MANAGING FLOOD DISASTERS UNDER A CHANGING CLIMATE: LESSONS FROM NIGERIA AND SOUTH AFRICA

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Abstract

There is a growing need to address vulnerabilities to climate change through adaptation efforts, complementing mitigation efforts aimed at reducing the rate and magnitude of climate change. At present, this development has taken place largely in parallel to the increasing shift from disaster management to disaster risk management. Disasters are associated with extreme weather events. Climate change directly interacts with the exposure to climatic extremes. The challenge in the context of adaptation is to move from the understanding that climate change is occurring to concrete measures that reduce existing vulnerabilities of human and natural systems. This study focussed on impacts and responses to flood risk among the urban poor living in the highly vulnerable informal settlements in the Cape Flats of the City of Cape Town, South Africa and those living along the Asa River channel in the city of Ilorin, Nigeria. It explores the underlying vulnerabilities of the two areas and the challenging problem of how to effectively shape human institutional responses to the risk of natural disasters with a special focus on floods. The social risk management (SRM) and asset-based approaches on which the study is based provide a conceptual framework for understanding the sequential links between risks; human exposure and sensitivity; the impacts of risky events; and risk management (or adaptation) strategies. The study utilised primary and secondary data. The outcome of the study shows marked differences in the vulnerability factors and the management of flood related disasters in the two study areas. Furthermore, it was revealed that the indigenous coping mechanisms employed by the poor may become less effective as increasingly fragile livelihood systems struggle to withstand disaster shocks. Strategies to reduce vulnerability should be rooted in vulnerability analysis and greater understanding of both household-level and macro-response options that are available to decrease the poor's exposure to climate risk.

Keywords: Climate change adaptation, Vulnerability, Disasters, Flood risk, Informal settlements, Cape Town

1. Introduction

Thabo watched the young man as he carried another sheet of corrugated iron down towards the river. Almost everyday now, someone new was building a house in New Situ. He could still remember when there were only a few houses there. Things had been better then: there was more space, and people built their houses away from the river. Now, more and more people seemed to be arriving from the Eastern Cape, hoping to find jobs. There was no more space, but the New Situ was close to the factories and other work opportunities in the towns nearby, and people kept coming in.

The new ones didn't want to listen when told that it was unsafe to build by the river. They told him that such a small river would not cause trouble. They told him he just wanted to prevent them joining the settlement. But they would see he was right in winter, when the river swelled with rain water. Every year, the houses built by the river got flooded – sometimes they even got washed away. The people never stayed long after that, but always there were new people coming in to take their place. He wondered as he watched his little granddaughter chasing a chicken: how many more people would suffer this winter? (Holloway & Roomaney, 2008, p.11)

Disaster risk and climate change are two threats to human well-being that reinforce each other. Hence, they represent some of the greatest challenges to humankind in this century. Disaster risk is an intrinsic characteristic of human society, arising from the combination of natural and human factors and subject to exacerbation or reduction by human agency. While the adverse impacts of climate change on society may increase disaster risk, disasters themselves erode environmental and social resilience, and thus increase vulnerability to climate change (O'Brien et al, 2008). Climate change – and the likely increase in disasters – threatens to block pathways out of poverty in developing countries especially those in Africa (Lemons and Tompkins, 2008) Any increase in disasters, whether large or small, will threaten development gains and hinder the implementation of the Millennium Development Goals (ISDR, 2008).

In the coming decades, climate change is expected to exacerbate the risks of disasters, not only from more frequent and intense hazard events but also through greater vulnerability to the existing hazards (ISDR, 2008). Approaches toward the management of climate change impacts have to consider the reduction of human vulnerability under changing levels of risk. A key challenge and opportunity therefore lies in building a bridge between current disaster risk management efforts aimed at reducing vulnerabilities to extreme events and efforts to promote climate change adaptation (Olorunfemi, 2008, Few et al. 2006)

The long term horizon of climate change and current scientific uncertainties pose special challenges. Strategies that address challenges recognise that there is no best solution. In this sense, climate change provides new incentives for the need to plan ahead and to anticipate extreme events and trends (Zevenbergen, et al, 2008). Within the context of extreme weather events especially flooding, this means that management strategies must meet the present needs while providing a path of adjustment for the future (Pahl-Wosll, 2006; Ashley et al., 2007; Miller, M., 2007).

