



## Concept Paper

# Reducing the Vulnerability of Urban Slum Dwellers in the Southern African Region to the Impact of Climate Change and Disasters

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## Abbreviations and acronyms

ACCCRN	Asian Cities Climate Change Resilience Network
AEFC	Africa Enterprise Challenge Fund
CAPA	City Adaptation Programmes of Action
CBA	Community Based Adaptation
COP	Convention of Parties
Danida	Danish International Development Assistance
DfID	Department for International Development
GHG	Greenhouse Gases
GLTN	Global Land Tools Network
ICLEI	International Council for Local Environmental Initiatives
IDRC	Canadian International Development Research Centre
IIED	International Institute of Environment and Development
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
LA21	Local Agenda 21
LAPA	Local Adaptation Programmes of Action
MAP	Municipal Adaptation Plans
NAPA	National Adaptation Programmes of Action
RISDP	Regional Indicative Strategic Development Plan
SADC	Southern African Development Community
SCCF	Special Climate Change Fund
SEWA	Self Employed Women's Association
SIDA	Swedish International Development Co-operation Agency
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-Habitat	United Nations Human Settlements Programme
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
WB	World Bank
WWF	World Wildlife Fund



## Glossary of terms

**Adaptation** is an adjustment in natural or human systems in response to actual or expected climate change in order to reduce its harmful impacts. It may take place before the impacts are felt, may be planned through deliberate policies, or may be a spontaneous response to the climate change. It can involve individuals, communities, local governments and nation states.

**Adaptive capacity:** Inherent capacity of a system (e.g. a city government), population (e.g. low-income community in a city) or individual/household to undertake actions that can help avoid loss and speed recovery from any impact of climate change. Elements of adaptive capacity include knowledge, institutional capacity and financial and technological resources. Low-income populations in a city will tend to have lower adaptive capacity than the rich/high-income population.

**Adaptation deficit:** Refers to the lack of adaptive capacity to deal with the problems of climate variability and any future climate-change impacts such as lack of infrastructure provision and lack of capacity to address this. 'Adaptation deficit' is an important concept because most discussions on adaptation focus on adjustments to infrastructure without acknowledging that the relevant infrastructure is not there in the first place. Thus funding for "adaptation" has little value if there is no local capacity to design, implement and maintain the needed adaptation.

**Adaptation and mitigation linkages:** Mitigation refers to avoiding the adverse impacts of climate change in the long run. Failure to mitigate the impacts of climate change will eventually lead to failure of adaptation, hence adaptation and mitigation are not alternative strategies but complementary ones that need to be pursued together. Failure to mitigate sufficiently in high-income nations will create ever more adaptation failures, mostly in low- and middle-income nations, including many with insignificant contributions to climate change.

**Adaptation in situ:** Actions that enable vulnerable populations to adapt successfully to climate change (and climate variability) without moving from their current location, including adaptations made or supported by local governments. In most instances, vulnerable urban populations would prioritise in-situ adaptation because their current home and location was chosen for its access to income-earning opportunities.

**Climate Change:** Generally refers to a change in the mean state of the global climate or to changes in its variability, persisting for several decades or longer. Until recently climate change has been due to factors such as continental drift, volcanic eruptions and changes in the in the chemical composition of the atmosphere, the earth's orbital cycles and solar activity. Current changes in climate and the bio-chemical system exceed the "natural" cycles and there is evidence to suggest that the rapid increase in greenhouse gas emissions and other human activities have changed the climatic cycles beyond what could be expected.

**Climate-change risks:** are seen as risks to people and their livelihoods/investments (e.g. buildings, infrastructure) due to the potential impacts of climate change. These risks can be direct, i.e. more frequent floods, or heat waves, or less direct i.e. negative impacts on livelihoods and access to food (Satterthwaite, et al, 2007).



**Concatenated hazards:** refer to a situation in which a primary hazard leads to secondary hazard (e.g. floods creating water-supply contamination), as well as “**natech**” events where natural hazards trigger technological disasters. The impacts of natural and technological hazards (including pollution events) overlap and compound one another (Lavell, 1999).

**Disasters:** are accidents or outbreaks of disease that kill or seriously injure people and / or damage or destroy property that exceed certain thresholds for the number killed (typically ten or more) or seriously injured (typically 100 or more) (WDR, 2010).

**Greenhouse gases:** are gases that absorb and emit radiation of specific wavelengths, leading to the trapping of heat in the earth’s atmosphere, a process known as the **greenhouse effect**. Although the process occurs naturally and is important in supporting life on earth, the emission of carbon dioxide, nitrous oxide, methane and other gases as a result of human activity has raised the concentration of these gases sufficiently to result in **anthropogenic climate change**.

**Hazard:** is a source of danger and includes both the event and its consequences. Environmental or natural hazards include geophysical and meteorological phenomena such as earthquakes, droughts, and hurricanes, as well as human induced or technological hazards such as pollution. An event is not seen as a hazard until humans are exposed to it. (White, et al, 1994).

**Intergovernmental Panel on Climate Change (IPCC)** is the global scientific body established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization. (WMO). It produces Assessment Reports (most recently, the Fourth Assessment Report in 2007) that summarize the state of knowledge on climate change and its potential consequences. Preparation for the Fifth Assessment Report acknowledges a need for greater attention to adapting cities to climate change and incorporating knowledge and experience on disaster risk reduction.

**Intensive versus extensive risk:** Intensive risk is the risk from major disasters. Extensive risk is the risk of premature death, injury and impoverishment from all events whose impact is too small to be classified as major disasters (Dodman, et al, 2009).

**Limits to adaptation:** Adaptation can reduce the adverse impacts of climate change considerably but cannot eliminate them. Thus, there are limits to adaptation. Also, certain places become permanently beyond adaptation (e.g. coastal zones inundated by sea-level rise), and the number of these places (and the populations at risk) obviously rises without successful mitigation.

**Maladaptation:** Actions or investments that enhance rather than reduce vulnerability to impacts of climate change. This can include the shifting of vulnerability from one social group or place to another; it also includes shifting risk to future generations and/or to ecosystems and ecosystem services. In many cities, investments being made are in fact maladaptive rather than adaptive. Removing maladaptations is often the first task to be addressed before new adaptations are implemented.

**Mitigation:** refers to strategies focused on the reduction in atmospheric greenhouse gases, thereby limiting the extent of anthropogenic climate change. It involves both reducing the quantities of emissions and enhancing the ability of natural and human systems to absorb greenhouse gases.



**Planned adaptation:** Adaptations that are planned in anticipation of potential climate change. Generally, government agencies have key roles in providing the information about current and likely future risks, and providing frameworks that support individual, household, community and private-sector adaptation. However, governments often do not fulfil this role, and civil-society organizations may instead be the initiators and supporters.

**Resilience:** is the capacity of a city or municipality to maintain core functions in the face of hazard, threats and the impacts of disasters, especially for vulnerable populations (Satterthwaite, et al, 2007).

**Risk** is seen as the chance of loss or injury, and environmental risks are defined as the product of the probability of an event and its severity measured in terms of the population exposed, and the nature of the consequences. For example, the risks of a nuclear accident have been expressed in terms of the chance (e.g., one in one million) per exposure unit (e.g., a person exposed to a certain level of radiation) getting cancer (consequences) (NRC, 1996) However, exposure to risk is not the same as vulnerability (WDR, 2010).

**Risk accumulation processes:** the idea that a series of small events and disasters and their linkage to everyday hazards increases the likelihood of harm, death or loss of assets for the poor (Bull-Kamanga, et al, 2003).

**United Nations Framework Convention on Climate Change (UNFCCC)** provides the global legislative framework for reducing global warming and responding to climate change and convenes the annual meeting for negotiating emissions reductions and adaptation financing known as the Conference of Parties (COP).

**Vulnerability:** how well/badly an individual, group or community or city is affected and is able to cope or handle a disaster or occurrence that happens to them.



## Executive Summary

This concept paper summarises some of the current issues, concerns and debates surrounding urban vulnerability, climate change and the ability of certain adaptation and mitigation strategies to reduce or moderate the impacts and effects of climate change for slum and informal dwellers.

Current estimates of climate change state that the world's average temperature is due to increase by at least 2°C to 2.4°C over the next 50-100 years. Furthermore it is expected that by the end of the century a range of additional impacts will be felt: sea levels will rise by an estimated 60cm, resulting in flooding and the salinisation of fresh water aquifers, and snow and ice cover will decrease. Simultaneously, precipitation patterns will change so that some areas will receive large increases whilst other areas will become hotter and drier.

Importantly for urban areas, it is expected that there will be an increase in the number and severity of certain types of "disasters" such as tropical cyclones, storms, floods and heat waves (GTZ, n.d.). There will also be a host of indirect impacts for cities, such as decreases in food production, freshwater availability and large numbers of migrants and climate change refugees (World Bank, 2010).

The end result is that poor urban dwellers who already live in states of vulnerability and currently bear the highest health and diseases burden will be most affected by climate change. Within that group, differentiations can still be made such that women, the very young, and very old, new migrants and the generally socially and politically marginalized will be most adversely affected.

In most cities the reason for such heightened ill effects is due to the situation of the urban poor. In general the urban poor live in the most dangerous situations within human settlements, such as unstable hill-slides, flood plains, and areas of seismic activity. During disasters and longer-term weather cycles, it is these areas, which are most affected and least able to cope, in large part due to poor infrastructure, poorly constructed buildings, over-crowding and inaccessibility to what emergency services may exist.

There is no question that climate change and its effect on the urban poor is an important area of enquiry and that Africa in general, and urban Africa in particular, need a great deal more research, advocacy and implementation if the urban poor are going to be able to reduce their vulnerability and adapt to a changing climate and all that it will bring.

Much can be done to reduce the vulnerability of the urban poor, and a large number of local organisations and international institutions such as the International Monetary Fund (IMF), World Bank (WB), United Nations, the UK's Department for International Development (DfID) and the Danish International Development Assistance (DANIDA) have devoted a great deal of time, effort and funding to these issues. They have been involved in examining and implementing climate change mitigation and adaptation strategies both in their own countries and the developing world.





They are joined by independent philanthropic societies such as the Rockefeller Foundation, who have also been involved in funding and supporting climate change interventions across the world. These have included general research as well as other approaches such as micro-lending and micro-insurance for the poorest groups. In the urban context, ideas around the development of sustainable and resilient cities have loomed large. The International Council for Local Environmental Initiatives (ICLEI) and the World Bank have been at the forefront of promoting such approaches.

While this paper reviews some of the work and literature that currently exist on the topic of urban vulnerability for informal and slum dwellers and the potential impact of climate change, as well as some relevant mitigation and adaptation strategies, it should be noted at the outset that this is a very large field with a number of sub-disciplines and specialist areas. A great deal of work has already been produced on vulnerability in general, and climate change and vulnerability in particular.

However, up until recently there has been a dearth of research on issues of urbanisation, vulnerability and climate change, and there are certainly 'gaps' in the literature, advocacy and interventions around this topic that we point out in this paper and which should be addressed in further work.



## 1. Introduction

Cities are both the most affected sites of climate change, and at the same time, some of the greatest contributors to climate change (World Bank, 2010). Poor and marginalised communities, who already live in stressed, dangerous and hazardous conditions, will potentially feel the worst effects of long-term changes in weather and increased extreme weather events. This is not to say that low- and medium-income countries will experience more frequent or more extreme events than high-income centres; rather that the impact of these events will be more severe on poorer households and communities, who are less able to protect themselves from these events and are often less able to recover afterwards. Poor or non-existent infrastructure, dangerously located settlements, and low quality housing (within a context of political exclusion) have meant that poorer households and communities are particularly vulnerable to the impacts of climate change and its associated set of extreme weather events and impacts.

Currently reducing communities' vulnerability to climate change is being considered through adaptation and mitigation strategies, which are being put in place at a range of scales in order to try and prevent further environmental degradation and to adjust to existing and future impacts of climate change. Large donor and international organisations have considered financial support, multi-lateral agreements and small-scale community initiatives amongst a host of other activities in their drive towards mitigating or adapting to climate change. However only a very few of these would significantly contribute to poorer people's ability to access, hold or use land in ways that would necessarily reduce their vulnerability to climate change.

Climate change – as an area for research, discussion and intervention – has generated a significant amount of attention, particularly around scientific, biological and zoological concern, however little work has focused on the issue of urban land, urban growth, spatial planning and vulnerability (UN-Habitat, 2010). This concept paper summarises some of the current issues, concerns and debates surrounding urban vulnerability, climate change and the ability of certain adaptation and mitigation strategies to reduce or moderate the impacts and effects of climate change for slum and informal dwellers.



## 2. Climate change: why and how?

According to the United Nations Framework Convention on Climate Change (UNFCCC, 2008), climate change is "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The basic premise of current thinking around climate change is that human actions, particularly since the industrial revolution, have exacerbated normal climatic cycles through enhancing the earth's natural greenhouse effect. The earth's average temperature is normally maintained through a system by which solar energy from the sun warms the planet, but is also reflected back out into space as infrared thermal energy. Human activities have effectively modified this process by increasing the amount of Greenhouse gases (GHGs) in the atmosphere (NASA, 2009). The argument is that over the last century the burning of fossil fuels like coal and oil has increased the concentration of GHGs, which in turn has ensured that less radiation is able to "escape" and is thus trapped within the atmosphere warming the earth's average temperature and causing a series of changes to the earth's climate.

According to climatologists and climate change experts there are two distinct types of drivers of climate change: climate 'forcings', which are the primary source of a climate shift and climatic 'feedbacks', which are processes that change or respond to a change in forcing, and exacerbate or diminish climate change. Forcings can include an increase in the amount of certain GHGs in the atmosphere or increased solar irradiation. Feedback that increases an initial warming is called a "positive feedback", whereas feedback that reduces warming is a "negative feedback". One of the most influential positive feedbacks in climate change is the ice-albedo feedback, whereby as the atmosphere warms, oceanic ice melts and exposes more of the ocean surface. The ocean surface is far less reflective than ice – absorbing more heat – thus creating an overall increase in the ocean and earth's temperature (NASA, 2009). While both forcings and feedback exist naturally, findings by Lockwood (2009) and Lean (2010) have shown that the current degree of climate change is unprecedented, and the natural causes are insufficient to explain recent climate changes and those expected over the next century (The Royal Society, 2010).

Human activities, such as industry, land clearances, and intensive agriculture, have led to increases in GHGs that in turn have exacerbated climate forcings and feedback. Certain GHGs, such as Carbon Dioxide, Methane and Nitrous Oxide are considered to be climate change forcings, whereas water vapour is seen as a climate change feedback. Carbon dioxide (CO<sub>2</sub>), which naturally comprises a very small percentage of the atmosphere, has increased through human activities. Although carbon dioxide is released through natural processes such as respiration and volcanic eruptions, over the last century its quantity in the atmosphere has increased due to deforestation, land use changes, and the burning of fossil fuels. NASA (2009) has estimated that humans have increased atmospheric CO<sub>2</sub> concentration by over a third since the Industrial Revolution. CO<sub>2</sub> is seen as the most important forcing GHG in climate change due to the quantity of the gas and its longevity in the atmosphere. The main concern is not just that the amount of CO<sub>2</sub> being produced by human activities but also that 'natural sinks', which absorb and utilise CO<sub>2</sub> such as photosynthesis, are being destroyed through deforestation and changes in land use (Petit, et al, 1999; IPCC, 2007).



Methane is a further climate change driver and is a far more chemically active GHG than CO<sub>2</sub>. However there is less of it in the atmosphere and is thus considered less of a danger. Methane is produced through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. As the demand for meat and meat products has increased so too has the amount of methane in the atmosphere. Similarly Nitrous Oxide has increased due to soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning. Entirely anthropogenic GHGs are the Chlorofluorocarbons (CFCs), which are synthetic compounds of industrial origin used in a number of applications. They are however, now controlled due to a series of international agreements. Water vapour, which is the most abundant greenhouse gas, acts as a 'feedback' and increases as the Earth's atmosphere warms. This makes it one of the most important feedback mechanisms to the greenhouse effect.

How much infrared thermal energy is retained is dependent on the concentration of these GHGs in the atmosphere. The more GHGs in the atmosphere, the less thermal energy is radiated into space and is trapped and re-radiated back to the earth's surface in a variety of ways, increasing the earth's average temperature (Mash, 2010). There are, however a number of uncertainties about the forcings, feedbacks and effects of climate change. At present there is some debate around the precise role of clouds, and particulate matter for example, and there are wide variations in models around oceanic circulation and precipitation (NASA, 2009). However there is consensus that the climate is changing and that it is likely that there will be large changes in temperature and precipitation over the next century accompanied by more frequent and more extreme weather events (IPCC, 2007).

## **2.1 The built environment and urbanisation: their role in climate change**

Different regions, cities, activities and communities have made significantly different contributions to climate change (Hoornweg, Sugar and Gomez, 2011). To put this in context, Africa's contribution to global GHG emissions is relatively marginal when compared with other continents: in 2009, it was estimated at between 2.8% and 3.1% of global emissions from fossil fuels (IPCC Summary 2007; SADC, 2008). Per capita, this means that historically, the average resident of the Indian sub-continent has produced around one tonne of CO<sub>2</sub> emissions per year and the average European approximately nine tonnes, while the average US citizen has been responsible for producing 20 tonnes (GTZ, n.d.). However, this pattern is changing as some rapidly industrialising nations and medium-income nations are now producing a disproportionate share of GHGs (GTZ, n.d.). In Africa, South Africa<sup>1</sup> produces almost 42% of the total carbon emission of the continent (Du Plessis, et al, 2003).

Within regions and countries, cities in general are responsible for producing massive amounts of greenhouse gas emissions – the World Wildlife Fund (WWF, 2010) states that cities contribute 80% of the CO<sub>2</sub> that is emitted into atmosphere. The high rate of emissions comes from a number of sources, including refrigeration and heating systems, domestic air conditioning, road and rail transport and aviation, and factories and industrial sites.

This makes them major drivers of climate change. New cities are constantly emerging and rates of urbanisation are increasing far more rapidly in the developing world than in Europe and North

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<sup>1</sup> Du Plessis, C., Irurah, D., and Scholes, R. J., 2003: The built environment and climate change in South Africa, *Building Research and Information*, 31 (3-4), 240–256 provide a detailed discussion of the role of the built environment on climate change.



America, which has further implications for climate change. The next few sections summarise the role that urbanisation is, and will, play in climate change.

### 2.1.1 Urbanisation / urban growth

2008 marked the transition from a world population that was mostly rural to one that is mostly urban (see Box 1). It is estimated that the urban population in the developing world is growing daily by 180 000 people and by 2030 there will be 2 billion new urban dwellers in developing countries (GTZ, n.d.). The table below (Table 1) shows the projected growth in urban population by continent. By 2030 Africa, the world's least urbanised continent, will have over half of its population living in cities (IPCC, 2007) most of whom will be living in small (less than half a million) and medium (between 1-5 million people) cities. Urbanised and urbanising populations require a range of services, amenities and facilities in order to survive. The increase in urbanisation, especially in the developing world, has meant an increased demand for housing, sanitation, employment, healthcare and transport. Simultaneously, it has meant an increase in the amount of energy consumed, the quantity of water used, ground and air pollution produced and a significant increase in waste.

