



CLIMATE CHANGE AND THE URBAN POOR:

RISK AND RESILIENCE IN
15 OF THE WORLD'S MOST
VULNERABLE CITIES

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- COASTAL CITIES
- DRYLAND CITIES
- HIGH ALTITUDE AND INLAND CITIES

‘Widespread erosion and flooding are devastating vast areas along the African coastline’

Dar es Salaam

‘Wells dry up, in many cases for the majority of the year, creating severe water shortages’

Bamako

‘Waterborne diseases are on the increase as the flood water stagnates in and around homes’

Kathmandu

The information presented in this report was gathered and analysed by Fellows of the Capacity Strengthening in the Least Developed Countries for Adaptation to Climate Change (CLACC) programme. CLACC is a multi-year project involving 15 countries in Asia and Africa, co-ordinated by the International Institute for Environment and Development (IIED). CLACC includes a series of research projects in each CLACC country which address key issues related to vulnerability and adaptation to climate change. In 2008-09, this focused on the particular challenges facing urban areas – which now contain half the world’s population – and the best ways in which these can be addressed by a range of stakeholders.



INTRODUCTION

Around the world, climate change is increasingly recognized as a major challenge. The effects are being felt already and will increase in intensity over the coming years. Although the Least Developed Countries – a definition used by the United Nations to describe countries with low gross national income, weak human assets, and high levels of economic vulnerability – account for only 3.2 percent of global greenhouse gas emissions,¹ they will be the most seriously affected by a rise in sea level, changing patterns of rainfall and increases in average temperature. Towns and cities in these countries, which are simultaneously dealing with issues of poverty, inadequate infrastructure, and environmental degradation, are particularly vulnerable. New assessments are required to identify patterns of risk, and new strategies are needed to make adaptation easier.

This report outlines lessons learnt regarding the principal effects of climate change on 15 cities in low-income countries, and what makes them vulnerable to these effects. **Coastal cities (page 2)** are susceptible to a rise in sea level and are made vulnerable by the low-lying land they are often built on, while **dryland cities (page 6)** suffer from scarce water resources due to extended periods of climate change-induced drought. In these and other **inland cities (page 12)**, the level of poverty, the rapid pace of urbanization and a lack of education about climate change increase vulnerability and aggravate the effects of climate change. Innovative urban policies and practices have shown that **adaptation (page 16)** to some of these effects is possible and can be built into development plans. These include community-based initiatives led by organizations formed by the urban poor, and local governments working in partnership with their low-income populations.



COASTAL CITIES

The biggest threat for coastal cities is a rise in sea level and they often suffer from flooding and coastal erosion. Many coastal cities in the Least Developed Countries are found in tropical areas with hot and humid climates and low-lying land, both of which heighten their vulnerability.



CITY PROFILES

MAPUTO, MOZAMBIQUE

Population: 1.1 million

Land: Coastal lowlands bordering the Indian Ocean

Climate: Tropical humid with an annual rainfall of 900 millimetres (mm)

Major concerns: Cyclones which cause flooding, a rise in sea level and coastal erosion

DAR ES SALAAM, TANZANIA

Population: 2.1 million

Land: Contains the watersheds of four major rivers; some woodland, coastal swamps, coastal shrubs and mangrove trees

Climate: Hot and humid with two rainy seasons and an average annual rainfall of 1,000mm

Major concerns: Flooding, a rise in sea level and coastal erosion

MOMBASA, KENYA

Population: 870,000

Land: Low-lying coastal plain

Climate: Warm and tropical with average temperatures of 26°C and high humidity

Major concerns: Rise in sea level, high temperatures and storms

KHULNA, BANGLADESH

Population: 1.3 million

Land: Part of the world's largest delta

Climate: Hot, wet and humid with a high annual average rainfall of 1,900mm

Major concerns: Increased frequency and level of flooding, increased frequency and extent of storm surges and increased frequency and intensity of cyclones, water-logging, saltwater intrusion, sedimentation and riverbank erosion

COTONOU, BENIN

Population: 665,000

Land: Located on the barrier beach between the Atlantic Ocean and a lake; land is made up of alluvial sands and lagoons

Climate: Sub-equatorial with temperatures between 27 and 31°C and average annual rainfall of 1,000mm

Major concerns: Flooding and violent winds

Only two per cent of the world's land is in the Low Elevation Coastal Zone (LECZ) – the area adjacent to the coast that is less than ten metres above mean sea level – but this zone is home to ten per cent of the world's population, 60 per cent of whom live in urban areas.² Countries with long coastlines and sparsely populated interiors have a higher proportion of the population in these zones. Of the countries with the largest share of their population in the LECZ, all but two are low- or middle-income nations, making them particularly vulnerable to the effects of climate change. Continued urbanization is likely to draw more people into this zone. The low altitude of many coastal cities makes them highly vulnerable to flooding as a result of a rise in sea level, and also to tropical storms.