Cities in developing countries are particularly vulnerable to climate change impacts, especially changes in rainfall (Vogel 2000), because of the exposure to extreme weather events and dependence on natural resources (Vogel, 2002). The vulnerability situation, the present and predicted impact of climate change on urban areas is particularly worrisome. According to Satterthwaite et al (2007), the scale of the

devastation to urban populations and economies caused by extreme weather events in recent years highlights their vulnerabilities. Worldwide, there has been a rapid growth in the number of people killed or seriously impacted by storms and floods and also in the amount of economic damage caused; a large and growing proportion of these impacts are in urban areas in low- and middle-income nations. For instance, in Nigeria, flooding affected more than three million people in selected urban areas between 1983 and 2009 (EMDAT disaster database). Climate change is likely to have been a factor in much of this, but even if it was not, it is proof of the vulnerability of urban populations to floods and storms whose frequency and intensity climate change is likely to increase in most places.

Henderson (2004) revealed that the level of risk and vulnerability in urban areas of developing countries is attributable to socio-economic stress, aging and inadequate physical infrastructure. Indeed, according to Satterthwaite et al (2007), hundreds of millions of urban dwellers have no all-weather roads, no piped water supplies, no drains and no electricity supplies; they live in poor-quality homes on illegally occupied or sub-divided land, which inhibits any investment in more resilient buildings and often prevents infrastructure and service provision. A high proportion of this are tenants, with very limited capacities to pay for housing – and their landlords have no incentive to invest in better-quality buildings. Most low-income urban dwellers face serious constraints in any possibility of moving to less dangerous sites, because of their need to be close to income-earning opportunities and because of the lack of alternative, well-located, safer sites. Nigerian urban areas are typical examples of this high level of risk and vulnerability (Olorunfemi, 2008; Olorunfemi and Raheem, 2007).

Successful national economies depend on well-functioning and resilient urban centres. Urgent action is needed now both to address urban centres' current vulnerabilities to extreme weather and to build into expanding urban centres protection from likely future changes (Satterthwaite et al, 2007). For most prosperous and well-governed cities, adaptation to the likely risks from climate change for the next few decades does not appear problematic. This centres on adapting buildings and infrastructure to the increasing risks; working with population groups and settlements most at risk to find solutions that serve them; and good disaster preparedness. But in developing countries, you cannot adapt infrastructure that is not there. The vulnerability of low-income urban dwellers to climate change is often ascribed to their poverty – but it is far more the result of failures or limitations in local government that ensure needed infrastructure is in place.

To date, the challenge of addressing urban floods and reducing urban flood vulnerability has received little attention (Zevenbergen, 2008). This is partly because in the traditional flood management approach, responses to mitigate urban fluvial and coastal flood risks have often been set outside the realm of the urban system (i.e. where confined to the catchment level), but also because responses at the city level were predominantly passive, using robust solutions such as urban defences and increasing the capacity of major culverts. The following major bottlenecks have been identified, which hamper the adoption and effective implementation of flood-risk management in urban planning practices (Sz¨Oll¨Osi-Nagy and Zevenbergen, 2005):
(i) Lack of understanding of current and future risks and implications at the city scale.
(ii) Lack of long-term planning, poorly integrated and comprehensive planning.

(iii) Inadequate controlling roles of local and regional authorities, and the conservative nature of the building sector.

This study, therefore, focuses on the impacts and adaptation to floods in the two cities. The specific focus is on the people living in the poor, marginal areas. The study is driven by the underlying assumption that human vulnerability to natural disaster and, particularly, those expected to be amplified by climate change, illustrates the inter-relatedness of governance and environment related issues. Central questions are what generates vulnerabilities and what improves resilience in people's livelihoods, and how can we build on people's own responses, providing a range of institutional support, and promoting resilience and adaptive capacity among vulnerable people in the affected areas.

Aside from physical location and exposure to flood hazards, vulnerability to floods arises out of the social, economic and ecological circumstances of everyday living that result form social power relations. Social relations, structures and processes can influence the vulnerability of households and communities to floods through several pathways. On the other hand, social, economic, political, cultural and historical processes influence how flood hazards affect people in varying degrees and differing intensities. The study supports the emerging view that places adaptation to shocks associated with climate change as a subset of disaster risk reduction.