There are two axes to the debate regarding the relationship between cities and consumption: the first is a temporal axis, where a city or space is within the phases of development and maturation. Cities consume far more in their start up phase than at other times of their development. However the second axes regarding consumption and size demonstrates that the size of a city does not necessitate a high consumption rate. Large cities are not necessarily the largest consumers of resources and can, with the relevant technologies, be far more resource efficient than other less densely occupied and populated areas.

**Table 1: Estimates of urban growth until 2030 (IPCC, 2007: 363)**

Year	Percentage urban				Percent of the world's urban population living in the region				Percent of urban population in different size-class of urban centre, 2000				
	1950	1975	2000	2030*	1950	1975	2000	2030*	Under 0.5 m	0.5-1 m	1-5 m	5-10 m	10 m +
Northern America	63.9	73.9	79.1	86.7	15.0	11.9	8.8	7.1	37.4	11.0	34.3	5.4	11.9
Latin America and the Caribbean	42.0	61.2	75.4	84.3	9.6	13.0	13.9	12.4	49.8	9.0	21.7	4.9	14.7
Oceania	62.0	71.5	70.5	73.8	1.1	1.0	0.8	0.6	41.9	0	58.1	0	0
Europe	50.5	67.9	71.7	78.3	37.8	29.2	18.4	11.1	67.8	9.8	15.1	5.4	1.9
Asia	16.8	24.0	37.1	54.1	32.0	37.9	47.9	53.7	49.0	10.0	22.6	8.8	9.7
Africa	14.7	25.4	36.2	50.7	4.5	7.0	10.3	15.1	60.2	9.6	22.1	4.6	3.5
WORLD	29.0	37.2	46.8	59.9	100	100	100	100	52.6	9.8	22.4	6.8	8.4



### *i. Urban cycles of expenditure and emissions*

The WWF (2010) provides a model that demonstrates that human settlements go through a predictable cycle of expenditure and emissions over time (see Figure 1). This means that during the early stages of city development, the bulk of expenditure and emissions comes from a combination of building construction, public transportation development and infrastructure improvements (UNEP-SBCI, 2009). To put this in perspective, the IPCC 4<sup>th</sup> Assessment states that worldwide building-related CO<sub>2</sub> emissions (including electricity usage) amounted to 8.6 billion tonnes in 2004, which constitutes about 30% of global anthropogenic emissions. The IPCC (2007) predicts that even under a low growth scenario, building activities will still produce 11.4 billion tonnes by 2030. This means that urbanisation, the development of new cities, and the growth of existing cities, have played and will continue to play a significant role in climate change emissions.

#### **Box 1: Urban squatters save the world**

Cities have always created wealth, and have always been a population sink. Still, a world now more than half urban and headed toward 80 percent urban by mid-century will be a historical first. The world's population is predicted to peak by 2050, probably below 9 billion people, and then decline rapidly.

Unless climate change or some other calamity intervenes, city-driven wealth and technology will accelerate worldwide, the bulk of humanity will continue its climb out of poverty, and peasant life dependent on subsistence agriculture will nearly disappear. Villages all over the world are emptying out as people flood into cities in search of opportunity. They keep coming because they are succeeding in town. Every year there are 70 million new residents in cities, decade after decade, most of them in the developing world – the “global south,” where five out of six people live (5.7 billion). The ex-peasants often start in nearby small towns to acquire urban savvy and then head to big city slums. When the existing slums are full, they build new ones. A billion people live in such places now, and another billion is expected.

It can be rough. New shanty-towns lack sanitation, water, electricity, and organization. In the early years, the place stinks, water and power are stolen and irregular, organization is improvised and sometimes criminal, and the homes are hovels. The whole community is always under threat of being bulldozed out of existence. But the outlaw citizens find themselves in a cash economy at last, and it is vibrant. Every lane among the shacks teems with food stalls, cafés, hair salons, clothing racks, temples, health clubs, and mini-shops selling everything. Cell phones abound. Most of the economy is “informal”—no deeds, no licenses, no taxes. Rupee by rupee, shilling by shilling, peso by peso, real by real, squatter families are working their way up in the world.

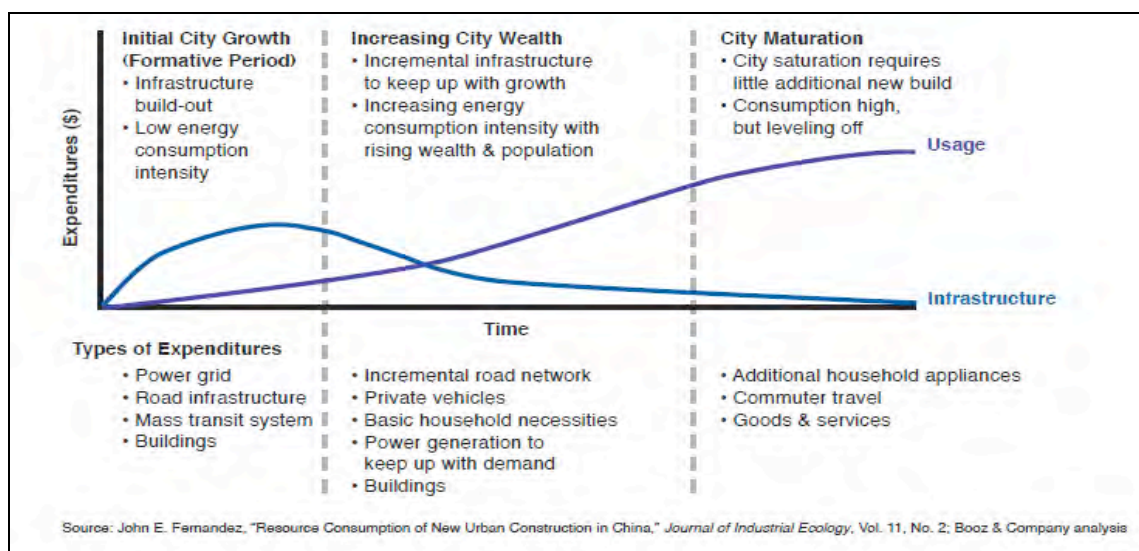
According to urban experts, squatters are now the dominant city builders in the world. Over time the tarpaper shacks are rebuilt of masonry, four and five stories high. The homes eventually have refrigerators, TVs, washing machines, and computers. Motor scooters multiply. Air conditioners require new levels of electricity. Meanwhile the marginal-land subsistence farms the squatters abandoned are growing back... According to a 2005 UN report, fifty-five times more rainforest is growing back as second growth in the newly empty rural areas than is being cut down from primary forest. In town, the squatters are the world's most efficient users of energy and materials. They recycle everything themselves, and provide extensive recycling services for the city at large. Dharavi, the biggest slum in Mumbai, has four-thousand recycling units and thirty-thousand ragpickers.

All the great cities in the world once began as shantytowns. The difference now is scale and pace. London, Paris, Berlin, New York, and Tokyo continue to grow, but the new great cities—Lagos, São Paulo, Mexico City, Jakarta, Delhi, Shanghai, Karachi, Manila, Tehran, and many more—are growing three times faster and nine times bigger. So what's new? For the next three decades we will have huge, churning new cities full of young people pursuing opportunity in the global south, contrasted with sclerotic old cities full of aging populations holding on to what they have in the global north. Where do you think the action's going to be?

*(Adapted from Brand, S., 2011, Urban squatters save the world, McKinsey and Company Website, <http://whatmatters.mckinseydigital.com/cities/urban-squatters-save-the-world>)*



According to the model, once cities “mature” and the rate of building decreases, their energy usage and emissions will change from building-related activities to use-related activities (WWF, 2010). Relatively speaking, using existing infrastructure and buildings contributes very little to GHGs, a figure of approximately 8% (GTZ, n.d.). The current and future issue that this model exposes is that cities are set to increase in size and number, with small and medium cities predicted to grow exponentially over the next few decades. Urbanising populations will need greater infrastructure and buildings to accommodate the new migrants coming into these cities, which, unless carefully managed, will result in high rates of GHG emissions and large ecological footprints.



**Figure 1: Infrastructure life cycle of cities: typical city and expenditure emissions trajectory (WWF, 2010: 4)**

## ii. Ecological footprints, densities, wealth and consumption

The start up or developmental phase of a city accounts for a great deal of its consumption, however findings from Ecological Footprint methodologies, which measure "the area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces" suggest that the size of a city's or country's ecological footprint is closely correlated to its GDP, rate of consumption and the ability of the state to provide efficient services rather than the size of its population. It is estimated that a city's absolute carbon footprint increases by an average of 57% for each doubling of consumption (WWF, 2010). There is a correlation between Gross Domestic Product and Ecological Footprints, which would seem logical as the more that people consume and produce economically the larger their footprint would be (WWF, et al, 2007). Findings from a Global Footprint Network and the WWF study of GDP and ecological footprints also notes that within the EU member countries, "...as levels of development, as measured by the Human Development Index (HDI), increase, so too do footprints" (WWF, et al, 2007: 3). Thus it would seem that on average countries and cities with high GDPs, and HDIs also have larger ecological footprints. This is also true at the scale of the individual: the wealthiest citizens of any society are the greatest contributors to climate change as they are responsible for higher rates of waster production and consumption than their fellow poorer residents (WDR, 2010; World Bank, 2010).



However, the size and density of cities may provide opportunities to reduce ecological footprints (World Bank, 2010). The average residents of cities such as New York and London demonstrate much lower per capita GHG emissions than their compatriots living in less densely settled areas. In fact the average resident of New York generates just 30% of the emissions of the average American, mainly due to higher densities and less reliance on automobiles and the average London resident generates just 55% of the emissions of the average UK resident (WDR, 2010: Hoornweg, Sugar and Gomez, 2011). Or put another way, the global average ecological footprint is approximately three hectares per person per year, in the UK the average is 5 hectares, which means that London with a population of over 8 million people has been able to keep its footprint closer to the global average than the rest of the country (Global Footprint Network, et al, 2010). In the same way the United States has an average ecological footprint of 8 hectares per person, which once again means that a large, densely occupied city is able to meet the global average (Global Footprint Network website, 2010). However, even within cities there can be large variances in the amount of resources consumed and GHGs produced. City cores, especially those that are densely settled and have good access to public transport, generally have lower footprints than suburbs and wealthier neighbourhoods, with high car usage and inefficient (and often large homes) homes, and sprawling suburbs have much larger footprints. Thus it would seem that in situations of high densities, relatively high HDIs and GDPs there are still opportunities for reducing the impacts of cities on the environment. Hoornweg, Sugar and Gomez (2011) cite the use of alternative energy sources, better public transport, and state intervention into building and urban planning. These issues will be discussed in further detail in the section on mitigation and sustainable cities (World Bank, 2010).

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### *iii. Heat islands and their contribution to climate change*

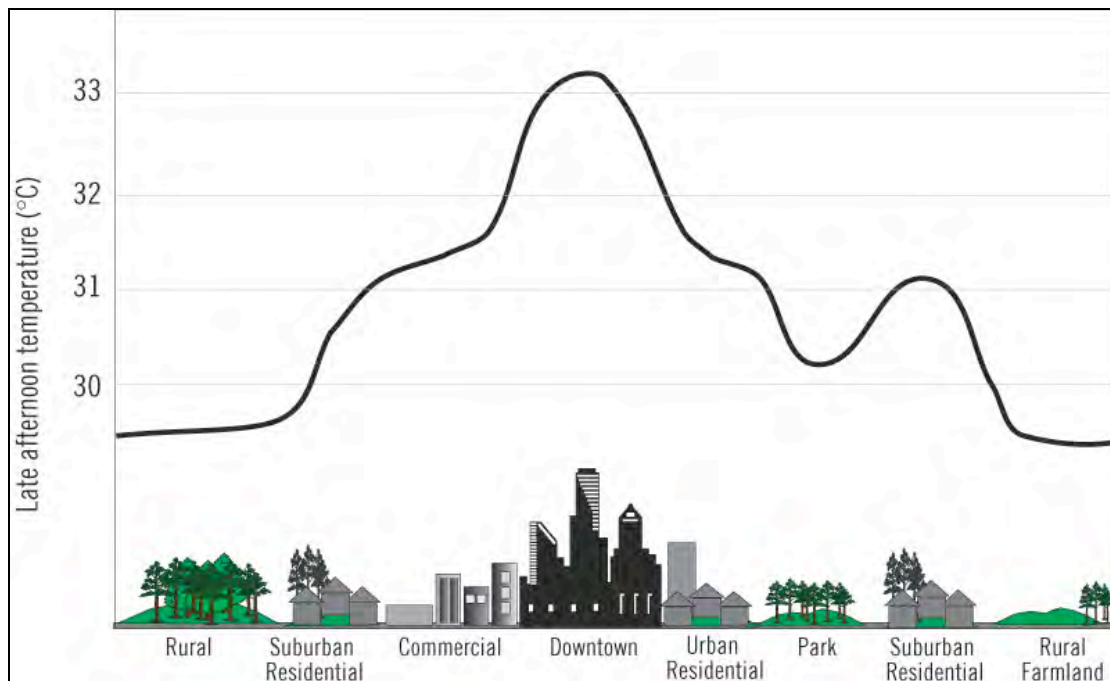
A further issue related to cities and their impact on climate change is that they produce a micro-climatic phenomenon known as the 'heat island effect', which contributes to changes in the local climate. Heat islands result from the absorption of heat and its re-radiation by built structures such as tall buildings and pavements, as well as the higher concentrations of GHGs over cities. Buildings and pavements absorb heat during the day and re-radiate it at night, whilst the higher GHGs trap more radiation, which increases the average temperature within a city, making it hotter than the surrounding countryside. Taha (1997: 99) notes that in northern hemisphere cities, for which there are more complete records, urban centres when compared to their rural surroundings have "an average of 12% less solar radiation, 8% more clouds, 14% more rainfall, 10% more snowfall, and 15% more thunderstorms than their rural counterparts. Urban pollutant concentrations can be 10 times higher than those of the 'clean' atmosphere and air temperatures can be on the average 2°C higher".

Cities are hotter than the surrounding areas, but even within cities there are certain areas that produce more heat and suffer greater effects of heat generation than others. Central Business Districts, which often have few green spaces and many tall buildings, as well as highly industrialised areas, tend to produce more heat than suburbs and less densely commercialised spaces (see Figure 2).





The heat island effect also increases and amplifies other temperature stresses so that cities have even hotter climates than would otherwise be experienced as a result of global warming (Bretz, et al, 1998).



**Figure 2: Heat island effects (Natural Resources Canada, 2009: webpage)**

However it should be made clear that the heat island effect does not have an overall impact on global temperature or precipitation, its effect lies in its ability to amplify other causes of climate change (Morris, 2006).

Cities' contribution to climate change lies in their large contributions to the GHGs produced and resources consumed. The current and predicted rates of urbanisation, which ensure that more cities are built and enlarged, does not bode well for climate change, as it is this phase which contributes the most climate change emissions.



### 3. Impact of climate change on urban settlements

According to the IPCC (2007), human activities have effectively increased the average global surface temperature by at least 2°C to 2.4°C and it is expected that by the end of the century a range of further impacts will be felt: surface temperature will go up by 5.8°C and sea levels will rise by an estimated 60cm, resulting in flooding and the salinisation of fresh water aquifers, and snow and ice cover will decrease. Simultaneously, precipitation patterns will change so that some areas will receive large increases whilst other areas will become hotter and drier. Most importantly for urban areas, it is expected that there will be an increase in the number and severity of certain types of “disasters”, such as tropical cyclones, storms, floods and heat waves (GTZ, n.d.).

The direct impacts of the climate changes mentioned above are just one aspect of the problem. Further concerns include:

- The longer term indirect effects of these factors
- The feedback loops which can exacerbate or trigger other issues (known as natech hazards)
- The issue of accumulation of risk and stresses over time, which gradually erode coping mechanisms, assets and livelihood bases.

These issues are discussed in further detail later in the paper (Bull-Kamanga, et al, 2003; Satterthwaite, et al, 2007; Du Plessis, et al, 2010).

#### **3.1 Impact of climate change: the effects of location and scale**

According to the IPCC Summary (2007). “[T]he costs and benefits of climate change for industry, settlement and society will vary widely by location and scale” (see Box 2 for a discussion of scale and Appendix I for a table of all of the various climate changes and their potential impacts on human settlements). Climate change-related events have far greater impacts in low- and medium-income countries than in high-income nations (UNISDR, 2004). By way of example, the WDR (2010) reports that on average Japan has more people exposed to tropical cyclones than the Philippines, and notes that if both countries were affected by a cyclone of the same magnitude, it is likely that the mortality rate in the Philippines would be 17 times higher than that of Japan.

Figure 3 also demonstrates this point by showing the vast difference in deaths related to disasters between low-, medium- and high- income nations. It is apparent that cities in developing countries are a great deal more affected than developed world states as more than 90% of deaths relating to natural disasters occur in the developing world. Since 82% of the world’s population live in developing countries this may be less surprising than it would first appear (UNISDR, 2004). However, between 1985 and 1999, the world’s wealthiest nations suffered 57.3% of the measured economic losses due to disasters, which translated into a figure of approximately 2.5% of their GDP, while in contrast, the world’s poorest countries suffered 24.4% of the economic toll of disasters, but loss amounted to 13.4% of their combined GDP (ADRC, 2005).



## Box 2: The relationship between scale and impact

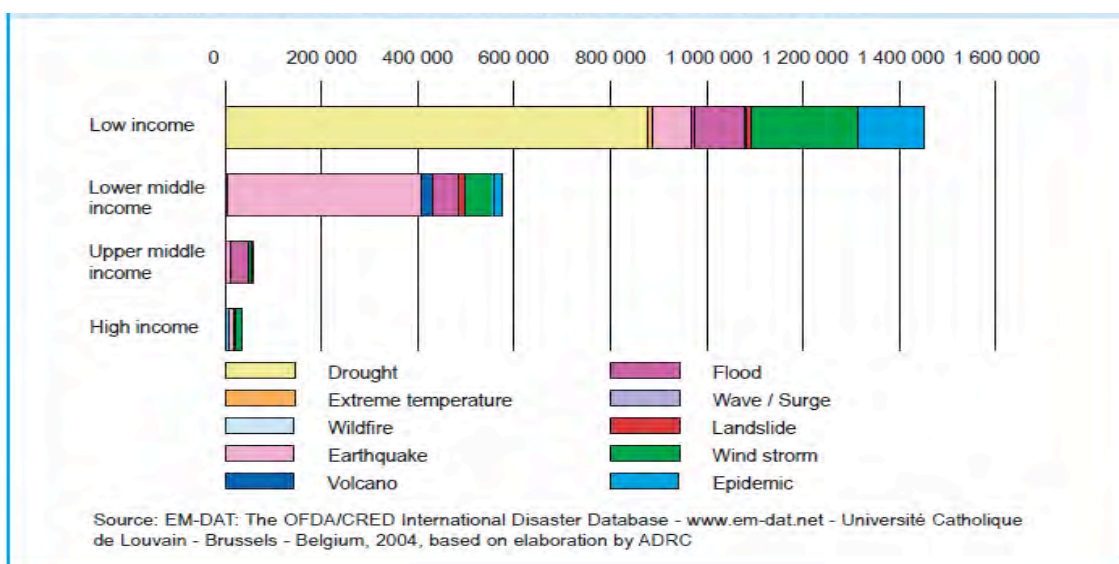
Scale matters in at least three ways in assessing the impacts of climate change on settlements and society:

First, climate change is one of a set of multiple stresses operating at diverse scales in space and through time. For developing countries, non-climate stresses play an equally if not more important role, and the distribution of elements such as poverty at the national, regional and local scales influence the extent of the possible impact of climate change.