Drainage channels in developing-world coastal cities—like this one in Dar es Salaam—are frequently blocked, leading to flooding

CASE STUDY 1

Coastal erosion in Dar es Salaam

Widespread erosion and flooding are devastating vast areas along the African coastline, causing severe ecological problems and distress among the local inhabitants. A rise in sea level would aggravate existing ecological problems through increased rates of coastal erosion, more persistent flooding, loss of wetlands, increased salination of groundwater and soil, and a greater influx of diverse pollutants.

Coastal erosion is a widespread problem along the coastline of Tanzania but is particularly serious to the north of Dar es Salaam. Kunduchi beach and Bahari beach have been eroded to such an extent that heavy investment has been required to ensure their preservation. Kunduchi beach has been gradually washed away by strong headwater waves, and has retreated by about 200 metres over the last 50 years so that it is now very close to the nearby village, according to a villager, Mzee Rajabu. A mosque and five houses have been washed away and a historic fish market and hotel have been destroyed. ■



Low-lying settlements such as Tudor in Mombasa (above) are at high risk from even small rises in sea level

‘Large areas of cities may become uninhabitable as a result of flooding or water-logging, or will be agriculturally unsuitable due to salt stress’



The Intergovernmental Panel on Climate Change (IPCC) – the global scientific body that assesses climate change – estimates that global sea levels rose by about 2mm per year during the 20th century, with the fastest average rates (4mm per year) recorded in the 1990s. Flooding caused by a rise in sea level is already affecting beaches, monuments, industries, ports and human settlements. Large areas of cities may become uninhabitable as a result of flooding or water-logging, or may be agriculturally unusable due to salt stress. As well as damage to infrastructure, many areas could be rendered completely uninhabitable as a result of inundation. This, in turn, could lead to migration and a loss of monuments and historic buildings. The infiltration of salt water can also change animal habitats: decreased light penetration to benthic organisms (organisms that live on or near the seabed such as oysters) can lead to loss of food for marine fauna and loss of coral reefs. This in turn may lead to a loss of biodiversity, fisheries, and tourism and recreational opportunities. As well as flooding and salination, a rise in sea level will cause increased coastal storm damage, seashore erosion and changes in sedimentation patterns.

There are many factors which make particular people or places more vulnerable to the effects of climate change. Areas may be vulnerable due to the nature of the land, for example if it is low-lying, or due to socio-economic reasons such as inadequate infrastructure, malnutrition and a lack of education. Low-income urban residents have little choice about which land they live on: to live near opportunities for making a living, they are forced to make trade-offs in security of tenure, land prices and land safety. In many low-income cities, houses are poorly constructed using wood, mud or old iron sheets – materials which cannot withstand heavy wind, let alone floods.

CASE STUDY 2

Salt intrusion in Mombasa

It is estimated that a sea level rise of just 0.3 metres (m) will submerge about 4,600 hectares of Mombasa (17 per cent of the city's total land area). At the same time, large areas will become agriculturally unusable due to salt stress, especially in the areas surrounding the city that are an important source of food. Some city residents get their water from inland waterways which could be affected by salt intrusion, which means that they are likely to experience problems obtaining fresh water. Migration may be necessary, leading to overcrowding upstream and potentially fuelling social conflict between migrants and other residents. This may disrupt schooling and other livelihood and social activities.

The main water pipeline serving Mombasa is old and leaks frequently. This further reduces the daily amount of water reaching the city. Renovation and improved management of the city's water and sanitation infrastructure is needed to serve the increasing water demand. This would stem the overexploitation of underground water that is exacerbating saltwater intrusion. ■



Fishing camps near Cotonou are threatened by coastal erosion

DRYLAND CITIES

In dryland cities, climate change has had a range of impacts such as increased water scarcity and more frequent sandstorms, the effects of which are aggravated by poor infrastructure.