The paper is divided into nine sections. The aim and objectives of the study are stated in section 2 while section three briefly examines the vulnerability of Nigeria and South Africa to climate change. In section four, the conceptual framework that guided the conduct of the study as well as literature review are presented. Section five discusses the methodology used for the study while section six describes the study areas. The seventh section discusses the findings of the study while the eighth section examines governance issues in disaster risk and climate change as currently obtained in the two cities studied. The conclusions of the paper and the suggested way forward are discussed in the last section.

2 Aim and Objectives of the study

The aim of this study is to analyse the impacts and vulnerability to flood risk in the City of Cape Town and Ilorin and the institutional responses to reducing the existing disaster risks in the affected communities. The specific objectives are to;

1. examine the dimensions and drivers of vulnerability to flood risk in the study areas
2. examine the current and potential impacts of flooding in the affected communities
3. examine the role of cities authorities in the management of flood risk
4. examine the existing and future adaptation options with respect to flooding impacts at the city level

3 Country Vulnerability to Climate Change

3.1 Nigeria

Nigeria is vulnerable to climate change impacts due to its geography, climate, vegetation, soils, economic structure, population and settlement, energy demands and agricultural activities. The location and size of, and the characteristic relief in Nigeria give rise to a variety of climates ranging from tropical maritime climate characterized

by the rainforest along the coastal and southern section to the tropical hinterland climate associated with the Sahel in the north eastern section of the country. Nigeria has a population of about 140 million impacting on the physical environment through their various activities within an area of 923,000 square kilometres. According to Gwary (2008), sixty per cent of the people live directly on the natural resource base as farmers, cattle rearers and fishermen while the informal sector constitutes the bulk of the urban population's economic activities. The technology adopted is rudimentary leading to low output and high levels of poverty.

Decadal changes in the climatological period (30 years) provide changes that have taken place in rainfall over the country since 1951. Total annual rainfall across the country was about 1,445.6mm in 1951-1980 climatological period. This amount dropped to 1,386.7mm in 1961-1990 and then slightly increased by 4.3mm in 1971-2000 (Afiesimama, 2008). In recent years, the total rainfall amount over the country increased again to 1,410.6mm. However, it is important to note that these increases are associated with floods in some areas while drought still prevails in other areas. These changes in the spatial distribution in rainfall amount and consequent impacts on agriculture, water resources, human settlements, among others, are indicators determining the vulnerability of the country to climate change and the socio-economic implications associated with such changes (Afiesimama, 2008).

Ilorin is a typical traditional African city whose urban history predates colonialism in Nigeria. The city therefore falls into the category of third world cities described as reputed for their dualistic internal structure (Mabogunje, 1968). The physical development of Ilorin also translates into significant change in the population of the city. For instance, from 36,300 inhabitants in 1911, Ilorin has a population of about 208,546 in 1963, 532,088 people in 1991 and a projected population of about 765,791 by the year 2006 at the rate of 2.84% annually. The facts of urbanization, development of the modern commercial/industrial economy and the multiplier effects of these factors on natural increase had combined to produce the changes in population described above

3.2 South Africa

A South African Country Study on Climate Change (2004) has identified the Northern and Western Cape provinces as being at greatest risk from projected climate change induced warming and rainfall change (Midgley et al, 2005). The future climate of the Western Cape is likely to be warmer and drier than at present. Three key groups have been identified to be the most vulnerable to climate change impacts in the Western Cape. These are people living along the coast, people living in informal settlements, and marginal groups living in rural areas.

On a local scale, Cape Town is found to be vulnerable to climate change (Mukheibir and Ziervogel, 2007). Using the regional downscaled projections from the Climate Systems Analysis Group, the most relevant change in atmospheric circulation observed for the Western Cape has been a decrease in the frequency of low pressures, typically associated with winter storms, during early winter. These trends have resulted in spatially varying trends in precipitation. Furthermore, the trend of fewer low pressure systems during early winter can lead to weaker synoptic forcing and

conditions conducive to brown haze and smog in the Cape Town area (Mukheibir and Ziervogel, 2007).

With respect to risks from these predicted changes in the overall climate in the City of Cape Town, Mukheibir and Ziervogel (2006) revealed that a significant number of previous disasters and events have been associated with weather conditions. These include the Cape Flats floods (1994 and 2001), the Manenberg wind storms (1999 and 2002), South Peninsula fires (2000), cut-off low severe storms (2003, 2004, 2005) and recurrent severe drought (2002-2005). Nearly all these occurred in the poor, informal settlements.