Second, both the exposure to climate change and the distribution of climate-sensitive settlements and industrial sectors vary greatly across geographic space. Social and economic conditions that influence adaptive capacity also differ with scale, and the ability to access to financial resources, infrastructure and prioritisation by the national government e.g. primate cities have generally experienced greater investment than secondary cities, small towns and agricultural villages.

Third, time is a critical determinant of the capacity of human systems to adapt to climate change; for instance, rapid changes are usually more difficult to absorb without painful costs than gradual change. Slow changes are more easily absorbed and can be incrementally included in behaviour, budget, and policy, whereas shocks are more difficult to respond to, particularly in situations of resource poverty.

*(Adapted from IPCC, 2007)*



**Figure 3: Number of people killed (income/disaster type), world summary 1973-2002 (UNISDR, 2004: 40)**

### 3.2 Hazards, risks, disasters and vulnerability: the inter-relationship

The reasons cities in low- and medium-income countries will be more affected by events related to climate change are due to a number of inter-related factors concerning the hazards and risks that low-income groups are exposed to, as well as their pre-existing vulnerability (Downing, et al, 2002) (see Table 2). Poorer households and communities live with a wide variety of hazards, including poor quality living environments and exposure to pollution.



Whether these factors impact on people’s lives and to what extent, is influenced by their vulnerability and the ability of these groups to cope. The more hazards that exist and the less people / communities are able to deal with them effectively raises the risk profile of the group in question.

According to the literature on climate change and its impacts, a disaster occurs when a risk moves from a probability to an actual event (Downing, et al, 2002). This set of relations helps to explain why poorer communities who are faced with greater ranges of hazards and are less able to cope, are more affected than wealthier and better resourced countries and communities.

Climate change should thus be seen as an additional layer to an already precarious situation, or as Satterthwaite, et al (2007: 4) states, “It makes no sense to discuss the vulnerability of urban populations to climate change and responses to it separate from their vulnerability to extreme weather events or disasters that are not caused by climate change”. The following section discusses the wide range of vulnerabilities that poor urban communities and slum dwellers are exposed to, and argues that the pre-existence of these factors exacerbates and amplifies the effects of climate related events.

**Table 2: The inter-relationships between hazards, vulnerability, risks and disasters (Downing et al, 2002: 15)**

<b>Hazard</b>	:	<b>potential threat to humans and their welfare</b>
<b>+</b>		
<b>vulnerability</b>	:	<b>exposure and susceptibility to losses</b>
<b>=</b>		
<b>risk</b>	:	<b>probability of hazard occurrence</b>
<b>disaster</b>	:	<b>realization of a risk</b>

### 3.3 Vulnerability

One of the key issues that mitigates or amplifies the effects of hazards and events and turns them into what can be categorised as ‘disasters’, is that of vulnerability. The term “vulnerability”, however, is not without its controversies. O’Brien, et al, (2004) point out that there is actually a schism in the way that the word vulnerability is used and understood, which has led to different uses of the term for policy and interventions. They claim that the term can be understood as an end point, or as “...a residual of climate change impacts minus adaptation. Here, vulnerability represents the net impacts of climate change” (O’Brien, et al, 2004: 1). In this context they argue that the term is used to define the extent of the climate problem, which allows states to calculate the cost of climate change versus costs related to greenhouse gas mitigation efforts, for example.

The second definition of vulnerability sees vulnerability as the starting position of the country, city or community in question, which is “generated by multiple environmental and social processes, but exacerbated by climate change” (O’Brien, et al, 2004: 1). This document uses the second definition to explore how well/badly an individual, group, community or city is affected and is able to cope with a disaster or occurrence, both at the time of the event and afterwards (IPCC, 2007).



In summary: if people, communities and cities were not vulnerable, there would be fewer and less fatal disasters. The World Disaster Report (WDR, 2010) reiterates this point, and argues that when disasters strike, well-managed and well-governed cities can be amongst the safest places to be both during the event and afterwards, due to the infrastructure and building quality and design. However, the opposite can be experienced in low-income areas, with existing vulnerabilities as the key factors, which can turn events into disasters (Pelling, 2002).

As mentioned earlier, vulnerability is also highly variable, and not all cities, individuals or communities are equally exposed or at risk of being negatively affected by disasters and the longer-term climate changes. Higher income groups and larger or more prosperous enterprises are often better able to avoid most or all such risk, and are generally better able to deal with the consequences and implications of a disaster or event (Satterthwaite, et al, 2007). The IPCC, the IIED and the GTZ all argue that the vulnerability of a group or city is largely determined by the development context, which influences everything from households' income, education and access to information, to the quality and extent of provision for infrastructure and services (including post-event services). Thus, in contexts of high Gini coefficients, where there are large discrepancies in the living conditions of different social groups, the poorer groups are hit hardest. That is not to say that the effect of a country with a low Gini coefficient will not have a uniformly greater effect but rather that in a situation where income disparities exist, it is the poor members of society who will feel the disproportionate effects of disasters rather than their wealthier compatriots. This is due to the combination of having the worst pre-existing conditions, such as poorer health and living environments, a far greater exposure to hazards due to a lack of infrastructure that can protect them and less capacity to cope and recover once an event has taken place, i.e. fewer assets, less political "pull", lack of insurance and access to legal assistance (CCD, 2009). Even in situations in which people have relatively good or even good infrastructure, if the settlements' location is vulnerable or dangerous then there is only a limited amount that can be done through infrastructure development to mitigate the impacts of climate change. It is, however, generally the poor who face the consequences of inadequate or non-existent spatial planning and who are forced to situate themselves in dangerous locations.

These points are made obvious when looking at the case of the impact of Hurricane Mitch on Honduras in 1998. The hurricane affected 3.5 million people and resulted in \$6 billion worth of damages. The Honduras accounted for 6,000 out of the 9000 killed by the Hurricane, and for economic losses of nearly \$4 billion. Thus the country experienced the lion's share of the impact. The majority of damage was due to landslides, and is closely related to land degradation and deforestation. The landslides destroyed bridges, highways, and infrastructure and accounted for most of the deaths. Two groups of people were disproportionately effected: very low income households who resided on the slopes of hills in poorly constructed units; and extremely poor rural dwellers who were outside of the main route of the hurricane but "were nonetheless significantly impacted because of their inability to respond and adapt to what little damage the area did experience" (Downing and Ziervogel, 2002: 6).

### **3.3.1 Urban governance and vulnerability**

Dodman, et al, (2009) argue that "...at the core of much of the urban population's vulnerability to disasters (and other environmental hazards) is the mismatch between the economic drivers of urban expansion (the concentration of profit-seeking enterprises and investments in particular cities) and the institutional mechanisms to manage or govern the direct and indirect implications of this concentration" (Dodman, et al, 2009).



The WDR (2010) describes this mismatch as the ‘vulnerability gap’. On one side of the gap is the lack of knowledge or financial capacity, and sometimes willingness of urban authorities to reduce vulnerabilities. On the other side of the vulnerability gap are poor urban communities, who do what they can to reduce their vulnerability, but ultimately are limited in their financial and political capability to reduce the risk they face. Satterthwaite, et al, (2007) agree that at its core, vulnerability is influenced by the inability or unwillingness of the state to provide the necessary housing or infrastructure to slum and informal dwellers. Part of this is also due to the perception by many governments that what should be provided is a fully serviced, house with all of the amenities. Such provision lies outside of the abilities of most states’ capacity and budget. Some therefore argue that what should be examined is not full housing provisions but rather an emphasis on the provision of planned secure land with basic services as a first step towards a longer-term housing and settlement upgrading process (Urban Landmark and Afesis-Corplan, 2009). This approach would, at the very least, reduce some of the factors that contribute to the urban poor’s vulnerability. Unfortunately the entrenched ideas of the social and political elite need to be addressed before such a programme could be implemented: the elite often see the poor and the marginalised as the cause of much of the environmental degradation, and their land use as illegal, “backward” and holding the city back from development and the attainment of modern city life. As such, the poor become even more vulnerable, as they face a double threat: that of climate change, as well as, a state that does not provide appropriate urban environments and is unlikely to help or support them when disasters do strike.

### 3.3.2 Location and situation

Within a context of poor state capacity, urban vulnerability is further influenced by the *location* of low-income settlements. Little if any safe, well-located, well-planned land is made available for poor populations (Satterthwaite, et al, 2007). As a result, the poor tend to live in informal settlements and slums, with irregular land tenure and self-built, substandard houses, lacking adequate water, drainage and other public services, and are often situated in risk-prone areas (World Bank, 2010). It is difficult to estimate the precise number of people living in these conditions, but the UN approximates the figure at around one billion, and it is expected that by the end of the next decade, this figure will rise to 1.4 billion (WDR, 2010).

Most informal settlements and slums are located on “dangerous” land due to the fact that this is the cheapest and least desirable property within the city. Thus, poor urban dwellers can generally only access spaces that effectively no one else wants, and UN-Habitat reports that four out of every ten non-permanent houses in the developing world are now located in areas threatened by floods, landslides and other natural disasters, as well as close to noxious industries, sewerage farms or landfills (Un-Habitat, 2009: xxii). In addition, the ‘heat island effect’ means that some areas of the city are hotter and have worse air quality than others and it is to these spaces that the poor are often relegated through market forces and lack of state intervention (Marx and Royston, 2007). As cities’ climates change and temperatures increase whilst rainfall declines, the ‘heat island effect’ will be more apparent in some areas than in others, even in more compact and densely occupied cities. Thus poor people will also most likely have access to areas where heat stroke and air pollution are worse, whilst those who can afford it will move to greener, cooler and less polluted areas, once again increasing the health burden on the urban poor. Thus when floods occur, sea levels rise or hurricanes and tropical storms occur; it is most likely to be the poorest who are most affected.



Globalisation and global mechanisms, in which cities aspire to the attainment of certain types of ranking, have also influenced low-income communities' ability to access land and services. UN-Habitat (2009) reports that the spatial changes that have taken place in most cities across the world have been characterized by fragmentation, separation and specialisation of functions, and an associated segregation of different income groups. In many cities this is due to specific urban strategies around an attempt to attain 'World Class City' or 'Global City Region' status. These strategies have emphasised greater investment into certain parts of cities to make them more attractive for foreign direct investment. The end result has been to construct ever more segregated cities, with noticeable contrasts in investment and quality of life, where parts of cities have benefited and gentrified, whereas those left behind have become worsening slums and tenements (UN-Habitat, 2009).

These processes make access to the formal land market difficult for many low income urban residents due to the high and increasing price of well-located and well-serviced land (Urban LandMark, 2008). The situation is made worse by difficulties in negotiating the formal/official system of land purchasing, and the inability to access credit for housing and land (Napier, 2008). As a result, many lower-income households buy land or property on the informal market, which may mean that they later lack secure tenure, as the change of ownership is never formally registered, or else they purchase or settle on land that is outside of the regulated system altogether (Marx and Royston, 2007). This land tends to lack formal protections and is not part of the formal planning system, which means that in general the land is dangerously situated and far more prone to risk than land that is formally recognised, protected and planned.

### **3.3.3 Quality of housing and services**

Vulnerability is directly affected by the quality of housing and people's access to services and amenities within slum and informal areas. Considering that it was estimated that in 2000 more than 680-million urban dwellers lacked adequate provision of water and a further 850-million or more lacked adequate provision for sanitation then what is being discussed is a large an increasing number of people (Satterthwaite, et al, 2007). Poor quality housing such as informal dwellings or slums can decrease household's overall health – statistics reveal that in these conditions, infant and child mortality rates are often five to 20 times worse (Satterthwaite, 2007) than in housing with better quality building or services. Populations with poor sanitation infrastructure and high burdens of infectious disease often experience increased rates of diarrhoeal diseases, cholera and typhoid fever after flood events and the transmission of enteric pathogens is generally higher during the rainy season. Poor indoor air quality, insufficient water or poor quality water, lack of sanitation and drainage, and over-crowding, increase the chance of diarrhoeal diseases, intestinal parasites, TB and acute respiratory infections. In addition, lack of access to electricity for cooking and heating increases the risk of fire for households living in these conditions.

High concentrations and large densities can also contribute to vulnerability, as some forms of hazard such as fire and disease are more easily spread in overcrowded conditions (Napier and Rubin, 2002). The lack of space for evacuation and emergency vehicle access can also exacerbate events and increase the likelihood of death and injury. These are the baseline conditions in which many poor urban dwellers are living. When extreme weather events take place, or when water becomes more scarce and temperatures increase, the existing health burdens will increase as communities and individuals are less able to cope and will be more affected by these events than their wealthier or more powerful counterparts who may be able to pay for or leverage more and better resources.



The provision of decent infrastructure and good quality services has the potential to reduce existing vulnerability and to moderate the impact of climate change events when they do occur (WDR, 2010). Further issues which contribute to vulnerability include age, gender, political and social disempowerment, and the newly arrived urban migrants who may not yet have had a chance to build up the necessary social and economic capital to lessen the impacts of disasters and other events (IPCC, 2007). The sections below will discuss some of the additional issues that contribute to the vulnerability of urban populations. Unfortunately it is impossible to model vulnerability in order to get a generalised sense of which vulnerability or combination of vulnerabilities would result in disasters or the extent of the disasters. Vulnerability is an extremely localised condition, and even within a certain area or location, specific groups and individuals may be more or less affected than others. However vulnerability is affected by a range of factors including location, , as well as individual and cultural characteristics, such as age, gender, and social status

### 3.3.4 The most vulnerable people in cities

#### *i. Seeing the poor as a heterogeneous group*

There are gradations and differences in poverty within the population of the urban poor, who cannot simply be “lumped” together into one homogenous mass (see Figure 4). The impact of climate change will be different for the different categories of poor people. The poorest may have the least to lose in monetary terms, but are least able to afford the loss of the assets that they do have. In contrast, communities who hover on the brink of poverty may be pushed over into unrecoverable positions by disasters and sudden events (Satterthwaite, et al, 2007). Better-off groups who have more assets and resources may have their ability to cope slowly eroded over time due to what Lavell (1999) calls concatenated risk, whereby constant small and large events wear away at a household and gradually increase their risk over time.

Aspects of poverty	Degrees of poverty			
	Destitution	Extreme poverty	Poverty	At risk of being poor
Income	Income below the cost of a minimum food basket	Income just above the cost of a minimum food basket but far too low to allow other necessities to be afforded	Income below a realistic poverty line* but enough to allow significant expenditure on non-food essentials	Income just above a realistic poverty line*
Housing with access to infrastructure and services	Homeless or living in a very poor-quality shack with no provision that is no-cost – or close to no-cost	Very little to spend on housing – often renting a room in tenement or illegal or informal settlement shared with many others	More accommodation options – e.g. slightly more spacious, better-quality rental housing or capacity to self-build a house if cheap or free land is available. The extent and quality of low-cost housing options is much influenced by government land, infrastructure and services policies and investments	
Assets	Typically none or very little (although membership of a community-based savings group may provide access to small amounts of credit for emergencies)		Often some capacity to save, especially within well-managed savings and credit schemes; housing the most valuable asset for those who manage to “get their own home” even if it is illegal	
Vulnerability	Extreme vulnerability to food-price rises, loss of income or illness or injury. Often also to discrimination and unfair practices (from employers, landlords, civil servants, politicians and the law)		Similar kinds of vulnerability to those faced by people facing destitution or extreme poverty, although usually less severe; often vulnerability to running up serious debt burdens; always vulnerability to illness/injury and its direct and indirect impacts on income	

Figure 4: Different degrees of poverty in urban areas (Satterthwaite, et al, 2007: 43).





## *ii. Gender and vulnerability*

Within poorer groups, women are often a great deal more vulnerable than their male counterparts both during and after disasters (see Box 3). This is due to their social roles of child and family care, which in many environments exposes them to some of the more dangerous, domestic pathogens that result from poor water quality and lack of proper sanitation. In addition to the domestic realm, women are often forced to undertake livelihoods and jobs that men refuse. These jobs are often more dangerous, worse paid and less stable than many of the jobs that poor men find. Alternatively, women are restricted to home-based enterprises and casual labour, which restricts their income-earning potential and limits the benefits they can receive from employment. In many countries and cultures, women are also unable to make claims on the state in their own right e.g. in some places, water and electricity meters can only be registered in a male family member's name (APFWLD, 2005). Thus single, widowed or women-headed households can be extremely restricted in their ability to access urban resources. A further issue increasing women's vulnerability are legal mechanisms, which make it impossible for women and women-headed households to buy or own land in formal and informal systems (APFWLD, 2005). This may have the result of pushing women onto even more marginalised or dangerous land than their male or married counterparts.

### **Box 3: Why are women more vulnerable during disasters?**

A report on the circumstances of women during and after the 2004 Tsunami has shown the disproportionate impact that the event had on women in the affected countries. The report states that:

"...in Aceh, India and Sri Lanka more women died in the tsunami than men, almost 80% of the dead are women. The tsunami has not only killed more women it has produced some very gender-specific after shocks, ranging from women giving birth in unsafe conditions to increased cases of rape and abuse. In Sri Lanka, dead bodies were sexually abused and women were dragged out of the rushing water and raped as payment for being saved. In Thailand, women are discriminated even in death: the government assistance for funerals provided twice as much money for a man's death than for a woman's".

To a large extent the reasons such abuses occur during disasters and women have higher numbers of deaths are due to the pre-existing conditions of women in these countries i.e. lack of gender rights, access to safe settlements and their vastly prejudiced role within society that allows such treatment to take place.

*(Adapted from APFWLD, 2005)*

## *iii. Age: the very old and the very young: some of the most vulnerable*

Aside from gender, age is also a consideration, and the physiology of children and the elderly makes them more at risk than other groups. Children and older people are often more susceptible to diseases and ailments related to the environment, such as poor quality or infected water, air pollution and significant changes in temperature. The impact of repeated events for children may result in long-term physical and cognitive damage, whereas the impact on the caregivers is an increased financial burden due to increased medical costs and a higher burden for such caretakers (generally women) who are responsible for familial care (World Bank, 2010). It is assumed that climate change will influence all of these factors, such as air and water quality, water quantity and temperature change, which will in turn have the greatest impact on these vulnerable groups (IPCC Summary, 2007).



#### *iv. Homeless and vagrant communities*

Homeless populations such as communities and individuals who are literally roofless or lack any type of shelter are often the most vulnerable members of any society. In terms of extreme events and post-disasters, many of these individuals are excluded during the recovery process, as they tend to be even more powerless and are even more stigmatised than the slum and informal settlement populations (WDR, 2010).

#### *v. Lack of power and new migrants*

New migrants in low- and middle-income nations often move to cities in an attempt to improve their economic opportunity, and urbanisation is often a response to declining prospects in rural areas. Where people move to and their number can be directly correlated with economic opportunities (IOM, 2007). To a large degree, mobility is a strategy to reduce the vulnerability of households.