Khartoum (above) is located where the Blue and White Nile meet. It is affected by climate-related phenomena including dust storms, thunderstorms and heat waves, which pose serious threats to human health and local livelihoods.

‘Desertification and sandstorms have severe effects on health and infrastructure’

In **dryland cities** where rainfall has always been low, drought is the issue most likely to be accentuated by climate change. The effects of drought are widespread but are focused in particular on drinking water shortages and increased food prices. Studies have shown that children in Africa born in drought years are significantly more likely to be malnourished or stunted, while contamination of water supplies is also a risk during droughts as water contamination increases when water is stored.³ If less water flows into a lake as a result of reduced rainfall, pollution will increase as pollutants deposited into the lake will be less diluted, thus leading to an increase in illness.

As the case study from Nouakchott shows, dryland cities are prone to desertification and sandstorms, which have severe effects on health and infrastructure as well as provoking coastal erosion. Droughts also result in increased dust pollution which can cause respiratory illness and eye infections.

Many of the cities examined in this study have experienced severe drought in the past. However, the combination of climate change and urbanization means that the problem is becoming increasingly intense. The amount of precipitation is likely to decrease in the future, with between 75 and 250 million people in Africa becoming exposed to increased water stress due to climate change by 2020.⁴ The infrastructure in dryland cities is often inadequate to deal with the growing impact of climate change, particularly in poor or informal settlements where houses are not built to cope with sandstorms and where wells are not dug to account for a lowering of the water table. Alongside a reduction in precipitation, an increase in temperature could lead to reduced agricultural yields, increased water demand, an increased risk of heat mortality and a general reduction in quality of life, particularly for those with inadequate housing.

CITY PROFILES



NOUAKCHOTT, MAURITANIA

Population: 550,000

Land: Low-lying on the Atlantic Ocean, predominantly on l'Aftout es Saheli, a long, narrow coastal lagoon

Climate: Arid Saharan, with temperature varying between 14 and 37°C and average annual rainfall of 600mm

Major concerns: Coastal flooding and sand damage

DIOURBEL, SENEGAL

Population: 100,000

Land: Located in a valley with no bodies of water and weak soil

Climate: Sahelian climate with 400-500mm of rainfall per year

Major concerns: Lack of water and problems with drainage and agriculture

BAMAKO, MALI

Population: 1.1 million

Land: Savannah, built on either side of the Niger River

Climate: Average annual temperature of 28°C and average annual rainfall of 1,100mm (although this falls mainly in August and has been declining in recent decades)

Major concerns: Deforestation due to fires, grazing and drought has led to erosion of the hillsides; flooding due to short intense rains; and water scarcity

KHARTOUM, SUDAN

Population: 3.9 million

Land: Located on the confluence of the White and Blue Niles

Climate: Hot arid climate with an average annual rainfall of 155mm and a very high average temperature of 38°C

Major concerns: Drought and extreme flooding

CASE STUDY 1

Sandstorms in Nouakchott

The amount of rain in Nouakchott (left) has been decreasing each year since 1968 and the urban population has been growing since 1970, putting acute pressure on the natural environment. The city's vegetation has been reduced due to grazing by livestock which arrived with nomadic groups. The vegetation used to play an important part in stabilizing the 11 coastal dunes which surrounded the city. There is now, therefore, an increased movement of sand in the dunes, exposing the city to sand damage mainly in the eastern and north-eastern areas of Nouakchott. The airport is surrounded by dunes which have been revived by drought. The sand accumulates at the foot of a wall which surrounds the airport before being redistributed inside the enclosure where it forms small dunes that encroach onto the runway.

Areas in L'Aftout es Saheli remain unaffected, as do other locations where urban growth has 'fixed' the sand. But sandstorms have huge socio-economic and health consequences, including damage to infrastructure and increased incidence of respiratory infections, which have subsequent effects on commerce, industry and the everyday lives of people in the city. Strong winds and storms, which are increasing with climate change, aggravate this movement of sand. ■



'The city's vegetation, which played a key role in stabilizing the dunes, has been reduced by grazing'

CASE STUDY 2

Water scarcity in Bamako

Bamako has significant water resources above and below ground but they are distributed unevenly across the city. Seasonal variability of water flow is significant and the capacity of aquifers is small. Wastage, bad management, diverse pollutants and a build-up of sand in rivers, lakes and ponds account for an annual loss of 30 trillion cubic metres of water in the interior delta of the Niger and an annual deposit of 13 million tonnes of silt. A reduction in water flow has been observed which could be linked to the weakening flow of the Niger, which in turn is linked to the reduction in ground water following droughts in the 1970s and 1980s.