The poor, informal settlements in Cape Town has become increasingly disaster prone because large contingent of low-income migrants have settled on the poorest, most vulnerable land in cheap, dilapidated and over-crowded houses constructed on land subject to floods (City of Cape Town, 2006, 2009). The combination of physical development on unsuitable lands such as wetlands, slopes, flood plains and other environmentally sensitive areas, and over-crowding, all exacerbate environmental degradation and vulnerability to environmental and anthropogenic hazards. Blocked drainage channels in urban areas worsen the externalities associated with flooding. Little wonder then the rampant incidences of flooding and in the poor neighbourhoods.

Poor housing quality in informal settlements exacerbates this vulnerability, because these structures are easily destroyed during a flood event. In most cases, poor access to services leads to an inability to cope and recover from such an event. The lack of tarred roads increases flood vulnerability in informal settlements. Unpaved roads wash away, hindering access (City of Cape Town, 2006, 2009). Other related vulnerabilities include inadequate sewage and storm-water infrastructure, creating stagnant pools of foul water that are a source of disease.

Despite the efforts of the Cape Town City administration such as the formulation its City Development Strategy, which will help to address the challenges, and enable the city to seize global opportunities and minimise the risk of the external environment for Cape Town (City of Cape Town, 2009), the countless impacts of flooding in the informal settlements are still very much apparent. The flooding has left many areas of the informal settlements uninhabitable for various reasons including health risks and physical dangers. Previous efforts have not been entirely successful in minimising the impact of flooding at the household and community levels (Wood, 2007). These recent events have prompted an emphasis that has moved away from physical control and engineering construction (structural measures) towards reducing human vulnerability through non-structural approaches (Smith, 1992, City of Cape Town, 2005, 2006).

It follows from the above that traditional flood-risk management approaches omit important ways of dealing with floods pro-actively at the city level and of building in bottom-up responses that reduce their impact and enhance recovery (Tippett and Griffiths, 2007). Dealing with these gaps should change the paradigm of the traditional approach to flood risk management.

4 Conceptual Framework and Literature Review

4.1 Conceptual Framework

Urban environments are complex - socially, economically and physically. This complexity multiplies the risk which comes from increasing poverty and inequality and failures in governance, high population density, crowded living conditions and the siting of residential areas close to hazardous industry or in places exposed to natural hazard (including the modification of environments which generates new hazard, e.g. through the loss of protective mangroves to urban development, or subsidence following ground water extraction) (Pelling, 2008). This, combined with the cumulative nature of many environmental problems, makes it difficult to identify causal relationships when considering risk and vulnerability (Oelofse, 2002). Urban risk and vulnerability need to be understood in terms of the nature of risk, the causal mechanisms that shape people's response to them and the contingent conditions that provide the context within which they occur. Many risk problems sit at the interface of the natural and social environment, such as flooding, which occurs as the result of the inadequate provision and maintenance of drainage systems, the location of people on marginal sites, and the physical characteristics of an area (Olorunfemi, 2008; Oelofse, 2002).

Galvanised in part by questions of societal adaptation to climate change impacts, there has been much recent theoretical work on hazard risk and related concepts of vulnerability and resilience (e.g. Wisner *et al.*, 2004). Flood risk is defined here in terms of risk to humans and human society, and is seen as a product of the severity and probability of occurrence of flood hazard and the vulnerability of the population/system (Brooks, 2003). Vulnerability is shaped by a combination of physical, social, economic and environmental factors - the attributes of the person/system that condition the impacts resulting from flooding. In the past, physical aspects of vulnerability - the spatial distribution of populations and infrastructure in relation to flood hazard - tended to receive more attention in hazards research (Hilhorst, and Bankof, 2004)). But there is now increasing recognition given to the social aspects of vulnerability. For individuals, susceptibility to hazards depends largely on behaviour, wellbeing and the resources people have to enable them to avoid and recover from harm. These, in turn, are largely determined by wider social, economic and political patterns and processes that differentiate how flooding impacts on people and human systems (Cannon, 2000, Wisner *et al.*, 2004). Analyses of vulnerability increasingly highlight its socially constructed nature (Cutter, 1996), underlining the importance of understanding how socio-political processes can create vulnerability and thereby create 'disaster' (Hilhorst, and Bankof, 2004; Pelling, 1999).