Unfortunately for many poor migrants, it may be a situation of 'out of the frying pan and into the fire', whereby having escaped rural poverty, new migrants are moved or choose to move into large cities where their social networks may be limited and the opportunities to access good quality land and housing are restricted by a lack of social and political capital and the unaffordability of safe housing and land.

For cross-border migrants there is a further issue of the legality and social legitimacy of foreigners' land rights (IOM, 2007). In times of land stress and conflict, when there is significant competition for land and resources, xenophobia is a very real threat. Climate change will, in some cities, reduce the amount of land that is available, exacerbating pre-existing competition for land between the rich and poor or the political and socially included and excluded. Foreign migrants may become an even poorer, more persecuted and landless underclass of people that are potentially moved into ever more dangerous and vulnerable positions (Napier, 2010) as a result of climate change.

The IOM (2007) cites a number of situations in which disasters have exacerbated migrants' vulnerability and insecurity. In Thailand, Myanmarese migrants have historically lived in slums and informal settlements along the piers and on construction sites, where they work in the fishing and construction industries. The Tsunami that hit the area in 2004 directly affected these settlements and left many of the migrants homeless. In addition, many of the migrants had their papers washed away and were forcibly repatriated, others were unable to receive aid from the state and many more lost their claims on jobs and livelihoods, which were taken over by local residents. Furthermore the local press and some of the Thai communities blamed the Myanmarese migrants for the looting that took place post the disaster and were thus arrested. For those who had lost their documents, such as temporary residence cards, and work permits they often faced major problems in obtaining new documents. Some were turned down for re-issuance of permits because they could not remember their 13-digit registration code while others found the costs of re-registration prohibitive (IOM, 2007).



There are other cases which demonstrate specific vulnerabilities for migrants after disasters: in the case of the Gujarat earthquake and the Orissa cyclone in India, it was reported that at certain points migrants were not able to access aid. Migrants caught up in Hurricane Katrina of 2005 are reported to have had difficulty in accessing aid due to fears of deportation and loss of identity documents. Other migrants found themselves ineligible for legal residence after the hurricane, as many of their resident applications were dependent on a relative or employer who suffered losses in the disaster (IOM, 2007).

### **3.3.5 Land rights, land tenure and vulnerability**

There are a number of issues relating to security of tenure and the vulnerability of the urban poor, which are exacerbated by climate change, and simultaneously makes the impact of climate change a great deal worse. Lack of secure tenure effectively means that low-income households residing in unregulated or extra-legal conditions have no legal defence of their claims and can be evicted either by the state or through the actions of the private sector, and moved into even more dangerous situations (Marx and Royston, 2007). The flipside of this is when municipal governments attempt to move people out of real danger and communities resist such removal, although resistance is often dependent on how the relocation and resettlement process is managed by the state.

Toulmin (2006) estimates that in West Africa, less than 2% of land has any formal paper documentation. The GLTN (2008) states that in 2005, an estimated 934-million people lived without secure tenure in informal settlements in the urban areas of developing countries, and predicts that the number will increase to 1.5-billion by 2020 and two billion by 2030. The majority of rights are claimed through unwritten systems of tenure and social legitimacy. Women, migrants, tenants and those reliant on common property resources are particularly insecure and have the most difficulty claiming any kind of land rights. Added to this, urban areas often have systems of overlapping rights with formal systems that are in turn embedded in traditional land systems and overlaid by social practice. The situation around tenure is made even more complicated by the fact that many of the formal and informal systems are open to corruption. This makes the likelihood of conflict and contestation over land extremely high, as records are open to unscrupulous modification in favour of the highest bidder. It also means that the ability of the poor to leverage these systems is extremely limited because they generally do not have the finances or political "pull" to be able to bribe their way into the system in order to access land or "protect" their claims (Toulmin, 2006).

It is within this milieu that evictions take place, motivated by a range of interests over a limited resource. Building regulations and by-law infringements are often cited as the reasons for evictions, but the underlying motivation may actually be more deeply embedded in unconscious beliefs and values about informal dwellers and the desire to remove them from cities, or at least from the sight of the elite. Formal or official land rights are also the channel or mechanism through which urban dwellers gain legitimacy in urban contexts and allows them to access infrastructure and services as well as political systems. There is, however, a great deal of reluctance by many governments to provide these residents with services, as they are seen as an illegal or temporary population. The lack of decent, if not any, services and infrastructure heightens low-income communities' vulnerability, and increases the immediate and longer-term impact of disasters (Satterthwaite, et al, 2007).



Lack of secure tenure not only discourages the state from investing in these areas but in many cases also affects the urban poor who refuse to invest in land and property from which they can be easily removed and thus lose both their housing, land and investments. Thus the lack of security directly contributes to the vulnerability of the urban poor to climate change events (Satterthwaite, et al, 2007). State authorities need to be encouraged to distinguish between the genuine need to protect communities against unsafe location, land and structures, which may necessarily lead to relocation to better places, and actions which are motivated by other factors.

Most of these settlements do not have registers (or registers that officials would recognise) or documentation, and so, post-disaster, the lack of documentation and recognition of the inhabitants' claims and stakes can have a number of outcomes. These include the removal and relocation of these communities to poorly located sites, which are problematic as they can and do deprive low-income households of their previous economic and livelihood opportunities (APFWLD, 2005). The lack of official documentation means that it is difficult to provide any kind of evidence of a claim to these sites (WDR, 2010). It is here that political connections and social networks become important ways of getting back into the property market and reclaiming land. For those who are unable to leverage these networks, the end-result of disasters and lack of secure tenure is increased competition for housing and land, increased cost and higher densities, as well as greater vulnerability to future events and dangers (WDR, 2010).

A further issue is the value of the land that has been affected. If it is high-value land or has the potential for development, landowners and landlords may see the disaster as an opportunity to get rid of poor populations and reconstruct developments for higher income markets (WDR, 2010). Even when there is some sensitivity to the claims of low-income communities, internal divisions and interests may become problematic as informal owners, shacklords or older residents may state that they have stronger claims than "renters", sub-letters or more recent entrants to the settlement. Residents' associations and land mafias may also want to direct re-development processes and procedures, which could create a situation in which only the most powerful or vocal groups are able to access land (WDR, 2010).

Napier (2010) sums up the issue of land and vulnerability by stating that "Land insecurity is an issue for large numbers of poor and otherwise vulnerable people in cities and towns for three reasons: poor and dangerous location, little access to the necessary resources to survive adequately in urban areas, and a lack of recognition of their rights. In other words, land security and insecurity are products of where people live (or conduct business, or both), what resources they have at their disposal to cope in that situation or to change that situation, and what of their rights are recognized". Being land-insecure inevitably and indubitably increases households' vulnerability to the impacts of climate change and less able to participate in the land market once a related event has taken place.

### **3.3.6 The vulnerability of urban sub-Saharan Africa**

#### *i. Sub-Saharan Africa: an overview*

Africa is considered to be the continent,<sup>2</sup> which will suffer most from climate change, and its urban population is rated as amongst the most vulnerable in the world. This is due to the "multiple stresses" which the continent currently and potentially faces (IPCC, 2007: 435). These include



<sup>2</sup> An interesting finding from this literature survey is how often the African continent is compared to countries such as the USA and China, as if the entire continent were one state.

existing developmental challenges such as endemic poverty (45% of the population of SADC countries live in situations of monetary and resource scarcity), problematic governance and institutional issues which include but are not limited to a lack of capacity and high rates of corruption; limited access to capital; as well as large numbers of disasters, epidemics and conflicts, and increasing urbanisation rates (IPCC, 2007; SADC, 2008). Some of these dimensions are explored in the next few sections and are depicted in Figure 5. However, it should be noted that how Africa, and where in Africa, is going to be most affected by climate change is an issue that according to the IPCC (2007: 443) is not well understood, “Very few regional to sub-regional climate change scenarios using regional climate models or empirical downscaling have been constructed in Africa mainly due to restricted computational facilities and lack of human resources, as well as problems of insufficient climate data”.

Sub-Saharan Africa is experiencing high rates of urbanisation and nearly all sub-Saharan cities with more than a million people are expected to expand by an average of 32% in the next 10 years (UN-Habitat, 2010). By way of example: Kinshasa is considered to be the fastest-growing city in absolute terms, with four million more people expected by 2020, which translates to a 46% increase of its current population. Lagos is the second-fastest growing, and is projected to have 3.5-million (a third) more people.

Abuja, Bamako, Luanda, Lubumbashi and Nairobi are all expected to grow by between 47% and 50% in the next decade, while Dar es Salaam, Kampala, Mbuji-Mayi and Niamey are projected to grow by between 50% and 57%. These figures are enormous, especially worrying given that most of these cities are unable to supply sufficient services for their current populations (IPCC, 2007).

Some estimates have been made around water and food security, and in his address to the United Nations Summit on Climate Change in 2009, IPCC Chairman Rajendra K. Pachauri spelt out what climate change could mean for the African continent: “In Africa, by 2020, between 75 and 250 million people are projected to be exposed to water stress due to climate change, and in some countries yields from rainfed agriculture could be reduced by up to 50%” (WDR, 2010). In part this will be due to a rise in sea levels infiltrating fresh water sources (IPCC, 2007). Food insecurity and the resulting conflict could play a major role in the future of African cities (WDR, 2010). Large-scale disasters, especially flooding and droughts, may reduce food availability in cities. In terms of precipitation there are fairly dire predictions for some coastal settlements. Currently 40% of the population of West Africa lives in coastal cities, and projections state that the 500 km of coastline between Accra and the Niger delta will become a continuous urban megalopolis of more than 50-million inhabitants within the next decade (IPCC, 2007). In addition, by 2015 it is expected that three coastal mega-cities of at least eight million inhabitants will be located in Africa. The lack of water in certain regions and the over-supply in others will cause increasing mobility amongst populations that cannot mitigate or adapt to the effects of climate change. Higher rates migrations rates would thus be expected as people move to areas that they see as being safer and having stable water supplies.

## *ii. SADC and climate change*

In the SADC region it is predicted that the climate will get warmer during the summer and generally drier all year round (SADC, 2010). Given these projected figures, increases in sea levels will have significant impacts (such as floods, destruction of infrastructure and displacements) on these coastal mega-cities due to the high concentration of poor populations living in vulnerable situations along the coast (World Bank, 2010).



There seems to be little doubt that cities such as Lagos and Alexandria will probably be impacted. Further impacts related to climate change are predicted to be the increase in severity and frequency of tropical cyclones and storms, with Indian Ocean coastlines and islands bearing the brunt of these events (IPCC, 2007). Changes in precipitation and temperature may also alter the distribution of certain disease vectors, such as malaria, whose geographical distribution may change to include some of Zimbabwe's cities, highland areas in Kenya, Ethiopia and Burundi and northern parts of South Africa which were previously unaffected but may then become malarial areas.

### *iii. Focusing on South Africa's climate change*

In South Africa, the Department of Environmental Affairs (DoEA, 2010) reports that the country has already seen climatic changes since 1950 and the changes, in the cases of temperature, have exceeded global averages. However rates of change are uneven and there are lower rates of warming in the higher altitude eastern interior, than the coast and to the lower-lying western interior. The DoEA goes on to say that if greenhouse gas concentrations only increase moderately then by mid-century the coast is likely to warm by around 1-2°C, and the interior by around 2-3°C. Precipitation patterns and rates are more difficult to measure and there is uncertainty at present about these changes and what would be the longer term patterns. This is of significant concern as "Water is arguably the primary medium through which climate change impacts will be felt by people, ecosystems and economies...Furthermore, many of South African ecosystems are climate- and water-dependent" (DoEA, 2011:v). The report also goes on to say that due to the fact that so many South Africans are impoverished, they are particularly vulnerable to climate change and sensitive to changes in water supply. The impact of Climate change in South Africa is expected to be exacerbated by the existing barriers to effective climate and disaster risk management and adaptation, which make the population even more vulnerable. According to the report these include a lack of accessible and reliable information, lack of market access and few social platforms to allow engagement of civil society on climate change issues. Previous experience in South Africa of severe weather-related events demonstrates that adaptation capacity to such events is made worse by pervasive social vulnerability, inadequate planning, constrained, integrated and spatial development and poor climate and disaster risk management.

### *iv. Existing inequalities and their role in climate change effects*

UN-Habitat also reports that African urban centres display high rates of segregation, fragmentation and inequality. An article in the Guardian (Vidal, 2010) records UN-Habitat as saying: "The pattern is ... oceans of poverty containing islands of wealth. Conditions in African cities are now the most unequal in the world. They are already inundated with slums and a tripling of urban populations could spell disaster...". In addition, the spatial separation of related urban functions in metropolitan areas increases transportation costs and environmental pollution, especially in circumstances in which little or no public transport is available (UN-Habitat, 2010). Thus, not only across Africa but *within* the cities of Africa, there will be a highly differential impact, the exact nature of which has yet to be determined for the various contexts. What can be said, however, is that African cities will follow the more generic patterns, which the poorest will be least able to cope with the climate changes.



The low rates of services in most African cities and the land insecurity that faces most of the population, within a context of poverty and poor human development, mean that poor African urban dwellers are particularly vulnerable. There is also the added burden of high HIV/Aids rates and enormous infection rates (Rugalema, 2000). Previous coping strategies that allowed households to deal with and bounce back from disasters and hazards have been found to be less effective when dealing with HIV/Aids than with other epidemics and disasters (Rugalema, 2000). As a result, African households have been left with fewer assets and a great deal less resilience to deal with hazards, since the spread of the disease. In addition HIV/Aids is on the increase and it is predicted that so too are climate-related disasters, the confluence could mean an even greater vulnerability to climate change for poor urban Africans than for the populations of other cities and continents (UN-Habitat, 2010).

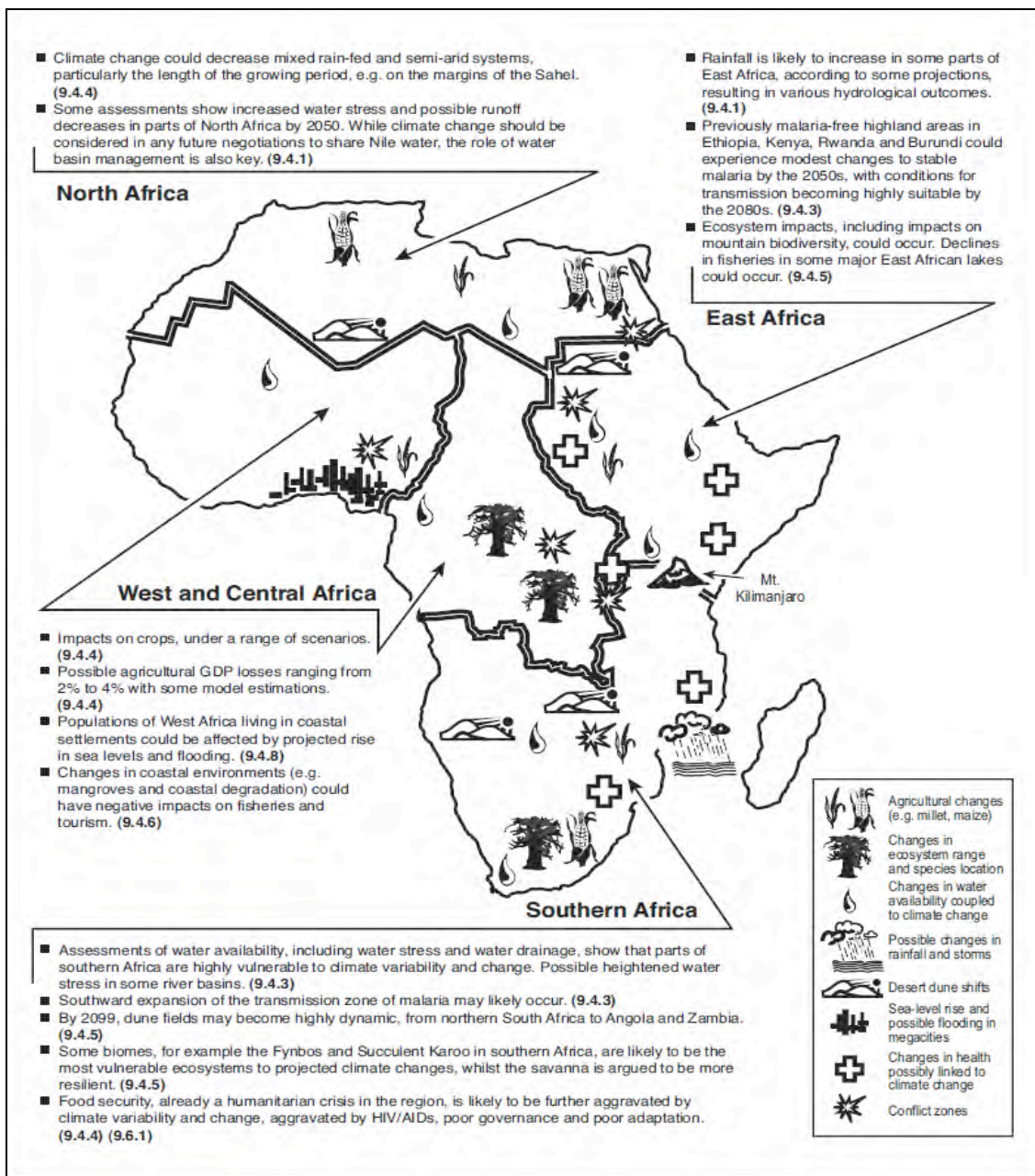


Figure 5: Depiction of climate change impacts on the African continent (IPCC, 2007: 451)



## 4. Mitigation and adaptation strategies

The literature generally refers to two approaches to dealing with climate change – mitigation and adaptation. The next two sections describe in general terms the ideas of mitigation, adaptation and combined approaches, as well as the various constraints and support that presently exist. The focus will be given to adaptation and mixed approaches, with less attention to issues of mitigation.

### 4.1 Mitigation definitions and concepts

To begin with, mitigation is underpinned by the idea that it is possible to take on measures and initiatives to reduce GHG emissions and enhance carbon and other GHG sinks (IPCC Glossary, n.d.) Adaptation on the other hand looks at what measures can be taken (both reactive and anticipatory) to reduce *vulnerability to the effects* of climate change (IPCC Glossary, n.d.).

At the international scale there is an acknowledgement that to stabilise the average global temperature increase at 2°C, the concentration of GHGs must be reduced to 450 parts per million. This means that GHG emissions must be reduced by 25% to 40% by 2020 and by 80% to 95% by 2050, compared with 1990 levels. In order to achieve this target, there have been a range of attempts at gaining multi-lateral agreement on mitigation targets. The most important of these has been the Kyoto agreement signed in 1997 and intended to have come into effect by 2005 which details the commitments and obligations of various countries to GHG mitigation. There have been a number of further conferences and conventions led by the UN Framework Convention on Climate Change (UNFCCC) Convention of Parties (CoP). However, negotiations have not always been successful and there has been a failure to gain agreement on acceptable carbon emissions for rapidly industrialising nations (Kaere, 2009)

There are various international mitigation initiatives, including the C40 Climate Leadership Group and Cities for Climate Protection, sponsored by ICLEI-Local Governments for Sustainability, which help to share knowledge and good practices between cities involved in reducing their GHG emissions. There are, however, relatively few mitigation strategies in the SADC region (see Appendix II), which may be due to the fact that Africa produces less than 2.8% of the emissions that cause climate change (SADC, 2008). In addition, most of the mitigation approaches within the region have a rural bias<sup>3</sup> and focus on deforestation, agriculture and alternative energy provision.