The distribution of water is inadequate and water taps are located far from residential areas. Where functional water fountains exist, they are always surrounded by long queues of women. In some areas, water comes from unsanitary traditional wells which are often polluted. These wells dry up, in many cases for the majority of the year, creating severe water shortages. Some areas arrange for drills to create water pumps but these are badly managed and many are now defective.

There are many factors which contribute to this life-threatening situation from which Bamako suffers: the occupation of river areas; a growing population; a lack of infrastructural investment; and reduced groundwater levels following changes in the climate. Techniques for storing and conserving water, recovering rainwater, reusing and using water more efficiently, and recharging the ground water level will help these communities to cope with further inevitable changes and more severe droughts. ■





INLAND AND HIGH ALTITUDE CITIES

Climate change is often simply associated with global warming and a rise in sea level. However, cooler inland cities will also be affected by climate change, predominantly as a result of changing patterns of precipitation.



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Changing patterns of rainfall have already affected many inland and high altitude cities. In some cases, overall total rainfall has decreased; elsewhere, rain has become more concentrated into fewer and heavier storms. Rainfall over long periods may produce a gradual but persistent rise in river levels which then inundate surrounding land for days or weeks at a time. In many of these cities, minor floods that affect people's lives and livelihoods take place more frequently than major disasters, but these events are seldom reported outside the local area.

Floods directly damage infrastructure, which can have knock-on effects on many areas of society. For example, damage to health-care infrastructure will affect the health of the population and damage to roads can disrupt livelihoods and incomes. Moreover, if crops are affected this could cause widespread hunger or even famine. Heavy rainfalls, which may become more frequent as a result of climate change, are also linked to an increased incidence of landslides in the city of Thimphu. Thimphu's steep slopes, along

with those of other mountainous cities, make them particularly vulnerable to this effect of climate change. A slope greater than 30 per cent is considered to be a landslide high-risk zone.

One of the key factors which affects all these cities is the lack of sufficient drainage, which leaves people vulnerable to flooding after heavy rains. Twenty-five per cent of households in Kathmandu have been flooded due to inadequate drainage as storm water no longer drains away as it used to and the technical systems put in place are not sufficiently flexible to deal with a changing climate. Furthermore, the sewage network in Kathmandu is only able to operate at 40 per cent of its capacity due to sludge and other debris blocking the system. The same can be said in many other cities: in Harare, women use sand to clean kitchen utensils which blocks the drains while polythene bags cause a similar problem in Kampala. Storm water flowing into temporary toilets, the use of inappropriate sanitary material and inadequacies in the capacity of solid waste management



A traditional bridge over Thimphu Chhu. Much of the vegetation in this picture was destroyed by flooding in 2009.



CASE STUDY 1

Hydropower in Kampala

Lake Victoria Environment Management Programme (LVEMP) studies have observed a reduction in total annual rainfall of 4.2 per cent for the period 2001-2004 compared to 1950-2000, and temperature records show that temperature has increased by 1°C since 1950. Evaporation from Lake Victoria depends greatly on climate. Wind and a lack of rain has led to a lowering of the water table which in turn has resulted in less rainfall at water catchments around the lake. As a result, the level of water in the lake has decreased by nearly a metre since 2005.⁵

The lake is an important resource for hydropower production, and hydroelectric generation has therefore been curtailed at Nalubaale and Kiira power stations. Many hydraulic structures now need costly modification to avoid becoming obsolete.

