Tacoli, Cecilia (forthcoming), “Climate change and migration”, *Environment and Urbanization* Vol. 21, No. 2, October. 2009
- Tibaijuka, Anna Kajumulo (2005), *Report of the Fact-Finding Mission to Zimbabwe to Assess the Scope and Impact of Operation Murambatsvina*, United Nations, 100 pages.
- Tiffen, M. (2003), “Transitions in sub-Saharan Africa: agriculture, urbanization and income growth”, *World Development*, Vol 31, No 8, pages 1343-1366.
- UNDP–DIPECHO (2007), “Proyecto regional de reducción de riesgos en capitales Andinas. Documento país: Bolivia”, Mimeo, Brussels.
- UN-Habitat (2003a), *The Challenge of Slums: Global Report on Human Settlements 2003*, Earthscan Publications, London, 310 pages.
- UN-Habitat (2003b), *Water and Sanitation in the World's Cities; Local Action for Global Goals*, Earthscan Publications, London, 274 pages.

- United Nations (2008), *World Urbanization Prospects: the 2007 Revision*, CD-ROM Edition, data in digital form (POP/DB/WUP/Rev.2007), United Nations, Department of Economic and Social Affairs, Population Division, New York.
- Uplink Banda Aceh and Gabriela Sauter (2009), *The Work of Uplink Banda Aceh*, Local Organization Profile, Gatekeeper Series, IIED, London.
- Valente, Marcela (2007), "Cambio climático. Inundación Santa Fe: aguas violentas, desidia humana", Buenos Aires, April 2, (IPS), <http://www.proteger.org.ar/doc621.html>.
- Van den Poel, E, O O'Donnell, E Van Doorslaer (2007) Are urban children really healthier? Evidence from 47 developing countries, *Social Science and Medicine* Vol. 65, pages 1986-2003
- Velasquez, Luz Stella (1998), "Agenda 21; a form of joint environmental management in Manizales, Colombia", *Environment and Urbanization*, Vol.10, No.2, pages 9-36.
- Wamsler, Christine (2007), "Bridging the gaps: stakeholder-based strategies for risk reduction and financing for the urban poor", *Environment and Urbanization* Vol 19, No 1, April, pages 115–142.
- Weru, Jane (2004), "Community federations and city upgrading: the work of Pamoja Trust and Muungano in Kenya", *Environment and Urbanization* Vol. 16, No. 1, pages 47-62.
- WHO (2001) *The World Health Report. Mental Health: New Understandings, New Hope*, WHO, Geneva
- Wilbanks T and Sathaye J (2007). 'Integrating mitigation and adaptation as responses to climate change: a synthesis' *Mitigation and Adaptation Strategies for Global Change* Vol. 12, issue 5, pages 957-962.
- Wilbanks T, Romero Lankao P, Bao M, Berkhout F, Cairncross S, Ceron J-P, Kapshe M, Muir-Wood R, Zapata-Martí R (2007). 'Industry, Settlement and Society' in Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge.
- Zeballos Moreno, Othon (1996), "Ocupación de laderas: incremento del riesgo por degradación ambiental urbana en Quito, Ecuador", in M A Fernández (editor), *Ciudades en Riesgo, Degradación Ambiental, Riesgos Urbanos y Desastres en América Latina*, LA RED, Lima.
- Zhu, Y. (2003), "The Floating Population's Household Strategies and the Role of Migration in China's Regional Development and Integration", *International Journal of Population Geography*, Vol 9, pages 485-502.