Urban authorities in low- and middle-income nations have begun to exploit opportunities to generate 'carbon credits' through reducing emissions from solid waste management and other activities. Much recent climate change policy has stressed the 'co-benefits' of mitigation strategies, i.e. the ways in which reducing GHG emissions can meet broader goals of increased energy independence, lower costs and higher quality of life (WDR, 2010). The figure below provides some examples of how the notion of co-benefits has been put into practise in some cities (See Figure 6).

One of the approaches that promotes co-benefits – and certainly the most popular urban mitigation strategy at the moment – is that of the 'sustainable city', which tends to consider the triple bottom line of environment, society and economy. A further approach, which is based on the

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<sup>3</sup> The SADC, 2010: *First Draft (Working Document) Southern Africa Sub-Regional Framework on Climate Change Programmes Report* prepared by Chishakwe, N.E., February 2010 provides a summary table of all mitigation activities within the SADC region.





sustainable city thinking but provides more detail, is that of the ‘compact city’, both of which will be discussed briefly below as mitigation strategies.

City	Action	Integrated Value
Mexico City, Mexico <sup>(i)</sup>	Infrastructure improvements for water supply pipes to reduce water losses and leaks	-Increases water supply -Reduces vulnerability to lack of water -Increases access of basic services to the poor
Dar es Salaam, Tanzania <sup>(ii)</sup>	Coastal and marine conservation project to plant mangrove trees along the coast	-Sequesters carbon via mangroves -Protects the city from storm surges -Maintains a healthy coastal ecosystem
Bogota, Colombia <sup>(iii)</sup>	Urban agriculture program	-Reduces transportation costs to deliver produce to cities -Reduces the need for fertilizers, pesticides, and large agro-systems -Provides a supply of food during disasters -Provides employment and is a source of food to poorer sections of society -Prevents settlements in high-risk areas such as slopes and coastal areas
Makati City, The Philippines <sup>(iv)</sup>	Major citywide tree-planting program, where 3,000 trees are planted each year	-Sequesters approximately 25,000 kg of CO <sub>2</sub> e/year in GHG emissions -Reduces atmospheric pollution -Reduces the urban heat island effect -Provides recreational space
Lviv, Ukraine <sup>(v)</sup>	Energy efficiency program for buildings	-Reduces energy consumption for buildings -Reduces energy costs -Makes buildings, and their occupants, better able to withstand extremes in temperature and precipitation

<sup>(i)</sup>Summary of Mexico City Climate Action Program: 2008-2012, Secretaria del Medio Ambiente, Gobierno Del Distrito Federal.  
<sup>(ii)</sup>Community Infrastructure Upgrading Programme-Get to know the Programme currently implemented in Dar es Salaam City, Tanzania, (2005-2010).  
<sup>(iii)</sup>Resources Centres on Urban Agriculture and Food Security (RUAF).  
<sup>(iv)</sup>Climate Resilient Cities, World Bank: 2008 Primer.  
<sup>(v)</sup>Energy Efficient Cities Initiative Practitioners' Roundtable, Workshop Proceedings Series, World Bank - ESMAP, Nov. 2008.

**Figure 6: Examples of co-benefit strategies in major cities (World Bank, 2010: 13).**

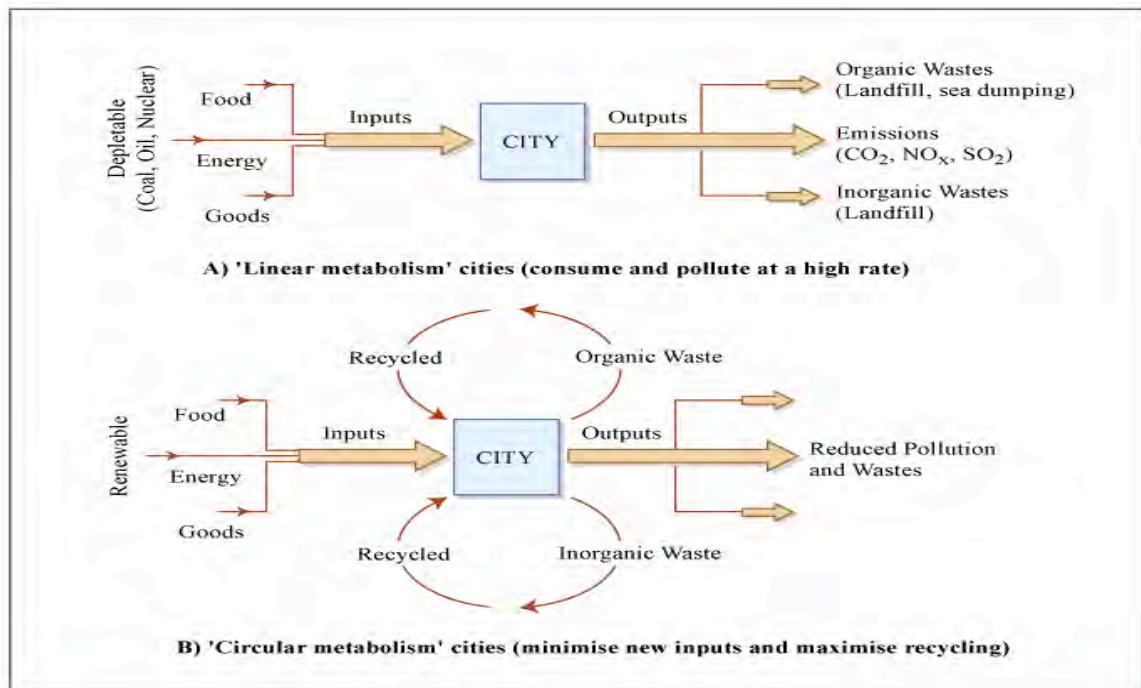
#### 4.1.1 Sustainable cities: compact cities?

The basis for sustainable cities is the idea that most cities in their current form are deeply unsustainable and consume far too many resources. Effectively the global average for consumption is between 2.63 hectares per capita per year, while only 1.8 ha are realistically available and sustainable (Global Footprint Network, 2009). A sustainable city is therefore regarded as one, which only utilises the resources that are available and which are sustainable i.e. a per capita footprint of 1.8 hectares per year. This is ideally achieved through a well-planned compact city (that needs to consider and also mitigate against the heat island effect) and preserves land, has mixed-use to increase access and reduce need to travel, is socially and economically balanced, uses clean and renewable energy and recycles all its waste.

Cities consume vast resources from the surrounding area, which adds to their already significant ecological footprints (Petric, 2004). To put it slightly differently, presently most cities are seen as having a ‘linear’ metabolism in which resources flow through the urban system without a great deal of concern by their users, either about their origin or about the destination of their wastes – effectively, inputs and outputs are considered unrelated.

Proponents of sustainable cities argue that what cities should aim for is a system similar to that which occurs in nature – a circular metabolism whereby inputs become outputs which in turn become inputs and so on. In this way resources would be used more efficiently and waste would be minimised (Giradet, 2004) (Figure 7).





**Figure 7: The metabolism of cities (MIT, 2010: webpage)**

One of the proposed models for sustainability is the idea of the compact city. As mentioned earlier the size and density of a city is not really an indication of its environmental/ecological footprint. This is rather indicated by the “phase” it is in, GDP/consumption rates, as well as the nature of technology and transportation systems. Gaigne, et al, (2010) argue that at the moment there is a great deal of consensus amongst national and local governments and international institutions that compact cities are the best way of reducing carbon footprints and making cities sustainable. The argument in its crudest formulation is that sprawled cities have higher transport costs, higher pollution, and greater waste of power and water as the systems become less and less efficient the further out they have to reach, and consume large tracts of land (Petric, 2004). In addition, the wide dispersion of parts of a city across a landscape has been directly attributed to the use of oil as a cheap energy source, which in turn significantly contributes to GHGs in the atmosphere. The cost of oil-based energy, both in terms of the environmental cost and the rising price of oil, makes the option of a sprawling, energy-consumptive city unsustainable (Un-Habitat, 2009).

Compact cities promote higher densities, less travel, less land used for urban purposes, and greater efficiency, and are thus seen as the antidote to the dangers of sprawl and their associated lack of sustainability (Petric, 2004). UN-Habitat’s 2009 Report on Human Settlements, “Planning Sustainable Cities”, agrees and makes the point that “Strategic spatial plans linked to infrastructure development can promote more compact forms of urban expansion focused around public transport. In this context, linking major infrastructure investment projects and mega-projects to strategic planning is crucial. An infrastructure plan is a key element of such strategic spatial plans. In this, transport–land-use links are the most important ones and should take precedence, while other forms of infrastructure, including water and sanitation trunk infrastructure, can follow” (Un-Habitat, 2009: vii).



The World Bank, (2010: 18) citing Glaeser puts it slightly more succinctly “To save the planet build more skyscrapers”. There is a great deal of conviction that this is the appropriate response – so much so that the UN has even established a Global Compact Cities Programme, which provides a model for approximately 40 cities around the world to develop innovative and sustainable solutions to long-term challenges based on the 10 principles of the Global Compact.

Gaigne, et al, (2010) are more sceptical of the compact city approach as a feasible mitigation method. They argue that this approach overlooks a vital and basic trade-off, which is that the concentration of activities does decrease the ecological footprint stemming from commodity shipping between cities, but it increases emissions of GHGs by inducing longer work trips between urban centres, and between the city and its hinterland. In addition the compact city and the sustainable city approach are both based on the cooperation of residents and the private sector to reduce consumption and to stick to land uses that are approved and align with the larger strategy. What matters for the ecological footprint of cities is the mix between urban density, the global pattern of activities and the relationship that the settlement shares with its hinterland (Petric, 2004). A further point is the concern over whether or not compact cities are able to address or mitigate against the large amount of pollution related to the initial urbanisation and building phase of cities, and if building more densely will reduce emissions.

#### **4.2. Adaptation strategies**

As mentioned earlier, climate change will have some severe impacts, and the likelihood is that the poorest and least able to cope will be the most affected (DfID, 2006). It is also clear that irrespective of the range of mitigation strategies that have been and will be put in place; some of the damage has already been done, not to mention that in many developing countries emission levels are already extremely low. As such the only sensible response to these impacts is adaptation strategies. *Adaptation* is considered to be the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007: 6). Adaptation effectively looks at the whole picture, everything from pre-disaster planning to post-disaster reconstruction. The array of potential adaptive responses available are encouragingly wide and range from highly technological interventions such as sea defences, to more behavioural approaches including, altering food choices and recreational activities, to changes in policy including planning regulations<sup>4</sup> (see also Appendix IV for a summary of existing resources and adaptation strategies in Southern Africa). However the question of what strategies and programmes are appropriate remains unanswered. As such DfID and the Canadian International Development Research Centre (IDRC) have developed a partnership of £32 million for the next five years to look at how African can adapt to climate change (DfID, 2010: website).

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<sup>4</sup> For a fuller discussion on the wide array of options available in all sectors see the UNFCCC Secretariat’s *Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change* (2008) prepared by Erica Pinto Robert C. Kay and Ailbhe Travers, CZM pty. Ltd Stratus Consulting Inc. [http://unfccc.int/files/adaptation/nairobi\\_workprogramme/compendium\\_on\\_methods\\_tools/application/pdf/20080307\\_compendium\\_m\\_t\\_complete.pdf](http://unfccc.int/files/adaptation/nairobi_workprogramme/compendium_on_methods_tools/application/pdf/20080307_compendium_m_t_complete.pdf)



#### **Box 4: Durban's climate change strategy**

Durban's Environmental Management Department initiated the development of a Climate Protection Programme in 2004:

**Phase 1:** Review and develop an understanding of the global and regional climate change science and translate this into an understanding of the implications of climate change for Durban. Key impacts include increases in temperatures, changes in the distribution of rainfall, decreased water availability, increased range of water- and vector-borne diseases, sea level rise, and the loss of biodiversity.

**Phase 2:** Develop a 'Headline Climate Change Adaptation Strategy' for the city to highlight how key sectors within the municipality should begin responding to unavoidable climate change. Some interventions look to enhance and expand existing initiatives, such as the modelling of vector-borne diseases and their relationship to climate change. Others stimulate new activity, such as the 'climate-proofing' of the city's open space system.

**Phase 3:** Incorporate climate change into long-term city planning, which includes developing a model to simulate, evaluate and compare strategic urban development plans within the context of climate change.

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The trouble with most of the approaches is their cost, and the reliance on strong governance strategies to change citizens' attitudes and behaviour (IPPC Summary, 2007). Poor urban governance acts as a constraint to a city's or community's ability to adapt. It should also be noted that, "The need for, type and scale of adaptation depends on the kind of change taking place, as well as the vulnerability of people and natural systems to this change" (Hammill et al, 2008: 114). Dfid and the IDRC agree and add that the success of local adaptation strategy is dependent on local knowledge, local competence and capacity in both the state and the community, and their willingness to work together (See Box 4 for a description of a local adaptation strategy). Thus they are looking to provide research and support that speaks to these issues and looks at pragmatic ways of implementing adaptation strategies.

Whereas developed countries tend to have greater resources to draw on in order to implement adaptation, developing countries often have more immediate concerns for their budget and also have to deal with a range of non-climate stresses that exacerbate the potential impact of climate change. These stresses are effectively the same as the factors that make certain groups more vulnerable to climate change.

They include issues such as poor health, lack of social and political power, lack of adequate facilities, amenities and good quality housing, insecure tenure and living in situations of danger and in countries with poor governance, as well as larger issues of poverty, low HDIs, poor economic growth and high disease burdens. In

addition, a number of low- and middle-income countries suffer from failures of governance, in a range of different ways, including the exclusion of the poor, a serious lack of capacity, as well as an ideological or dogmatic understanding of poor urban dwellers as "the problem" rather than as the people most affected by the situation (Satterthwaite, et al, 2007).

The WDR (2010) notes that climate change adaptation strategies can be used as an "entry-point" to develop more effective environmental policy as well as better institutions and improved state-resident links. As mentioned earlier these are known as co-benefits i.e. adapting to climate change, whilst also creating a series of developmental opportunities. Janjua (2010), however, points out that if this is to happen then governments need see climate change adaptation as a learning process, whereby changes in policy for climate adaptation are not sufficient to achieve change.



What is needed in conjunction with policy change is to construct enabling conditions whereby institutions are made aware of climate change interventions and incorporate them into their day to day functions, and an openness and willingness to learn and incorporate new thinking into climate change and urban management policy. Janjua further suggests that “without changes in various institutions (with learning as a part of that change), adaptation efforts will remain unproductive as the current top-down (scenario-based, technical) and bottom-up (vulnerability reduction, moving towards resilience, and social and organisational) approaches will remain disconnected, and organisations will therefore continue to function with large, outdated and ineffective structures”. Aside from a more open approach to climate change, governments also need to consider how to join a range of desired outcomes, such as poverty alleviation and human development, to climate adaptation.

#### 4.2.1 Adaptation and development: “joined-up”/co-benefit approaches

There is a strong sentiment at the moment that one of the key problems with adaptation strategies is the fact that they operate in isolation from other issues that drive vulnerability on the one hand and human development on the other (Schipper and Pelling, 2006). Authors have pointed out that the fields of international development, risk reduction, disaster management and climate change have for a long time operated separately, rather than inter-relatedly as they should have (Thomalla, et al, 2006). The reduction in vulnerability through human development and physical infrastructure will reduce the range of hazards to which populations are exposed and thus reduce risk and the impact of climate change related events. This in turn will ensure that the investment in human development is not retarded by disasters and anthropogenic-related climate change (Schipper and Pelling, 2006). Although there are some significant differences between the various fields, which do need to be considered when attempting to align the agendas, there is also a great deal of scientific and policy-work which can be shared and utilised to reach the same end – the decrease of vulnerability and improvement of human lives within a context of changing climatic conditions (Thomalla, et al, 2006). A further limitation is that while there is currently a great deal of acceptance around the issues of disaster-management and poverty reduction in most countries’ policy and discourse, the reality of climate change and a willingness to mitigate and adapt to it is not universally present (O’Brien, et al, 2006).

Another way of thinking of the same process is the idea of co-benefits, which has a number of proponents, including the African Development Bank, Asian Development Bank, the UK’s DfID and the European Commission Federal Ministry for Economic Cooperation and Development. They point out that there are two ways of going about the process of incorporating climate change into a range of approaches, disciplines, and policies: *mainstreaming*, which is seen as the consideration of climate issues in decision making processes such as planning and budgeting; and *integration*, which is when specific adaptation measures are added to policy, design and implementation strategies (African Development Bank et al, 2009). By way of example for both integration and mainstreaming, the Danish International Development Assistance’s (Danida) Danish Climate and Development Action Programme, has attempted to “climate proof” their work. The intention is to be able to effectively fight poverty and promote economic and social development, whilst simultaneously identifying and acting on opportunities for climate change adaptation (Danida, 2007). According to Danida’s website<sup>5</sup> they intend to accomplish such climate proofing by, “... examining ways in which development aid can contribute to enhancing adaptation to climate

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<sup>5</sup> Further details on Danida’s Climate Proofing process can be found at <http://www.danidadevforum.um.dk/en/menu/Topics/ClimateChange/>



change, e.g. through better infrastructure, improved management of water resources, the introduction of disaster risk reduction measures and so on". They are also very supportive of the National Adaptation Programmes of Action (NAPA) in developing countries and see them as important frameworks for integrated action and gaining external assistance from international agencies and other countries. DfID (2010) supports such a view and maintains that poverty and climate change are the key problems facing developing countries and that they are inextricably linked and must be tackled together in partnerships with city governments,

SADC is also very much in favour of the co-benefit approach and their Climate Change Adaptation and Mitigation Framework (2008) discusses the need to align climate change programmes with a focus on poverty alleviation and sustainable development, and in keeping with existing plans such as the Regional Indicative Strategic Development Plan (RISDP). In order to do so SADC relies on its African Ministerial Conference on Environment (AMCEN), which meets once every two years as the body that can help to ensure the integration of a range of outcomes into the regional and sub-regional development programmes. They are assisted by AMCEN's African Group of Experts who have developed an indicative outline for the framework of programmes that will serve as a tool for future programming work especially with regards to filling gaps on areas that require attention. In light of such an approach SADC states that "It is vital for the [climate change] programme to be inclusive and synergistic in terms of taking into account other initiatives and implementation of relevant multilateral environmental agreements including ... [the] Commission on Sustainable Development (CSD) among others...The programme should also carry out capacity-building in order to enhance the region's capacity to benefit from emission trading and other related opportunities. Capacity building also stands to benefit the region in developing the mitigation and adaptation architecture" (SADC, 2008: 7).

The abovementioned examples provide an outline of the thinking that is occurring at the international and regional level, and the realisation that general urban vulnerabilities and vulnerability to climate change have the same roots, and adaptation and development strategies may have multi-faceted and overlapping outcomes.

The following sections of the report look at a range of generic adaptation strategies and approaches, which include pre-planning, efforts such as vulnerability assessments, as well as the principles of post-disaster redevelopment for poor urban dwellers. This will be followed by a discussion on some of the existing combined mitigation and adaptation strategies.