This has a number of economic and social implications for Kampala and Uganda. Indicators show that there is a decline in revenues from electricity generation. Although the number of consumers is increasing (by 1.8 per cent between July and August 2006), they are encountering a decline in supply. A central bank report shows that electricity consumption in August and September 2006 recorded a 2.4 per cent decline. This decrease in available energy has clear implications for the lives and livelihoods of those living in the city and the surrounding areas. Individuals and households receive less electricity, affecting cooking and education, while industries are unable to produce their goods and services. ■

‘Many epidemics in Kampala including cholera, malaria, dysentery and diarrhoea are attributed to flooding’

A view over the city of Thimphu



CITY PROFILES

THIMPHU, BHUTAN

Population: 100,000

Land: The city lies in a gentle valley along a river at an altitude of 2,300m, with a mixture of forest areas, terraces and marshlands

Climate: Cool and temperate with temperatures ranging from 0 to 25°C and average annual rainfall of 675mm

Major concerns: Flooding, landslides and fires

KATHMANDU, NEPAL

Population: 1 million

Land: The city is situated in a valley 1,300m above sea level

Climate: Cool and temperate with an average annual rainfall of 1,300mm and temperatures ranging from 10 to 24°C

Major concerns: Flooding

HARARE, ZIMBABWE

Population: 2 million

Land: Watershed plateau between two major rivers at an altitude of 1,550m; hilly in rocky areas and flatter in the south

Climate: Humid subtropical climate with average temperature of 18°C and an average annual rainfall of 850mm

Major concerns: Flooding and pollution

KAMPALA, UGANDA

Population: 1.1 million

Land: Built on seven hills 1,200m above sea level

Climate: Equatorial climate with cool breezes from Lake Victoria and the mountains; average annual rainfall of 1,200mm, with temperatures ranging between 17 and 22°C

Major concerns: Flooding and droughts

LUSAKA, ZAMBIA

Population: 1.1 million

Land: The city is situated at an altitude of 1,300m

Climate: Sub-equatorial but moderated by the city's altitude

Major concerns: Flooding and droughts

BLANTYRE, MALAWI

Population: 700,000

Land: Located in the Shire Highlands with varied topography ranging from an elevation of about 780 to 1,600m above sea level

Climate: Tropical continental climate with a rainy and a dry season

Major concerns: Flooding

systems in cities also contribute to blockages. In some cities such as Harare, the underlying problem is identified as a rapid growth in population which has not been matched by expansion of the sewerage systems.

Where there is insufficient drainage, stagnant floodwater provides an ideal breeding ground for parasites, particularly mosquitoes, which may lead to an increase in malaria and other vector-transmitted diseases. The threat of water-borne diseases also increases as drinking water becomes polluted due to stagnant water remaining in settlements. Furthermore, floods can carry contaminated water containing wastes and toxic chemicals into living spaces. In Kampala, despite the efforts of the Ugandan Ministry of Health, outbreaks of cholera, malaria, dysentery and diarrhoea have been attributed to flooding.

Inland areas can also suffer from drought, particularly where the water supply depends on an inland lake or groundwater. Changes in climate may cause a lowering of water levels that can have a knock-on effect on hydroelectricity supply, as shown in the case study of Kampala, and also in Harare and Kathmandu.

As in all the cities studied for this report, the people most vulnerable to climate change are low-income residents of slums and squatter settlements. Because of their systematic exclusion from the formal economy of the city, their lack of basic services and entitlements and the impossibly high costs of entry into legal land and housing markets, most of the urban poor live in hazardous sites and are particularly vulnerable to the consequences of climate change.



Cities like Lusaka are often affected by flooding. Yet simultaneously, many urban residents face difficulties in accessing sufficient water supplies.

CASE STUDY 2

Squatter settlements in Kathmandu

There are 64 squatter settlements in Kathmandu and the total population of squatters has been estimated at 14,500, most of whom live along riverbanks or on steep slopes. Although the proportion of squatters in Kathmandu is much lower than in many other Asian cities, it is increasing at an alarming rate.

Among the most vulnerable squatters are those living near to the Bagmati, Bishnumati and Dhobi Khola, the major rivers of Kathmandu. Most of the settlement houses are single storey with mud walls and tin roofs. Some of the houses are concrete and made of cemented walls while others are made up of plastic and tin. Lighting, ventilation and space are limited and many houses lack basic facilities such as access to water and electricity.

As these settlements lie so close to rivers, flooding is a major problem. According to people living in the squatter areas, they are always at risk of flooding as water levels rise every year in the monsoon season. People from Devinagar have to shelter with relatives or friends during the monsoon as rising water inundates their homes. They are also susceptible to water-borne diseases which are on the increase as the flood water stagnates in and around their homes.