This study adopts the framework developed by Heltberg *et al.*, (2008). The framework presents and applies the social risk management and asset-based approaches to the context of climate change. The social risk management (SRM) and asset-based approaches provide a conceptual framework for understanding the sequential links between risks; human exposure and sensitivity; the impacts of risky events; and risk management (or adaptation) strategies. This provides a unifying conceptual framework to examine the characteristics of the risks faced by households; how adaptation responses at multiple levels depend on livelihoods, policies, and institutions; and household vulnerability outcomes. It highlights the importance of a multidimensional and equitable approach to adaptation policy and the need to include higher level (national and international) risk management interventions. This includes social policy and social protection interventions to build resilience at the household

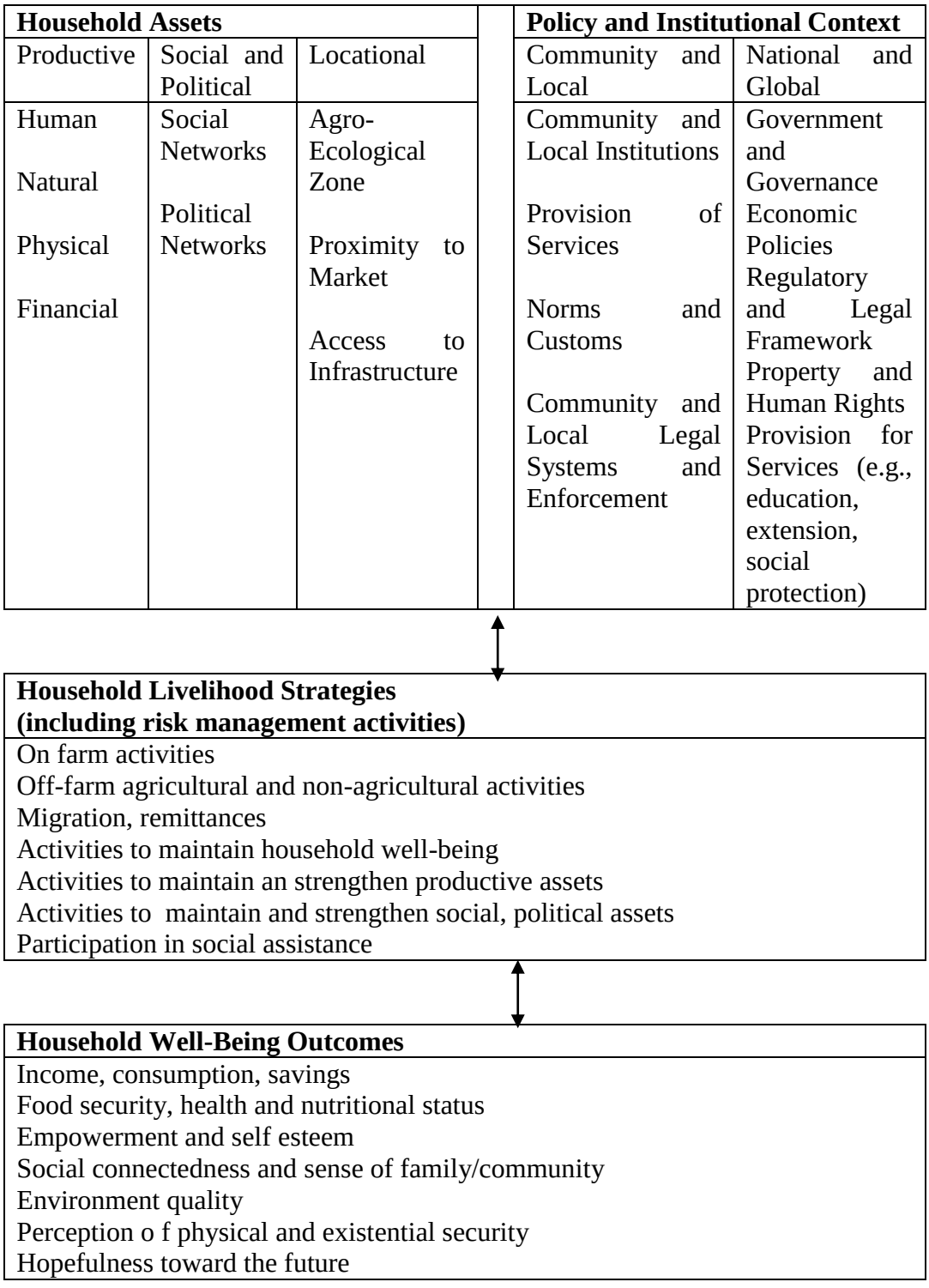
level through improved human and physical capital and access to risk management instruments such as safety nets and insurance.