#### **4.2.2 Vulnerability assessments**

Most adaptation strategies begin with vulnerability assessments, which are ways of "anchoring assessments of climate change impacts to present development planning" and examining the current realities that face a country, city or community (Downing, et al, 2002). A myriad of vulnerability assessment methods have been developed looking at natural hazards, food security, poverty analysis, sustainable livelihoods and related fields, a number of which have been adapted to look at climate change<sup>6</sup>. The latest vulnerability assessment and the version that is supported by the World Bank, UN-Habitat, UNEP, and implemented through the Cities Alliance is the Urban Risk Assessment (URA) (see Box 5) (World Bank, 2010).



<sup>6</sup> See Downing, et al, 2002 for a description and evaluation of a variety of vulnerability assessments.

This assessment has been developed especially for urban environments. However Downing, et al, (2002) in their technical paper for the IPCC point out that irrespective of the specific vulnerability assessment, a series of generic phases can be identified:

1. Review of existing regional or national assessments, or development of conceptual and analytical frameworks that relate to vulnerability, for instance national development plans, poverty reduction strategy papers, environmental sustainability plans and natural hazards assessments
2. Review present conditions in order to get sense of who the vulnerable groups are (demographics, culture, livelihood, gender) and establish a development baseline to identify who needs to be targeted and what progress is made over time. If there are existing vulnerability assessments then these should be used e.g. poverty maps, human development inventories etc. If not then indicators need to be developed.
3. Refine the analysis and link the development baseline explicitly to climate impacts and risks so that it is clear where certain types of events will happen and who or what may be most affected.
4. Provide a more qualitative understanding of the drivers of vulnerability so that the factors (social, economic, political etc) which shape and influences exposure to climatic risks are clarified. The idea is to link the present with a sense of the future and how potential climatic risks can be avoided.
5. The final task is to turn the research and indicator findings into a range of outputs for use by stakeholders, decision makers, and the general public awareness, as well as to plan for further assessments, The guiding concern is to present useful information that is analytically sound and robust across the inherent uncertainties. Vulnerability assessments are also often used to construct National Adaptation Programmes of Action, which are the preferred climate change adaptation tools of the UNDP, UNEP and World Bank and are discussed below.

#### **Box 5: Urban risk assessments**

The Urban Risk Assessment (URA) was recently proposed and is intended to lay the groundwork for a plan for strategic collaboration across city governments, the private sector, and development agencies to begin benchmarking their own progress towards the reduction of urban vulnerability. The objective is to move toward a common cost effective approach for specifying where and how many people are vulnerable to natural hazards, in addition to identifying susceptible infrastructure that if damaged, would also have detrimental effects on the urban population. The assessment is based on four principal building blocks to improve the understanding of urban risk:

- i. Historical incidence of hazards
- ii. Geospatial data
- iii. Institutional mapping
- iv. Community participation.

The URA is structured to allow flexibility in how it is applied based on available resources and institutional capacity of a given city. Through a phased approach linked to complexity and required investment, city managers may select a series of subcomponents from each building block that individually and collectively enhance the understanding of urban risk.

*(Adapted from World Bank, 2010: 13)*



### 4.2.3 NAPAs, CAPAs and LAPAs: the fraternities of preferred adaptation approaches

National Adaptation Programmes of Action (NAPAs) are climate change adaptation programmes intended for the least developed countries (LDCs) in order to address their most pressing and urgent adaptation needs. NAPAs do not have a specific template, but the UNFCC's *Guidelines for the Preparation of National Adaptation Programmes of Action* provides 10 guiding elements to inform the process of developing NAPAs. These include: a participatory approach involving stakeholders, a multi-disciplinary approach, a complementary approach that builds on existing plans and programmes, sustainable development, gender equity, cost-effectiveness, simplicity, and flexibility (UNITAR, 2003; UNFCC, 2008).

The NAPAs, once completed, should prioritise adaptation measures so that the country in question can apply for funding from the LDC Fund, based on the above-mentioned principles. However, some authors (Satterthwaite, et al, 2007; Mukheibir, & Ziervogel, 2007) point out that the NAPAs operate at a national scale but the impacts of climate change and the resources and plans that need to be operationalised occur at the municipal or city scale. In addition, the risks and vulnerabilities of climate change are generally shaped by local contexts and by the actions or inaction of local governments. As such Mukheibir, & Ziervogel (2007) have derived a methodology for the development of local programmes for climate change called Municipal Adaptation Plans (MAP). The best example of where this has been realised and incorporated into every day reality and practise is EtheKwini (see Box 4) and the City of Cape Town is currently in the process of developing its own MAP. Satterthwaite, et al, (2007) have articulated the need for NAPAs to be derived from the local to the national, in which case city-focused CAPAs (City Adaptation Programmes of Action) and locally focused LAPAs (Local Adaptation Programmes for Action) would be used to construct NAPAs, instead of NAPAs being used as the guiding mechanism for local adaptation.

### 4.2.4 Post-adaptation principles

The WDR (2010) has recognised the dangers for poor urban land users and residents living in informal settlements and slums, and the post-disaster vulnerabilities that they are subjected to. As such they have developed five key principles, which they recommend for inclusion in post-disaster adaptation and reconstruction programmes in order to reduce land conflicts, insecurity and land grabbing which result from disasters. These principles are also designed to lessen future vulnerability of these households and to improve their security of tenure and access to resources. In brief they are:

- i. Expand beneficiary participation in housing, land and planning processes and decision-making
- ii. Define 'building back better' as 'lands for the landless and homes for the homeless'
- iii. Treat owners, tenants and informal dwellers equally by emphasizing security of tenure
- iv. Oppose openly arbitrary and disaster driven land grabs
- v. Prioritise restitution first.

### 4.2.5 Financial mechanisms for adaptation

The last few sections have briefly described some of the approaches that have been taken to climate change adaptation. The next few sections discuss some of the work on financial mechanisms that have been and are being considered to support climate change strategies.





These include multi-lateral agreements for funding for adaptation; adaptation insurance; and micro-finance options.

#### a. Multi-lateral agreements for funding support for adaptation

There have been a number of bilateral and multi-lateral agreements on funding for climate change with the first one emanating from the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocols. These agreements require high-income countries to help the countries most at risk from climate change and with the least resources, to adapt through the provision of funding including:

- The **Adaptation Fund** supports 'concrete adaptation' activities. Unlike the other funds linked to the Convention on Climate Change, this fund backs adaptation projects and programmes in developing countries that are parties to the Kyoto Protocol. The Adaptation Fund is considered by international agencies to be the most important and the most strategic fund for African countries in light of its financing mechanism, which should ensure its sustainability.
- The **Special Climate Change Fund (SCCF)** was set up in 2001: this fund finances projects focusing on adaptation; technology transfer and capacity building; mitigation in the areas of energy, transportation, industry, agriculture, forestry and waste management, and economic diversification. To receive SCCF funding, projects must be long-term response strategies rather than short-term reactive measures. As of October 2008, SCCF had mobilized USD 94.4 million and USD 58.6 million had been distributed. Six of the 14 approved projects are in Africa (Egypt, Ethiopia, Kenya, Mozambique, Tanzania and Zimbabwe) at a total value of USD 14.9 million.
- The **Least Developed Countries Fund**, used to support the development of NAPAs, which specify their urgent and immediate adaptation needs. The fund was set up in 2001 at COP 7 to support the LDCs in the preparation and implementation of their national adaptation programmes. As of 2 October 2008, USD 132.2 million had been marshalled by the Fund's operating body, the GEF, and USD 31.8 million had been distributed. Of the 62 projects supported by the Fund, 12 have been implemented so far, including nine in Africa — in Burkina Faso, Cape Verde, DR Congo, Djibouti, Eritrea, Malawi, Sierra Leone, Sudan and Zambia.
- **Strategic Priority on Adaptation Trust Fund:** The aim of this USD50-million fund, managed by the Global Environment Facility (GEF), was to support pilot projects<sup>7</sup> that show how adaptation planning and assessment can be translated practically into full-scale projects. All of these funds have now been committed to 22 projects, with 18% going to Africa. The Fund is now closed.

Canada, Germany, the Netherlands, Japan, the United Kingdom and the United States and their various organisation have allocated funding for adaptation activities, including research, and pilot projects such as 'climate proofing' of existing projects and programmes and 'stand alone' adaptation projects, which are new projects (Eldis, 2008) (See Appendix III). Further agreements have come out of the Copenhagen Accord such as the Copenhagen Green Climate Fund. The intention is that the fund will provide \$100 billion annually to help developing countries mitigate carbon emissions by 2020 and investigate adaptation strategies.

There is, however, some concern that the targeted funding level is not sufficient for the estimated requirements to combat global warming and adapt to climate change in developing nations. The figure of \$100 billion amounts to less than 0.1 per cent of predicted annual urban infrastructure in-

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<sup>7</sup> For a summary of the budget and costs of the 22 projects that have thus far been supported by this programme, go to [www.thegef.org/gef/sites/thegef.org/files/documents/C.34.8%20Report%20on%20the%20Completion%20of%20the%20SPA.pdf](http://www.thegef.org/gef/sites/thegef.org/files/documents/C.34.8%20Report%20on%20the%20Completion%20of%20the%20SPA.pdf)



vestments in developing countries (and even less of their overall investments in infrastructure). The SA DoEA Report (2010) also notes that there is a great deal of uncertainty as to exactly what will need to be done to adapt and as such how much is actually going to be needed. This means that to a large extent the country does not even know what or how much to ask for. The WWF (2010) also argues that the timing of the funding is problematic as it will not supply enough funding to be able to bring down global emissions, which are set to peak by 2015. They argue that the best that can be expected from the funding is for it to act as seed funding to attract further investment (WWF, 2010).

## b. Adaptation insurance

An area of growing interest is the use of insurance as a means of achieving the co-benefits of climate change adaptation and poverty relief such that the impacts of climate change can be reduced (Linnerooth-Bayer, et al, 2009). There is investigation by into insurance products for households and businesses that would normally be excluded (Satterthwaite, et al, 2007). There is also an interest in the potential for public/private partnerships between governments and insurance companies to help realize this. This is important as the private sector has historically been anxious about getting involved in this market and evidence shows that private insurance is far less common in low- and middle-income countries than in high-income countries (Satterthwaite, et al, 2007). About only 1 per cent of households and businesses in low-income countries and only 3 per cent in middle-income countries holding catastrophe insurance, compared to 30 percent in high-income nations.

This is, however, changing and the Global Insurance Industry, Climatewise, as well as the Geneva Association (an insurance think tank), along with the IMF and UNEP, have called on governments to start using insurance and insurance-type products to decrease vulnerability and increase hedging against disasters<sup>8</sup> (Linnerooth-Bayer, et al, 2009; Mortimer, 2010). There has also been the suggestion of transferring risks associated with natural disasters to capital markets in the form of catastrophe bonds (cat bonds)<sup>9</sup> and other similar products. The International Monetary Fund (IMF) has proposed that they expand their role to include insurance provision for low-income countries against global volatility and the effects of climate change. Strauss-Kahn, IMF's managing director, was recently reported as saying that although climate change does not currently fall within the IMF's core "mandate," the serious macroeconomic and financing consequences of climate change, as well as the need to support and promote long-term global stability, certainly fall within the Fund's responsibility. He called for developing creative solutions "to what is perhaps the most critical issue facing the planet in the 21st century." (IMF, 2010: webpage).

Effectively the insurance industry can offer:

- **Expertise in risk management**, particularly in areas such as risk and vulnerability assessment, putting a price tag on risk, and the design of risk reduction and risk transfer activities
- **Prioritising adaptation measures** by enhancing adaptive capacity and advising on the cost effectiveness of resilience measures
- **Incentivising loss reduction** by informing economic actors about the risks they face, advising them on risk mitigation options and providing them with existing insurance options for loss reduction
- **Developing new insurance products** which cover risks affected by climate and weather events, such as human health, crop yields and animal diseases

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<sup>8</sup> For a full discussion of the proposals of the various think tanks and global insurance industry see Linnerooth-Bayer, et al, 2009

<sup>9</sup> In 2009 Swiss Re teamed up with the World Bank to issue a \$290 million cat bond to cover against earthquakes and hurricanes in the city



- **Raising awareness among the many stakeholders of the insurance industry** – including governments and regulators, clients and business partners, business and industry, civil society and academia – about the impacts of climate change, the adaptation needs of those most at risk, and the role that the insurance industry can play in advancing adaptation, as described in this Statement. (Global Insurance Industry, n.d.)

The insurance sector thus has much to offer, especially to those engaged in the land market and as Walter Stahel, the deputy secretary general of the Geneva Association stated, "The insurance industry has the tools and knowledge - now we need the heads of government to provide the framework and conditions in order for these instruments to function". Appendix III provides a series of examples of where insurance has been put in place in developing countries. What is clear is that while much thought has been given to the rural and agricultural sectors, further attention needs to be paid to low-income urban communities in developing countries.

### **c. Micro-finance and adaptation**

The specific use of micro-finance is another approach for helping poor people to cope with climate-change impacts (Hammill, et al, 2008). Micro-finance is a catchall phrase for a range of products including, but not limited to the delivery of loans, savings, and insurance and other financial services. Micro-finance has traditionally focused on money lending and local savings groups and attempts to channel the services of large institutions to very local and sometimes hard to reach places. A particular approach to micro-financing looks at how these products can be used to support, further accumulate and more successfully manage poorer people's assets and livelihood strategies (Hammill, et al, 2008). The intention is to reduce their vulnerability to shocks and stresses so that they are better able to cope and recover. The augmentation is intended through direct income effects and indirect non-financial impacts (see Table 3) to lessen general vulnerability and to provide support when disasters strike.

The trouble is that the specifics of the situation, community, and climate change combine to show that stock standard micro-financing approaches with uniform conditions are not appropriate for adaptation. There are some useful examples of micro-finance services such as Grameen Bank of Bangladesh and the Self Employed Women's Association (SEWA) in India (Satterthwaite, et al, 2007). Oxfam, and SwissRe in conjunction with the Rockefeller Foundation, have begun to look at micro-finance for climate change (although currently their work is in rural areas). The limits and possibilities of these systems should be further investigated for urban contexts and specific climate change related events.



**Table 3: Micro-finance services and livelihood assets adaptations to climate change (Hammill et al, 2008: 116)**

	Direct contribution of MFS	Less direct contribution of MFS
Financial	<ul style="list-style-type: none"> <li>• Cash/capital for investing livelihood activities</li> <li>• Savings (depending on credit scheme)</li> <li>• Increase in household assets</li> <li>• Diversification of assets</li> </ul>	<ul style="list-style-type: none"> <li>• More regular inflows of money</li> <li>• Financial safety nets</li> <li>• Credit standing for future loans</li> <li>• Improved skills/capacities in financial management</li> </ul>
Social	<ul style="list-style-type: none"> <li>• Establishment or strengthening of social networks</li> <li>• Establishment or strengthening of formalised groups</li> </ul>	<ul style="list-style-type: none"> <li>• Reinforced relationships of trust, reciprocity and exchange (i.e. through loan groups)</li> <li>• Informal safety nets</li> <li>• Increased access to civic or political bodies</li> <li>• Increased social prestige and value</li> <li>• Increased sense of wellbeing</li> <li>• Women's empowerment, increased self-confidence</li> </ul>
Natural	<ul style="list-style-type: none"> <li>• Practice of sustainable soil and water management techniques as a loan condition (e.g. more favourable interest rates)</li> </ul>	<ul style="list-style-type: none"> <li>• Capital for investing in sustainable natural resource management (SNRM) practices; renewable energy</li> <li>• Reduced pressure on natural resource base (as activities are improved or diversified)</li> <li>• Enhanced skills and institutions for SNRM</li> <li>• Political empowerment to secure resource rights, land tenure</li> </ul>
Human	<ul style="list-style-type: none"> <li>• Loans for education, healthcare</li> <li>• Skills training, education (depending on credit scheme)</li> </ul>	<ul style="list-style-type: none"> <li>• Increased literacy, knowledge base</li> <li>• Better health</li> <li>• Improved ability to labour and employability – expanding labour force</li> </ul>
Physical	<ul style="list-style-type: none"> <li>• Loans for equipment, infrastructure</li> <li>• Housing, sanitation improvements (as part of credit package)</li> </ul>	<ul style="list-style-type: none"> <li>• Better health and living environment</li> <li>• Better infrastructure or equipment (able to invest in better quality and more, result of less intense use)</li> </ul>

#### 4.2.6 Slum upgrading and redevelopment

The existing vulnerability of many slum and informal dwellers can be moderated by investment into better human settlements, with improved housing, services, infrastructure and tenure (WDR, 2010). It seems an obvious point that better settlements, better access of the poor to better located and better quality housing will decrease existing vulnerabilities. As such adaptation strategies within the land market need to face the age-old question of how to provide affordable housing and well-located land to the poorer members of society. The WWF (2010) and the WDR (2010) seem to indicate that current assessments of the cost of upgrading have severely underestimated real costs, as these need to be informed by an analysis of current disaster risks and the required investment in housing, early warning systems and rapid and effective post-event responses. These include temporary accommodation, restoring access to services, supporting rapid return to damaged settlements and supporting rebuilding (WDR, 2010).

The current approach thus seems to favour a formalisation and regularisation approach, which would no doubt be ideal but is fairly unlikely to work in a host of low- and middle-income contexts and where urbanisation is occurring extremely quickly. The literature survey and examination of current approaches did not turn up many other approaches by the state, aside from upgrading and formalisation. It is suggested that CBA best practice be further examined to see if it surfaces anything that the state can support and that is between full formalisation on the one hand, which is often impossible, and completely ignoring the reality of informality and slums on the other.

#### 4.2.7 Land use planning and adaptation

Land use planning can also be used as an effective response to climate-change risks. It should however be noted that zoning and planning controls have often been used to exclude large portions of the urban population in low- and middle-income nations from legal land markets.



New land use plans and regulations should be cautious and not be used in the same way. Nevertheless land use regulations could be used in opening up safe and well-located land for low-income households while reducing their exposure to the risks of flooding, slope failure and other disasters. Land use regulations can also be broadened to allow the poor more flexible use of their land and property in order to adapt their livelihoods to climate changes.

Since women often operate home-based enterprises and are increasingly moving to casual but paid work and are, in general, responsible for domestic duties, women's livelihood and life strategies need to be considered in both the pre-disaster and reconstruction phase as well as when re-designing land use instruments (UN-Habitat, 2009). In point of fact women's needs around land use may even be more important to the family unit than their male counterparts who spend less time at home (APFWLD, 2005).

There is evidence to suggest that in general people affected by disasters would prefer the restoration of livelihoods rather than aid and emergency donations (WDR, 2010). The appropriateness and affordability of building standards for local contexts should be considered and where necessary, incremental improvements rather than evictions on the grounds of safety could be thought about (WDR, 2010). Satterthwaite, et al, (2007) make the comment that for all cities, floods are influenced as much – if not more – by land-use practices in surrounding watersheds, and by solid-waste management, land-use and drain maintenance in the city. In many cities, future risk can be reduced in the face of climate change by appropriate water resource management and governance.