At the same time, there are serious shortages of water. Squatters have to walk for nearly an hour to reach the nearest public tap and then have to queue for up to five hours to get a bucket of clean drinking water. Solid waste is repeatedly thrown into the rivers as waste collection often does not extend to these areas, and this may lead to illness. These problems are exacerbated by the lack of affordable medical treatment for the urban poor. ■

ADAPTATION

The experiences presented in this report clearly show that climate change will affect already vulnerable individuals, households and cities in a variety of different ways. New strategies and financing for adaptation will be necessary to respond to this, but examples from communities and cities can help point in the right direction.

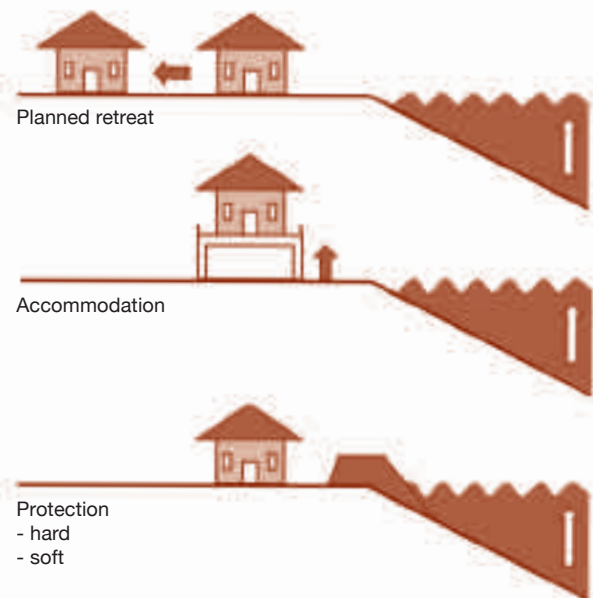


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What is adaptation?

Adaptation describes the adjustment in natural or human systems in response to actual or expected changes in climate. However, in many low-income cities, urban infrastructure is insufficient for dealing with current climate variability. Adaptation therefore needs to take broader issues of development into account in order to ensure that households, communities and cities are able to meet the challenges of today, as well as those that will arise in the future.

Adaptation of infrastructure to cope with climate change can take several forms: it can involve planned retreat, accommodating the changes, or constructing various protective measures. Adaptation can also involve “soft” or ecosystem infrastructure, including the use of mangroves or other vegetation to protect coastlines. Yet cities are also made up of people, and the responses of individuals, households and communities are key to adaptation. A wide variety of coping strategies is already in evidence among many low-income groups: moving valuable items; sending children to stay with friends or relatives elsewhere during disaster events; or constructing flood barriers around their homes. However, adaptation also requires building resilience to a wider range of shocks and stresses, which can be achieved through the improvement of health and education systems, as well as through the provision of adequate shelter, sanitation and drainage.



Responding to climate change can take a variety of forms – as shown in this example of strategies to reduce the impacts of sea-level rise (above).⁶

CASE STUDY 1

Providing better information in Kenya

The government in Kenya, through the local administration and the Kenya Meteorological Department, has taken a leading role in gathering climate information and sending information to residents and businesses in the expected impact areas, especially strategic holiday and business areas. The Kenya Meteorological Department is working towards establishing an operational weather observation network of the western Indian Ocean within Kenya's exclusive economic zone. To this end, it has procured and installed a variety of equipment including three tidal gauges fitted with meteorological sensors, 35 drifting buoys and one marine automatic weather station. This will help in monitoring a rise in sea level and in detecting extreme events such as tsunamis, storm surges, coastal flooding and tropical cyclones. Concerted efforts are being made by the government, marine scientists, non-governmental organizations and local communities to reforest degraded coastal areas. In addition, the government is in the process of formulating an effective and enforceable coastal zone management policy to regulate developments along the coastline and provide for appropriate management of coastal resources.⁷ ■



Residents of Tandale, Dar es Salaam, prevent floodwaters from entering their homes by constructing protective walls around windows and doors

Small-scale efforts at adaptation – such as these rocks placed on the coast near Cotonou – need to be supported by effective investments in protective infrastructure

‘In many low-income cities, urban infrastructure is insufficient for dealing with current climate variability: addressing this ‘infrastructure deficit’ is an important component of climate change adaptation’