This analytical framework helps focus on the sequential links between climate risks, human vulnerability, and interventions to help manage vulnerability to climate change. The framework is consistent with IPCC (2001) definitions of vulnerability and adaptation and highlights that:

1) All households and individuals face risks associated with climate change, but not all are vulnerable. Vulnerability is a function of risks, exposure and sensitivity and adaptive capacity, and depends on the relationship between losses and some benchmark indicator of household well-being (e.g., poverty line).
2) The exposure and sensitivity of household assets and livelihoods to climate change and their adaptive capacity are to a large extent shaped by policies and investments outside of their direct control.
3) Risks related to climate change can impact household assets, livelihoods and well-being directly and indirectly, so a multi-dimensional approach to risk management is required.
4) Ex-ante management of climate related risks, especially those that lower exposure and sensitivity of assets and livelihoods, can strengthen household assets and increase returns on assets, thereby contributing to improved livelihoods and well-being.
5) Climate risk management (or adaptation) has to be multidimensional and span interventions at household, community, national, and (increasingly) international level.
6) Institutions and good governance are keys to a multidimensional and multisectoral approach to improved adaptation to climate change.

Thus, household livelihoods and well-being depend on the interface between assets (broadly defined), the policy and institutional context, and risks (Figure 1). Risk affects the expected returns and variance of returns on assets and livelihood strategies, and therefore household well-being and future asset accumulation. Households are poor because they have limited quantity and quality of assets; and their assets have low expected returns and high variance of returns. The combination and flexibility of assets also matters: Poor and vulnerable households tend to lack key assets and whatever assets they have are not mobile and of poor quality and location. Many poor rural households are also landless and depend on selling their labour, which is typically of low quality in terms of education, skills, and health and nutritional status. Furthermore, because of gender, class, or caste, some individuals and households can have limited access to markets and livelihood opportunities, including migration. This, in turn, limits labour productivity and returns to human assets.

Figure 1: Schematic Presentation of Asset-Based Approach



Source: Heltberg et al, 2008

4.2 Literature Review

4.2.1 Climate Change Impacts on Flooding

Though information on recent flood trends is inconclusive, global trends in sea level and temperature now provide strong evidence of a climate change signature (Few et al, 2004**)**. The weight of international scientific opinion has swung decisively toward the perspective that a process of anthropogenically-forced global climate change is now under way, over and above normal background climatic variability. The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC) draws on a series of modelling approaches to estimate how climatic parameters might change in future and set out a range of potential impacts resulting from these changes. The magnitude of change depends partly on whether society succeeds in reducing greenhouse gas emissions. Yet, even with strenuous efforts in climate change mitigation, some climate impacts are inevitable. Over the next 100 years, yearly average near-surface temperatures across the globe are predicted to rise by between 1.4°C and 5.8°C, causing an increase in flood hazard in some areas because of sea level rise, changes in seasonal precipitation or the pattern of wind storms (Houghton *et al.* 2001; McCarthy *et al.*, 2001).

Climate change is making weather less predictable, rains more uncertain and heavy storm rainfalls more likely. The unpredictability of rainfall is shown both by observations, such as the large fluctuations in the levels of Lake Victoria in Africa since 1980, and by the experiences of long-term urban slum residents, who report much more frequent storms producing floods since 1990 (ActionAid International, 2006). Climate models predict that winter rainfall will increase by 20-30% by the 2080s. Such an increase could lead to a much larger (up to 200%) increase in flood risk (POST, 2007).