### **4.3 Mitigation and adaptation strategies**

Mitigation and Adaptation strategies should not be seen in isolation and to the exclusion of each other; rather they are interconnected and necessary for the success of each strategy (IPCC, 2007). Unless they are carefully aligned they can compete for resources and budgets, and in worst-case scenarios, may have conflicting goals or outcomes. The section below provides an account of some of the combined mitigation and adaptation approaches and programmes that are currently being used and thought about.

#### **4.3.1 The resilient city approach**

The idea of resilience is of an integrated or eco-system approach, in which all aspects of city, including governance, infrastructure development and maintenance, social relations and disaster management, are treated as inter-related and equally important (World Bank, 2010). The idea is to ensure that all of these factors are developed and protected so that a city or municipality has the capacity to maintain core functions, especially for vulnerable populations, in the face of hazards, threats and impacts.

#### **Box 6: The components of resilience**

The Resilience Alliance and the Asian Cities Climate Change Resilience Network (ACCCRN) suggest that urban resilience involves the following components:

**Redundancy.** When one system is disrupted, another system can provide similar services. For example, if individuals are trained in basic health and emergency responses, they are able to provide immediate support if transportation and communication systems are disrupted following an extreme event.

**Flexibility.** The failure of a single system causes a minimal impact to other systems. For example, a city with a diversified economic base will avoid catastrophic failure if a single industry fails due to economic change or environmental disaster.

**Capacity to reorganize.** Climate change will result in changing conditions – and resilient cities are able to introduce new structures, organizations and land-use measures in response to this.

**Capacity to learn.** This ensures that future decisions are made on the basis

*(ISET, 2009)*



Proponents of the resilient cities approach see the ultimate objective of disaster risk reduction and climate change adaptation as producing resilient cities (World Bank, 2010). Resilience is normally considered to require a capacity to anticipate climate change and plan necessary interventions.

In order to accomplish this end, action is required from a wide range of stakeholders, including those who are affected, have financial resources, technical expertise, and decision-making authority (WDR, 2010). Instead of concentrating on specific issues, or disasters, the idea is to put in place broader, more integrated plans that are able to cope with a host of current and future issues and can basically withstand whatever challenge is thrown at it (Rockefeller Foundation, website) (Box 6 describes the components that need to be in place in order for a city or community to be truly resilient).

Resilience therefore takes into account the economic, social, psychological, physical and environmental factors that are necessary for humans to survive and to thrive. DfID in their thinking on Climate Change, sees the inter-related stressors as the heart of the matter and state that their overall aim in sub-Saharan Africa is “to improve the ability of poor people to be more resilient to current climate variability as well as to the risks associated with longer-term climate change” (DfID, 2006: 3). Thus keeping resilience in mind their programme examines and seeks to address the implications of interacting and multiple stresses, such as HIV/AIDS, poor governance and climate change, on the vulnerability of the poor. This is very much in keeping with the overall thinking around resilience strategies, which need to be integrated and rooted in the local in order to embed risk reduction and climate change adaptation within a city’s institutional and organizational framework. Resilient cities work hard to reduce all measures of vulnerability with the understanding that Individuals and households who have access to adequate food, clean water, healthcare, good infrastructure and education will inevitably be better prepared to deal with a variety of shocks and stresses – including those arising from climate change. Presently there has been some support of building the idea of resilience into farming activities and rural communities<sup>10</sup> and institutions such as the Rockefeller Foundation have been supporting rural communities so that they will be able to cope with imminent consequences of climate change. However such an approach to resilience has not yet been successfully translated to urban areas even though it is currently a vital topic on the international agenda.

The idea of resilience is very much on the agenda at the moment and the United Nations International Strategy for Disaster Reduction (UNISDR), has decided to focus their strategy in their 2010-2011 World Disaster Reduction Campaign on “Making Cities Resilient. The International Council for Local Environmental Initiatives (ICLEI) has also developed its Resilient Communities & Cities Initiative, which is aimed at mainstreaming disaster resilience in the planning and decision-making processes of local governments. The initiative is based on their longer programme of initiating and supporting the Local Agenda 21 (LA21) movement and now looks at incorporating participatory municipal resilience planning and management into their LA21 work. They also host an annual conference called Resilient Cities, whose theme is billed as “Cities and Adaptation to Climate Change”, Similarly the Asian Cities Climate Change Resilience Network (ACCRN)(funded in part by the Rockefeller Foundation<sup>11</sup>), by 2012 intends to have developed resilience plans for a

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<sup>10</sup> For further details into the Rockefeller Foundation’s work on climate change and resilience go to [www.rockefellerfoundation.org/what-we-do/current-work/developing-climate-change-resilience](http://www.rockefellerfoundation.org/what-we-do/current-work/developing-climate-change-resilience)

<sup>11</sup> The Rockefeller Foundation’s work on resilience in Africa has tended to focus on agriculture and food security and less on urban centres and infrastructure, for further details go to [www.rockefellerfoundation.org/what-we-do/where-we-work/africa](http://www.rockefellerfoundation.org/what-we-do/where-we-work/africa)



network of cities in Asia in order that these cities can withstand and recover from climate change impacts.

### 4.3.2 Community-based initiatives

There are not only mitigation and adaptation strategies from “above”; there are also a range of other initiatives that are in place “from below”. Table 4 indicates the differences between autonomous i.e. state conceptualised and run initiatives or from below, which are community-based initiatives led by the urban poor and are generally put in place to try and reduce their vulnerability and to mitigate and adapt to the changing environment and done with little if any state support. As opposed to policy or state driven initiatives.

**Table 4: Adaptation and mitigation strategies from "above" and "below" (Satterthwaite, et al, 2007: 51)**

Type of response to climate change	Autonomous (by households, communities and firms)	Policy-driven
Short-run	Making short-run adjustments, e.g. reducing water use, spreading the risk of loss through insurance	<ul style="list-style-type: none"> <li>– Developing greater understanding of climate risks and vulnerabilities</li> <li>– Improving emergency response</li> </ul>
Long-run	Investing in climate resilience – much encouraged if future effects are relatively well understood and benefits are easy to capture for household, community organization or firm	<ul style="list-style-type: none"> <li>– Investing to create or modify major infrastructure, e.g. larger reservoir storage, increased drainage capacity, higher sea-walls</li> <li>– Avoiding negative impacts, e.g. land-use planning to restrict developments in floodplains and at-risk coastal sites</li> </ul>

A workshop co-hosted by the International Institute of Environment and Development (IIED) and the Regional and International Networking group in Dhaka in 2007 of key stakeholders identified the following three stages for any community-based adaptations<sup>12</sup> (CBA): (1) focus on addressing current climate risks within a development context, (2) monitor progress and look outward, and (3) assess future development options under climate change. It was felt by the participants that putting these three generic stages in place would help to support any community, not just vulnerable communities, in their desire to achieve greater resilience (See Box 7 for further details of this approach).

A key financial community-based intervention has been the development of community-managed savings groups in urban areas. These savings groups generally pool money or resources and then allow members to withdraw or have access to funds when they experience some kind of shock. The problem however is if all members experience the same shock or disaster at the same time. If however the community savings groups can be scaled up into larger networks then the risk can be spread and the scope of funding expanded to other areas/communities then the risk can be spread. Currently the best-known urban examples of savings groups are amongst those living in “slums” or informal settlements (see Appendix III for details). The savings groups are able to put in place both mitigation and adaptation strategies and have been responsible for improved infrastructure and housing as well as finding ways of securing tenure all of which increase resilience to climate-change related risks (Satterthwaite, et al, 2007).



<sup>12</sup> Despite the name the CBAs include mitigation activities and ideas.

Aside from savings groups, which are designed to cater for the provision of financial assets and the development of more resilient communities, communities have also put in place a whole host of ground-level interventions to try and prevent the severity of disasters and other events. Communities modify their homes to make them more resistant to disaster. Interventions include raising plinth levels, paving courtyards, and using landfill materials to raise levels and prevent flooding, having high or raised cupboards or other types of furniture that people can sit on in case of floods, fitting high shelves on which goods can be stored (including food and water) and keeping all electric wiring and plugs close to the roof (WDR, 2010). An interesting innovation is the construction of removable roofing, which can be quickly taken off if the structure is in danger. During certain seasons and times of the year when disasters are more likely, households also have suitcases ready packed with valuables and important documents so that they can be quickly taken away should the need arise.

#### **Box 7: IIED and RING stages of CBA**

**Stage 1:** Ship-building. This addresses climate-related vulnerability by adapting to current climate risks, especially those shown to be consistent with those projected for the future. These risks are most often exacerbated by other human activities. This stage may have much in common with current disaster or development projects and need not have a strong emphasis on climate change as long as adapting to current climate risks remains a central focus.

**Stage 2:** Map-making. This stage monitors progress at the local level and brings in data and information from outside. It is mainly a reflexive stage where adaptation may continue but monitoring ongoing change (such as environmental and social change) also occurs so that the causes and management of risks become better understood. The progress of adaptation options can be quantified.

**Stage 3:** Exploring new horizons. This stage investigates how risks may change and be managed over time. The primary aim is to give communities a greater choice in their future. Projections of climate-change risks and development pathways may be investigated. Exploring new horizons does not imply that communities must move location or change activities, but if they continue along their historical pathway, they do so with a full understanding of what the alternatives may be.

This structure seeks to offers communities the opportunity to explore adaptation possibilities under different development approaches. Obviously, it needs to recognize that many political, financial and social barriers will hamper this process. These barriers need close examination, as do the strategies and mechanisms for addressing them. One key element of CBA is that of improving the capacity of individuals and communities to make choices about their own futures. In many instances, this will involve difficult decisions – for instance having to move – which makes it all the more important that people should be fully engaged in choices about where to move to, when, and how the move should be managed.

*Adapted from the Second International CBA Workshop in Dhaka in February 2007 was an initiative of the Bangladesh Centre for Advanced Studies, the International Institute for Environment and Development and*

Post-disaster responses from the state also need to support a range of community responses, including allowing communities to meet, network and share their grief and trauma. Responses also need to involve local people from the beginning rather than as a later addition in the reconstruction process (WDR, 2010). Best practice indicates that post-disaster responses have to strengthen and support the survivors' own organizations and keep women at the centre. Women have been shown to have enormous individual and collective capacities that allow them to act as the central figures within the domestic sphere as well as in the larger community and network (Satterthwaite, et al, 2007).





Given that this is the case, it is ironic that in many redevelopment and reconstruction programmes women and their needs are ignored, misunderstood or not considered. In some cases support to community initiatives need to be careful not to reinforce or re-establish earlier forms of prejudice or bias within land access and holding. As such representative community organisations should be carefully constituted to represent both previous power-brokers as well as newcomers. As the Asian Coalition for Housing Rights has noted, unless disaster aid quickly learns to work with the untitled, the unregistered, the unlisted and the undocumented, it can support and even reinforce the inequalities that existed prior to the disaster (WDR, 2010). It should also be mentioned that although disasters do not often change attitudes within government agencies in regard to the needs and rights of the inhabitants of informal settlements, they could provide the opportunity to catalyse a change in relations with the state and gain longer-term benefits for the urban poor, especially if communities can prove to government and international agencies that they are competent and capable of rebuilding. Alternatively communities can “take the gap” and rebuild better more permanent structures after a disaster, which could potentially provide leverage for discussions with the state at a later point (WDR, 2010).

A useful case study cited in the WDR (2010) was that of CARE’s Kabul Area Shelter and Settlement Project, funded by the United States Agency for International Development’s (USAID) Office of Foreign Disaster Assistance, in 2007. The programme began by undertaking a land use survey and the creation of community councils to select beneficiaries in clusters rather than individually. CARE then signed a memorandum of understanding with the Kabul Municipality, which linked housing to broader issues of land tenure, occupancy rights and housing security, and partnered with the Afghan Development Association and the Sanayee Development Organization, two local NGOs. CARE’s report on the project noted: “Essentially, a successful shelter intervention must include strategies for good governance that focus on increasing people’s understanding of their rights and responsibilities, as well as enhance the ability of authorities to listen to the needs of the people, that encourage all to find solutions to problems that affect everyone.”

#### **4.3.3 Urban governance and its role in adaptation and mitigation**

Urban governance is increasingly accepted as a multifaceted process involving a range of stakeholders, including civil society organisations, the private sector, the academic and research community, and the formal mechanisms of local government (WDR, 2010). To a large degree the vulnerability of urban populations and the responsibility for adaptation and mitigation is laid firmly at the feet of the local municipalities. Unfortunately as discussed earlier, many local governments are unwilling to work with informal and slum dwellers as they see them as illegal and undesirable as well as responsible for many of the problems facing their cities. Local governments do not see the poor and marginalized as failures of their policy but rather as the problem. In addition local authorities are also dictated to through mechanisms such as NAPAs and international agreements. As a result local government can be unwilling or unable to provide well-located land, good quality state subsidized housing and services to a population that they see as undesirable or outside of their care. Such an attitude increases the vulnerability of poor people enormously and makes adaptation programmes difficult to implement (Satterthwaite, et al, 2007). Similarly weak or ineffective local governments are unable to institute environmental regulations, irrespective of how good or indifferent it might be. They will also be unable to generate real buy-in for programmes such as LA21s, which require real stakeholder engagement.



In order for mitigation and adaptation processes to be institutionalised an important ideological/paradigm-shift needs to take place, whereby officials no longer see poor and marginalised communities as the problem but rather as legitimate residents of urban areas, with rightful claims on the state. Once such a shift takes place, then a series of interventions become potentially possible, including subsidies for well-located land, state-guaranteed credit, new forms of tenure to secure land for low income communities, and so on. Better urban governance and a change in thinking and attitude is not a silver bullet but rather an important place to start, which may provide some potential for movement (WDR, 2010). The point is that local governments who take the safety of their residents seriously demonstrate that cities can be the safest places for people of all income groups when disasters strike.



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## Appendix I: Climate change impacts on human settlements (IPCC Summary Report, 2007)

Climate Driven Phenomena	Evidence for Current Impact/ Vulnerability	Other Processes/ Stresses	Projected Future Impact/ Vulnerability	Zones, Groups Affected
<b>a) Changes in extremes</b>				
Tropical cyclones, storm surge	Flood and wind casualties and damages; economic losses; transport, tourism, infrastructure (e.g., energy, transport), insurance (7.4.2; 7.4.3; Box 7.3; 7.5)	Land use/ population density in flood-prone areas; flood defences; institutional capacities	Increased vulnerability in storm-prone coastal areas; possible effects on settlements, health, tourism, economic and transportation systems, buildings and infrastructures	Coastal areas, settlements and activities; regions and populations with limited capacities and resources; fixed infrastructures; insurance sector
Extreme rainfall, riverine floods	Erosion/landslides; land flooding; settlements; transportation systems; infrastructure (7.4.2) (see regional Chapters)	As for tropical cyclones and storm surge, plus drainage infrastructure	As for tropical cyclones and storm surge, plus drainage infrastructure	As for tropical cyclones and storm surge, plus flood plains
Heat or cold-waves	Effects on human health; social stability; requirements for energy, water and other services (e.g., water or food storage), infrastructures (e.g., energy transportation) (7.2; Box 7.1; 7.4.2.2; 7.4.2.3)	Building design and internal temperature control; social contexts; institutional capacities	Increased vulnerabilities in some regions and populations; health effects; changes in energy requirements	Mid-latitude areas; elderly, very young, ill and/or very poor populations
Drought	Water availability, livelihoods; energy generation; migration; transportation in water bodies (7.4.2.2; 7.4.2.3; 7.4.2.5)	Water systems; competing water uses; energy demand; water demand constraints	Water resource challenges in affected areas; shifts in locations of population and economic activities; additional investments in water supply	Semi-arid and arid regions; poor areas and populations; areas with human-induced water scarcity
<b>b) Changes in means</b>				
Temperature	Energy demands and costs; urban air quality; thawing of permafrost soils; tourism and recreation; retail consumption; livelihoods; loss of melt water (7.4.2.1; 7.4.2.2; 7.4.2.4; 7.4.2.5)	Demographic and economic changes; land-use changes; technological innovations; air pollution; institutional capacities	Shifts in energy demand; worsening of air quality; impacts on settlements and livelihoods depending on melt water; threats to settlements/infrastructure from thawing permafrost soils in some regions	Very diverse, but greater vulnerabilities in places and populations with more limited capacities and resources for adaptation
Precipitation	Agricultural livelihoods; saline intrusion; tourism; water infrastructures; energy supplies (7.4.2.1; 7.4.2.2; 7.4.2.3)	Competition from other regions/sectors. Water resource allocation	Depending on the region, vulnerabilities in some areas to effects of precipitation increases (e.g., flooding, but could be positive) and in some areas to decreases (see drought above)	Poor regions and populations
Saline intrusion	Effects on water infrastructures (7.4.2.3)	Trends in groundwater withdrawal	Increased vulnerabilities in coastal areas	Low-lying coastal areas, especially those with limited capacities and resources
Sea-level rise	Coastal land uses; flood risk, water logging; water infrastructures (7.4.2.3; 7.4.2.4)	Trends in coastal development, settlement and land uses	Long-term increases in vulnerabilities of low-lying coastal areas	As for saline intrusion,
<b>c) Abrupt climate change</b>				
	Analyses of potentials	Demographic, economic, and technological changes; institutional developments	Possible significant effects on most places and populations in the world, at least for a limited time	Most zones and groups

Orange shading indicates very significant in some areas and/or sectors; yellow indicates significant; white indicates that significance is less clearly established.



## Appendix II: Mitigation strategies currently in place in the SADC region

### **COOPENER Project “Development and Energy in Africa (DEA)”**

The project aimed to “support decision makers with the implementation of more sustainable energy policies,” by identifying and quantifying, where possible, the elements of concrete energy interventions that contribute to sustainable development (SD) and systematizing this in an Assessment Framework which can enhance policy to promote energy for sustainable development. Funded by the European Union and implemented by The National Laboratory for Sustainable Energy (Technical University of Denmark), as project coordinator, in collaboration with the Energy Centre of the Netherlands (ECN), and in partnership with six African Centres. In Southern Africa it covers Botswana, Tanzania, and Zambia.

<http://deafrica.net/workshops/Regional%20WorkshopArusha/Regional%20Workshop%20Report.pdf>

**ProBEC (Programme for Basic Energy and Conservation).** This is a SADC project that manages and stimulates the establishment of various projects based on basic energy conservation in 10 member states in SADC. Currently ProBEC is actively involved in Malawi, Lesotho, Mozambique, Tanzania, Swaziland, Zambia, Botswana, Namibia and South Africa.

**African Bio Carbon Fund** The fund is part of the Africa Bio-Carbon Initiative, which seeks to advocate for broader eligibility for bio-carbon in the Kyoto and related regional and national frameworks for climate change. This objective will contribute to the overarching goal of increasing the benefits for sustainable agriculture and land use practices, biodiversity conservation, maintenance of environmental services, successful adaptation to climate change, and improvements in rural livelihoods, in addition to the delivery of cost effective and verifiable reductions in greenhouse gas emissions in Eastern and Southern Africa and beyond.