CASE STUDY 2

Coping with risk in Dar es Salaam

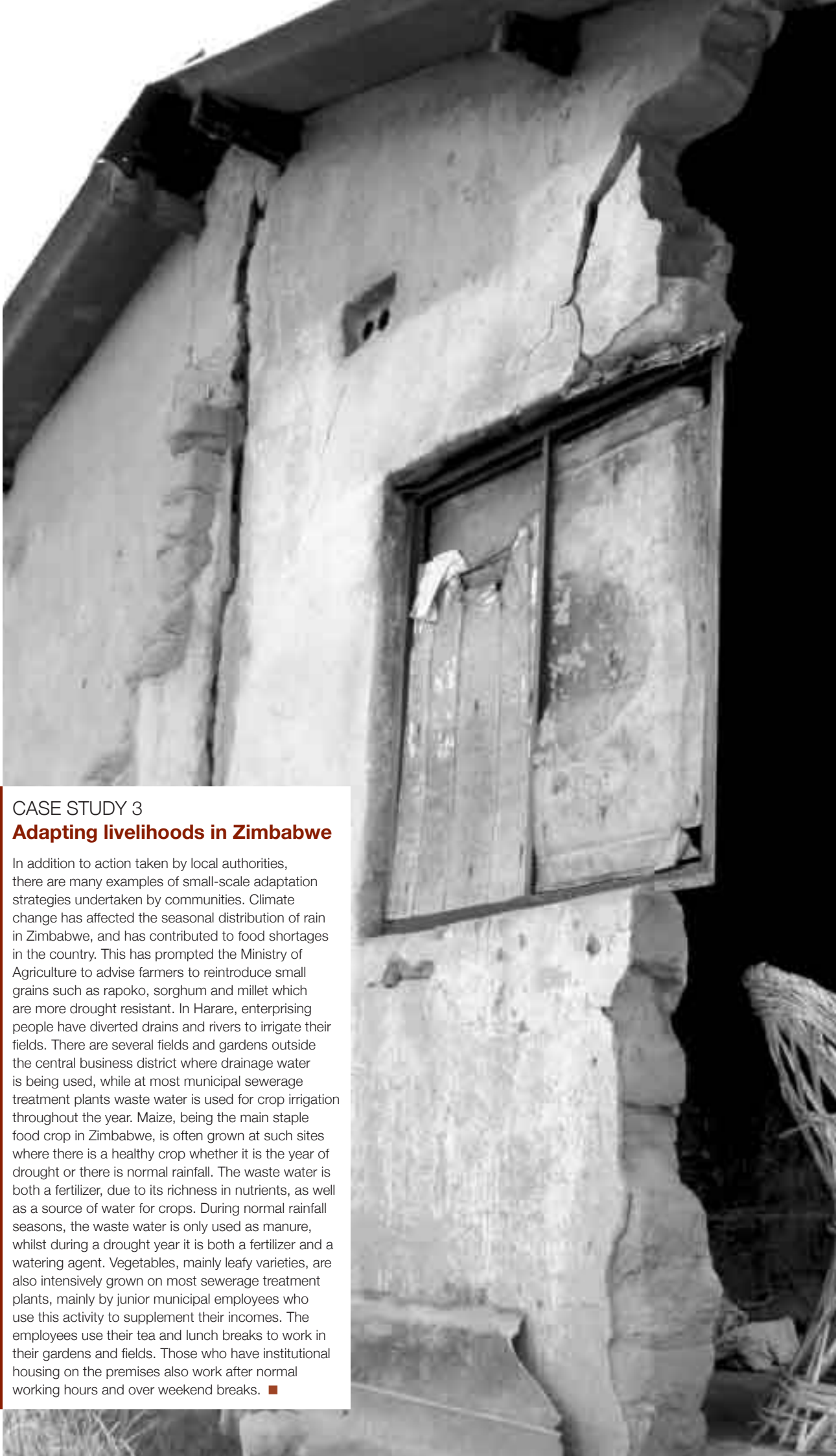
Residents in Dar es Salaam recognize that a long-term solution to climate change requires addressing underlying infrastructural problems, but have developed strategies to protect themselves and their houses from flooding. Some of these are short-term strategies, as one resident, Jamila Balari, explains: “When it starts to rain, the first thing to do is to take the mattress and small items and put them in the ceiling. If it gets worse, young men will carry children to the upper side of the area”. These short-term solutions generally involve moving items that can be moved, and temporary relocation. However, there are also longer-term structural solutions, mainly related to the construction of additional walls around houses, with entry to the house via a flight of steps.⁸ ■