Flooding, as one of the most frequent and widespread of all environmental hazards and of various types and magnitudes, occur in most terrestrial portions of the globe, causing huge annual losses in terms of damage and disruption to economic livelihoods, businesses, infrastructure, services and public health. Long term data on natural disasters suggest that floods and wind storms (which frequently lead to flooding) have been by far the most common causes of natural disaster worldwide over the past 100 years (Few et al, 2004). According to the International Federation of Red Cross and Red Crescent Societies, in the 10 years from 1993 to 2002 flood disasters ‘affected more people across the globe (140 million per year on average) than all the other natural or technological disasters put together’ (IFRC, 2003).

Climate change works in an indirect way to aggravate urban flooding in especially in the African continent. Droughts and floods in rural areas, such as the African Sahel droughts and major floods in Mozambique, have forced many rural people to migrate to towns and cities, adding large new populations to existing slum communities (ActionAid International, 2006). These rural refugees further add to the urban activities that increase the flow of rainwater to rivers and thus the intensity of local flooding.

With an increasingly urbanizing world, flood disasters are reportedly increasing in urban areas and particularly negatively impacting on poor people (Alam et al, 2008)

and urban development in general. However urban flood risk research was strongly influenced by the concept of floods within the natural, rural environment (also see Zevenbergen, 2007). Consequently there is a growing need to revisit urban flood risk knowledge with a focus on understanding the interaction between urban development and urban flood risk (Benjamin, 2007). In this way urban flood risk should also be informed by focusing on the physical, technological, social, economic and political parameters. Such an understanding should ideally contribute to appropriate urban flood risk management strategies and policies.

4.2.2 Urban Vulnerability to Flooding in Africa

A review of climate change impacts on urbanization by the international institute of environment and development (Huq et al, 2007) found that the floods are already having severe impacts on cities, smaller urban centres and rural areas in many African Nations. Examples cited include floods in Mozambique in 2000, which displaced around 4000 people in Maputo alone and crippled transport networks, breaking market links (Christie and Hanlon, 2001); heavy rains in East Africa in 2002 that brought floods and mudslides and forced tens of thousands to leave their homes in Rwanda, Kenya, Burundi, Tanzania and Uganda (Huq et al, 2007). More common, but less often reported, such as the many small floods that affect neighbourhoods in cities and small towns such as the 2 June storm that led to flooding in the western region of the Gambia destroying houses in Darsilameh village and affecting 300 people (IFRC, 2008).

With an increasingly urbanizing world, flood disasters are reportedly increasing in urban areas and particularly negatively impacting on poor people (Alam et al, 2008) and urban development in general. However urban flood risk research was strongly influenced by the concept of floods within the natural, rural environment (also see Zevenbergen, 2007). Consequently there is a growing need to revisit urban flood risk knowledge with a focus on understanding the interaction between urban development and urban flood risk. In this way urban flood risk should also be informed by focusing on the physical, technological, social, economic and political parameters. Such an understanding should ideally contribute to appropriate urban flood risk management strategies and policies.

Climate change puts African slum dwellers at increased risk (ActionAid International, 2006). ‘Environmental refugees’ from climate-related droughts and floods are already swelling the tide of rural-to-urban migration across Africa, and the trend is expected to intensify as drought increases its grip over large swathes of the continent. By 2030, the majority of Africa’s population will live in urban areas (ActionAid International, 2006). Unfortunately, however, global warming is also bringing chronic flooding to the cities, which can be just as disastrous for poor urbanites as droughts are for farmers. Urban floods spread disease, interrupt schooling, and destroy houses, assets and income.

According to Manuta and Lebel (2005), climate change compounds the existing challenges of managing floods. Firstly, the anticipated sea level rises could have a major impact on flood risks in the coastal cities. Secondly, but less certainly, increases

in the frequency or intensity of extreme precipitation events exacerbate risks of disastrous flooding in parts of the world. Thirdly, climate change may alter flood regimes in some basins in other more complex ways, for example, through impacts on melting of glaciers in the uppermost reaches or reduced precipitation in inland continental areas. Reductions in duration or changes in timing of onset of seasonal floods may have as large an impact on livelihoods and production systems as more discrete high water events although the former is rarely recognized as a disaster. Finally, concurrent changes in land- and water-use may exacerbate or reduce effects of changes in climate on disaster risks. (IPCC, 2001).