**Greenhouse Gases Mitigation Programme (Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ))** The programme focuses on identifying technologies that are associated with GHG emissions for various sectors, together with technical possibilities of minimising of GHG emissions. It also analyses the technical characteristics of various technologies identified as well as evaluating their reduction potentials



## **Appendix III: Examples of where insurance has already provided effective risk management solutions in developing countries, particularly those most vulnerable to the impacts of climate change**

**1. The Caribbean Catastrophe Risk Insurance Facility (CCRIF)** is a public-private partnership designed to limit the financial impact of hurricanes and earthquakes for 16 Caribbean governments. Established in 2007, the Facility provides short-term liquidity (within 2 to 3 weeks) to participating governments when the policy is triggered by a catastrophe, such as the 2010 Haitian earthquake. The Facility uses a parametric mechanism to determine the potential future risk and trigger a payout whenever a pre-defined modelled loss level is exceeded. By pooling the risks of its members, CCRIF serves as a risk aggregator and can provide insurance coverage at a comparatively low premium for otherwise mostly uninsured catastrophe risks borne by sovereigns. CCRIF member states decide on the level of coverage for each peril insured. This Facility illustrates that dialogue between governments and insurers can create tailored, institutionally light and flexible solutions for particular regions. For more information, [www.ccrif.org](http://www.ccrif.org).

**2. Horn of Africa Risk Transfer for Adaptation (HARITA)** is a parametric insurance scheme that brings together climate change risk mitigation and crop insurance for farmers and has been rolled out in five communities in Northern Ethiopia. Underwritten by a local company, and reinsured by a global reinsurer, it uses a rainfall index to trigger compensation for farmers growing the Ethiopian three staple grain crops in case of drought. It is unique, however, in allowing farmers to pay for their premiums through labour on projects that will mitigate the effect of climate change in their area, such as tree planting. To turn the labour into monetary value, the scheme takes advantage of a national government “cash for work” programme, which enables it to reach the most vulnerable farmers. HARITA therefore integrates insurance with both risk reduction and credit provision. By allowing very vulnerable farmers to pay their premiums through risk-reducing labour, farmers benefit even when there is no payout because these risk reduction activities will help minimise vulnerability to drought and improve yields. Lack of cash is the main reason that people do not participate in insurance schemes. Using this government national cash for work programme is a way to address this issue and to scale up the size of the programme. Cash-paying farmers also participate in the programme, advancing market development. The programme will roll out to the Tigray region in 2011. Nationally about eight million farmers are beneficiaries of the cash-for-work safety net. [www.oxfamamerica.org/articles/weather-insurance-offers-ethiopianfarmers-hope-despite-drought](http://www.oxfamamerica.org/articles/weather-insurance-offers-ethiopianfarmers-hope-despite-drought).

**3. In Mongolia**, the World Bank and other organisations have been actively involved in developing programmes for sustainable livelihoods that emphasise pastoral risk management including early warning systems and risk preparedness actions, access to supplementary feed and grazing reserves, coordination of pastureland use, and conflict management. These measures were combined with efforts to extend the outreach of micro-finance services to herders, and community-prioritised investments in basic infrastructure. An index-based micro-insurance coverage helps reduce the administrative costs of insurance, making it more affordable. Micro-insurance and complementary interventions in a wider risk management framework in Mongolia are therefore helping reduce herders’ vulnerability to climate and non-climate hazards.



The main objectives of the insurance scheme, provided by the Government of Mongolia in partnership with local private insurance companies and banking organisations, is to provide insurance coverage against catastrophic livestock mortality events to complement household-level risk management strategies for smaller livestock mortality losses. The programme involves the domestic insurance market while protecting it against extreme losses, and also limits the government's fiscal exposure to loss and damage. Participating herders pay fully loaded risk premiums and if the livestock mortality during a harsh winter is between 6%-30%, the involved insurance companies cover the losses with some combination of herder premiums, their own capital, global reinsurance and contingent credit from the World Bank if necessary. The government pays for losses in excess of 30% using only the contingent credit. Herders bear the cost of smaller losses, which are not likely to affect their business in the long term.

This self-insurance for livestock mortality, with rates of up to 6%, leads to risk-reducing behaviour by the herders because of the strong incentive to engage in activities that may decrease the mortality risk of their livestock. This index insurance does not cover every single livestock loss due to winter conditions – it is about addressing consequential losses and extra costs that come with a harsh winter, killing large numbers of adult animals.

For more information, visit [www.globalagrisk.com](http://www.globalagrisk.com)

**4. Weather insurance in Malawi.** The value of data collection in the establishment of insurance mechanisms is well demonstrated by a project in Malawi. A combination of sufficient weather stations and start-up assistance helped by the World Bank and World Food Programme helped start a pilot weather insurance project. The insurance pilot bundles loans and insurance for nearly 1,000 smallholder farmers enabling them to buy affordable index-based drought insurance. The insurance is linked to loans, and both improve the creditworthiness of participating farmers and enables them to increase their farm productivity. A challenge with such initiatives tends to be scalability: current schemes tend to cover only a few hundred or thousand farmers but with government assistance this could be scaled up. An initiative in India launched in 2007 offered insurance with crop loans and was taken up by 700,000 farmers.

**5. Index-based insurance to promote climate resilience in Bolivia.** An insurance scheme has been developed in four provinces in the north and central Altiplano regions of Bolivia that combines incentives for proactive risk reduction and an insurance index mechanism. In this scheme the index is based on the production levels of reference plots of farmland in areas, which are geographically similar in terms of temperature, precipitation, humidity, and type of soil. A group of farmers identify a peer who is considered to use the best available methods. That farmer serves as a technical assistance agent to help other farmers reduce their risks and improve their yields. The system encourages other farmers to match the reference farmers in implementing risk reduction efforts to reduce the effects of drought, excess rains, hailstorms and frost. The reference farmer's land becomes the reference plot, the yields from which serve as an indicator of whether production levels have been adversely affected by environmental factors (triggering an insurance payout) or by other factors within the farmer's control. The objective becomes to perform or outperform the reference plot by improving agricultural practices and reducing risk of damage from weather hazards. (Global Insurance Industry, n.d.)



## Appendix IV: Adaptation Programmes and tools currently in operation in urban areas in Southern Africa

### Information services

- **SERVIR** is a regional visualisation and monitoring system for Mesoamerica and Africa that integrates satellite and other geo-spatial data for improved scientific knowledge and decision-making. Developed by USAID, NASA, the Institute for the Application of Geospatial Technology (IAGT), the University of Colorado, and CATHALAC. [www.servir.net](http://www.servir.net)
- **World Bank Climate Change Portal and ADAPT** The World Bank Climate Change Portal is intended to provide quick and readily accessible global climate and climate-related data to the development community. [www.sdwebx.worldbank.org/climateportal/...](http://www.sdwebx.worldbank.org/climateportal/...)
- **ci:grasp** Aims to provide a sound information basis on climate stimuli, climate impacts, vulnerabilities, and response options in selected threshold countries on an open, web-based platform. Developed by the Potsdam Institute for Climate Impact Research (PIK) and GTZ, funded by the German Federal Ministry for Environmental Protection, Nature Conservation and Nuclear Safety (BMU). [www.ci-grasp.org](http://www.ci-grasp.org)
- **weADAPT Climate Change Explorer** The Climate Change Explorer provides users with an analytical foundation from which to explore the climate variables relevant to their particular adaptation decisions. Developed by the Stockholm Environment Institute (SEI). [www.weadapt.org](http://www.weadapt.org)
- **wikiADAPT** is a Flexible, accessible, inclusive medium for enhancing the knowledge base of the climate adaptation community. The wiki is a collaborative project, and the idea is to have a community of contributors. Part of the weADAPT platform. [www.wikiadapt.org](http://www.wikiadapt.org)
- **Adaptation Learning Mechanism**  
Features tools and practical guidance to meet the needs of developing countries, complementing the wide range of adaptation knowledge networks and initiatives already underway such as the Nairobi Work Programme, particularly the 'Methods and Tools' and 'Planning and Practices' areas of work, and the interactive weADAPT platform. Developed by the United Nations Development Programme (UNDP). [www.adaptationlearning.net](http://www.adaptationlearning.net)
- **SAEON (South Africa Environmental Observation Network)** DST funded, NRF hosted initiative to provide a comprehensive South African Earth observation network that delivers long-term reliable data for scientific research to bring more certainty about environmental change, and to enable formulation of adaptive and mitigating management policies and practices, for themes ranging from food production to population health. <http://www.saeon.ac.za/>



- **AEON (Africa Earth Observatory Network)** A research and teaching network of African and Africa-based scientists with a physical hub in Cape Town (UCT) concerned with scientific understanding of how the earth works; the resilience of its interconnected systems; the value of its services; and documentation of its heritages, particularly in Africa. <http://www.aeon.uct.ac.za/>

## Research

- **ORCHID and CRISP**  
Opportunities and Risks from Climate Change and Disasters (ORCHID): Vulnerability and poverty reduction research, climate change and disaster risk screening of development agency portfolios. The methodology was developed by the UK Department for International Development, an adapted version is known as CRISP. [www.ids.ac.uk/climatechange/orchid](http://www.ids.ac.uk/climatechange/orchid)
- **Southern Africa Regional Climate Outlook Forum (SARCOF)** This forum brings together Climate scientists from SADC National Meteorological and/ or Hydrological Services (NMHSs) and the Drought Monitoring Centre (DMC) to prepare reports on seasonal climate status and outlook.
- **Climate Change Adaptation in Africa Linking African Researchers with Adaptation Policy Spaces Project:** This project aims to build the capacity of researchers to influence policy. Researchers will investigate the complexity of adaptation policy processes in different countries and identify policy spaces; use this knowledge to build policy engagement tools and strategy; develop an analytical framework for investigating climate change adaptation policy processes in Africa; and mentor relationships between participatory action researchers and academic. Funded by International Development Research Centre (IDRC) the project covers Malawi. <http://www.ids.ac.uk/ids>;
- **ACCESS (African Centre for Climate and Earth System Science)** DST/NRF Centre of Excellence, hosted by the CSIR. Will be used as a platform to develop South African and international research programmes in support of the DST Global Change Grand Challenge. The focus of ACCESS is on climate related phenomena that range from the transient fluctuations in conditions on land and in the adjacent oceans, to future climate changes associated with global warming. Currently developing the South African Risk and Vulnerability Atlas (SARVA) for DST with the input of several South African research partners. The Atlas will be a repository of global change research, structured to provide usable information in support of adaptation responses. <http://www.africaclimatescience.org/>
- **African Centre for Cities (ACC):** Applied research on the regulatory reforms required to implement a regional climate change strategy in the Western Cape. ACC chairs a scientific reference group for the Cape Town metropolis to promote and assure all applied research on climate change commissioned by the municipality. Latest research project is on collaborative governance and the reduction of flooding risk in Cape Town (within the context of increased climate variability). The ACC also hosts the Cape Urban Observatory. <http://africancentreforcities.net/>



## Capacity-building for climate change adaptation

- **Capacity Development and Knowledge Management CapNet** Cap-Net is an international network for capacity building in IWRM. It is made up of a partnership of autonomous international, regional and national institutions and networks committed to capacity building in the water sector. One of its key focus areas is capacity building for Climate Change Adaptation and Hydroclimatic disasters. [www.cap-net.org](http://www.cap-net.org)
- **Danish Action Program** – This focuses on: awareness raising about national and local impacts of climate change; capacity building related to climate data and forecasting; interdisciplinary Master’s and PhD training, and case study analysis at provincial level, where climate information, socio-economic impacts and policy implementation are considered in an integrated way Danish Embassy. Mozambique. <http://amg.um.dk/en/menu/PoliciesAndStrategies/Climate+and+Development/>
- **USAID Programme on Climate Change** This programme supports the design, implementation, and evaluation of programs linked to climate change; provides training for decision-makers and stakeholders; disseminates information to local officials; and supports pilot activities using renewable energy technologies Partners in climate change activities in South Africa include: Ecoserv, The Alliance to Save Energy (ASE), The Johannesburg Roads Agency (JRA), The Louis Berger Group, Inc (LBG), The National Energy Efficiency Agency (NEEA), The SAG’s Department of Environmental Affairs and Tourism (DEAT), The South African Cities Network (SACN), The South African Government (SAG)’s Department of Provincial and Local Government (dplg) [www.usaid.gov/our\\_work/environment/climate/country\\_nar/safrica.html](http://www.usaid.gov/our_work/environment/climate/country_nar/safrica.html)
- **Climate Change Capacity Development (C3D) project** This project addresses capacity needs for climate change through an innovative training and capacity building partnership. Research themes relating to global climate change include: mitigation, greenhouse gas inventories, the impact of potential future allocation schemes on South Africa, Clean Development Mechanism, and capacity building and adaptation to the impacts of climate change Funded by The European Commission through EuropeAid Co-Operation Office, Irish Aid, Swiss Federal Aid for Environment and DANIDA and implemented by Climate Change Programme of the United Nations Institute for Training and Research (UNITAR) South Africa. (Energy and Research Centre (ERC) - Faculty of Engineering and the Built Environment at the University of Cape Town). <http://www.c3dunitar.org/?q=node/2>

## Vulnerability assessment methodologies

- **Adapting to Coastal Climate Change: A Guidebook for Development Planners** Developed in conjunction with the US Agency for International Development (USAID), the Guidebook is both a tool itself and a link to other resources valuable for assessing vulnerability, developing and implementing adaptation options, and integrating options into programmes, plans, and projects at the national and local levels. [www.crc.uri.edu/...](http://www.crc.uri.edu/...)





- **Assessments of Impacts and Adaptations to Climate Change (AIACC) project** The project focuses on linkages between AIACC Regional Studies and National Communications to the United Nations Framework Convention on Climate Change. Some of the activities include: Vulnerability and adaptation assessments; Integrated assessment of food security, land use, land cover; Food security, water, land use vulnerabilities and adaptation; Benefit-Cost analysis of adaptation responses; Human health, climate change, and adaptive responses; Impacts of climate change on tourism and the coastal/marine; environment and adaptation strategies. Currently at work in South Africa, Malawi, Zambia, Zimbabwe, and Mozambique, Botswana, Tanzania, Seychelles.

[http://www.aiaccproject.org/publications reports/AIACC Links to UNFCCC NC.pdf](http://www.aiaccproject.org/publications_reports/AIACC%20Links%20to%20UNFCCC%20NC.pdf)

## Mainstreaming adaptation

- **ADB Climate Screening Checklist**  
The Asian Development Bank (ADB) is helping the region's economies enhance their resilience to adverse climate change impacts through mainstreaming adaptation into national, sectoral and project level plans and actions. To mitigate climate change, ADB is addressing the main causes of emissions in the region. The Climate Screening Checklist is not publicly available. [www.adb.org](http://www.adb.org)
- **BMZ/GTZ Climate Check**  
The "Climate Check" tackles climate change issues from two angles: "Climate Proofing" deals with the impact climate change risks can have on the sustainability of development projects. "Emission Saving" identifies contributions of the cooperation programmes to mitigating climate change and helps maximise these contributions. [www.gtz.de/climate-check](http://www.gtz.de/climate-check)
- **Development Policy Planning and Implementation in Eastern and Southern Africa (ACCESA)** The programme focuses on, amongst other things, promoting the mainstreaming or integration of vulnerability and adaptation to climate change into sustainable development plans and planning processes through a pilot project in Mozambique. Community-based fire management in central Mozambique will reduce the area of forests that currently burn on an annual basis, and provide the skills necessary to address the rise in fire outbreaks anticipated as a result of climate change. Funded by the United Nations Environmental Programme Global Environmental Facility (UNEP-GEF) the project covers Mozambique. [www.acts.or.ke/](http://www.acts.or.ke/)

## Mainstreaming adaptation into CBAs

- **CRiSTAL** The Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL) is designed to help project planners and managers integrate climate change adaptation into community-level projects. Developed by the International Institute for Sustainable Development (IISD), International Union for Conservation of Nature (IUCN), and Inter-cooperation and Stockholm Environment Institute (SEI). [www.cristaltool.org](http://www.cristaltool.org)



- **International Federation of Red Cross And Red Crescent Societies (IFRC) Disaster Management Programme** The disaster management (DM) programme focuses on: Building strong early warning and early action capacities at national and provincial levels; Helping national and provincial authorities to improve the national disaster management framework (national disaster response plan) and address issues related to climate change and climate adaptation; Community based disaster risk reduction initiatives that will include community preparedness for floods, volcanic eruption and epidemics (cholera); Building community resilience to food insecurity will also be a large component of the disaster management program. [www.ifrc.org](http://www.ifrc.org)
- **South African Climate Action Network (SACAN)** is a network of like-minded Non-Governmental Organisations (NGOs), Community Based Organisations (CBOs) and individuals working on climate change issues in South Africa. It facilitates local civil society organisations' participation in responding to climate change at national, regional and international levels. It also coordinates information exchange on national, regional and international climate policies and issues, amongst civil society organisations and with other interested institutions; and formulates national, regional and international policy options and position papers on climate related issues. It further initiates civil society capacity building and public awareness-raising to promote government and individual action, to limit human-induced climate change to ecologically sustainable levels and develop capacity to adapt to climate change. [www.earthlife.org.za](http://www.earthlife.org.za)

### Co-benefits/development and adaptation strategies

- **SADC Environment and Sustainable Development Programme** The overall objective of the Environment and Sustainable Development programme is to ensure the equitable and sustainable use of the environment and land based resources for the benefit of the present and future generations. The economies of SADC Member States are mainly agro based, however the region continues to experience high levels of environmental degradation manifested, among other things, by deforestation, loss of biodiversity, pollution, soil erosion, decreasing quality and quantity of water, poor sanitation services and poor urban conditions.
- **COMESA Climate Change Initiative** The goal of COMESA's Climate Change Initiative is: *"Achieving economic prosperity and climate change protection."* The overall objective of the Initiative is to address climate change and its impacts in a manner that builds economic and social resilience for present and future generations. The specific objectives are to consolidate a shared vision for Africa on climate change and a common and informed voice for the continent in the Post Kyoto Climate Change negotiations and beyond; foster regional and national cooperation to address climate change and its impacts; promote integration of climate change considerations into regional, national policies, sectoral planning and development and budgeting; enhance human and institutional capacities of COMESA Secretariat, specialized institutions and Member States to effectively address the challenges of climate change; mobilize African and international scientific and technical communities to increase knowledge base and its management to support informed decision making processes; promote and enhance collaboration, synergy, partnerships and effective participation of Governments, business community, civil society and other stakeholders in climate change matters; and provide a framework



for the establishment of an African BioCarbon Facility that combines market-based offsets, public and private funds.

## **Governance and adaptation**

- **Change and the Governance of Carbon Trade Initiatives in Africa-** Corruption and Governance Programme (Institute Of Social Security Studies) As part of a commitment to stimulate the debate on policy initiatives designed to mitigate the impact of climate change, the Programme is engaged in a multi-country study (Ethiopia, South Africa and Uganda) on the implementation of carbon 'off-set' projects in Africa. Three of the four projects form part of the clean development mechanism under the auspices of the Kyoto Protocol. The research aims to investigate the sustainability of such projects – and understand the opportunities they may create for corrupt behaviour  
[http://www.iss.co.za/index.php?link\\_id=1&mlink\\_id=159&link\\_type=13&mlink\\_type=12&tmpl\\_id=3](http://www.iss.co.za/index.php?link_id=1&mlink_id=159&link_type=13&mlink_type=12&tmpl_id=3)