KEY LESSONS FOR AUTHORITIES

Urban authorities and municipal governments can take action to reduce the impact of climate change, not only through supporting climate-proof infrastructural developments, but also through their influence on regulatory frameworks and behavioural change. However, it is important to ensure that these changes also build the resilience of the most vulnerable groups within society. The following ‘top ten tips’ show how reducing urban vulnerability can also reduce the vulnerability of high-risk groups.

- 1. Engage in detailed consultations with citizens and community organizations.** Involving people at an early stage in the adaptation planning process is essential.
- 2. Ensure that infrastructure works for the poor.** Improving waste collection services from low-income communities and attending to poor drainage systems, for example, can reduce flooding at times of heavy rain, and can improve children’s health through reducing exposure to diseases.
- 3. Support slum and squatter upgrading.** Properly constructed houses and the provision of basic services are a priority for adaptation.
- 4. Build broader resilience.** People and communities which are healthier, better educated, and have secure tenure are able to deal more effectively with a wide range of shocks and stresses.
- 5. Facilitate household coping strategies.** Better sharing of forecasted information for extreme weather events, and better provision of evacuation services, are just two ways in which households can be supported in their own responses.
- 6. Support sustainable livelihoods.** Households with secure incomes can invest in many protective measures for themselves but it is important to ensure that livelihood activities do not generate detrimental environmental consequences.
- 7. Reconsider zoning and planning regulations.** These controls can be used to help provide appropriate and safe locations for low-income households while also reducing their exposure to the risks of flooding, slope failure and other disasters.
- 8. Ensure that building standards are appropriate.** The standards should also be applied in ways that support incremental improvements to make housing resistant to extreme weather, while still enabling poor residents living in self- or artisan-built constructions to upgrade at an appropriate pace and cost.
- 9. Gather information on the impacts of extreme events.** The people and places that were most affected by previous storms, floods and heat waves are likely to be those most affected by future climate change.
- 10. Make improvements in disaster preparedness.** Good plans for responding to disasters may not reduce hazards, but they can dramatically reduce injury, loss of life and damage to property.

A house in Epworth, Harare that was destroyed by heavy rains in 2008



CASE STUDY 3

Adapting livelihoods in Zimbabwe

In addition to action taken by local authorities, there are many examples of small-scale adaptation strategies undertaken by communities. Climate change has affected the seasonal distribution of rain in Zimbabwe, and has contributed to food shortages in the country. This has prompted the Ministry of Agriculture to advise farmers to reintroduce small grains such as rapoko, sorghum and millet which are more drought resistant. In Harare, enterprising people have diverted drains and rivers to irrigate their fields. There are several fields and gardens outside the central business district where drainage water is being used, while at most municipal sewerage treatment plants waste water is used for crop irrigation throughout the year. Maize, being the main staple food crop in Zimbabwe, is often grown at such sites where there is a healthy crop whether it is the year of drought or there is normal rainfall. The waste water is both a fertilizer, due to its richness in nutrients, as well as a source of water for crops. During normal rainfall seasons, the waste water is only used as manure, whilst during a drought year it is both a fertilizer and a watering agent. Vegetables, mainly leafy varieties, are also intensively grown on most sewerage treatment plants, mainly by junior municipal employees who use this activity to supplement their incomes. The employees use their tea and lunch breaks to work in their gardens and fields. Those who have institutional housing on the premises also work after normal working hours and over weekend breaks. ■



Notes

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- 2 Gordon McGranahan, Deborah Balk and Bridget Anderson (2007). 'The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones' *Environment and Urbanization* 19(1): 17-37.
- 3 United Nations Development Programme (2007). *Human Development Report 2007/2008*. Palgrave Macmillan, New York.
- 4 Intergovernmental Panel on Climate Change (2007). *Climate Change 2007: Synthesis Report*. Intergovernmental Panel on Climate Change, Geneva.
- 5 Holli Riebeek (n.d.). *Lake Victoria's Falling Waters*. Available online: <http://earthobservatory.nasa.gov/Study/Victoria>.
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