Majority of flood research in South Africa has adopted a hazards approach that is concerned with hydrological modelling of floods. These typically employ deterministic or rainfall-runoff methods; statistical methods, that are either site-specific or regional; and empirical and pseudo-statistical or empirical-probabilistic methods. Very limited research has employed an integrated hazards and vulnerability paradigm to flood risk. Consequently the majority of risk reduction research and practice in the country is orientated towards structural measures or the technical, hydrological component of the non-structural early warning systems. Limited emphasis has been placed on community-based approaches to flood risk reduction practices (Benjamin, 2007).

With Specific Reference to South Africa, the majority of the published flood research is commissioned by the Water Research Commission (WRC) (Benjamin, 2007). The WRC operates in terms of the Water Research Act (Act 34 of 1971) whose mandate it is to support water research and development as well as building a sustainable water capacity in South Africa (see http://www.wrc.org.za). The floods of 1988 and the revision of the National Flood Management Policy in South Africa resulted in ex ante (risk reduction/mitigation) flood damage research in South Africa (Viljoen et al, 2001). The aim of ex ante research (that comprised 3 phases) was to develop flood damage management aids (loss functions, computer programmes, and questionnaires) to assist planners and authorities involved in flood damage assessment and management (ibid). Flood risk estimation models were also viewed as essential for developing such flood damage management aids, especially in determining potential flood-prone areas. Consequently the majority of flood risk-related research in South Africa has historically focused on the physical parameters of the flood hazard that drew heavily from hydrological modelling. Only a limited number of predominantly unpublished studies in South Africa focused on the vulnerability of those at risk to flood hazards or extreme weather events.

However recent research, particularly in poor urban environments, and adopting a more socially-oriented lens, has indicated that traditional physical science models are not adequate for defining flood risk in all environments (Benjamin, 2007). As the nature and form of flooding in poor urban environments does not qualify as “flooding” according to conventional physical science models, this has resulted in poor urban settlements exposed to flooding not being considered as being vulnerable to flood risk. Furthermore, flood risk reduction measures or flood adjustments in such poor urban environments cannot be solved through adopting the technical and physical structural measures typically associated with a physical science approach to flood risk.

Past development of flood management policies consisted predominantly of a process of incremental change, while reactive responses to flood disasters or narrow escapes have acted as catalysts for accelerating this process. An important notion is that current flood protection measures are based on the accumulated knowledge of past weather events (Zevenbergen, 2008). Major flood disasters have created the need to shift from flood protection to a more integrated approach. In the last decade, however, climate change has become recognised as a potential trend breaker in the way that hydrological variables and existing statistical distributions of flood probabilities are affected (e.g. Kabat et al., 2005). The present challenge seems to be that we must recognise the future as being inherently uncertain and that science will not necessarily reduce that uncertainty.

The present challenge seems to be that we must recognise the future as being inherently uncertain and that science will not necessarily reduce that uncertainty. The long-term horizon of climate change and current scientific uncertainties pose special challenges. Strategies that address these challenges recognise that there is no best solution. That they embrace future scenarios that fit a range of distributions of events will not come as a surprise (Pahl-Wostl, 2006). In this sense, climate change provides new incentives for the need to plan ahead and to anticipate extreme events and trends (Zevenbergen, 2008). A large number of studies show that we should start to adapt to climate change now, to prevent costly 'emergency' interventions in the future. This means that flood risk management strategies must meet present needs, while providing a path for adjustment for the future (Pahl-Wostl, 2006; Miller, 2007).

4.2.3 Governance of Climate Change and Disaster Risk

Climate change is a global problem that requires global solutions. But since it is also a local phenomenon, interventions to cope with climate change impacts require the engagement of stakeholders at national and local levels (Madzwamuse, 2010). Adaptation requires the active involvement of different actors and responses at multiple levels. The impacts of climate change will be felt at a local level and therefore renders the active participation of stakeholders at local, national and regional levels critical for the advancement of adaptation decisions reached through UNFCCC negotiations. This reality raises the question of governance within the climate change adaptation agenda.

Climate change governance is consequently also about the extent to which developing countries can bring developed states and global companies and corporations to account. These are all critical questions for climate change governance and decisions about climate change adaptation. So far, states and government agencies have played a dominant role in shaping adaptation policy responses and decision-making, with inadequate space for non-state actors and local communities. This has resulted in significant shortcomings in the formulation of adaptation policies and strategies. Climate change adaptation governance falls short of reflecting internationally agreed principles for good governance explained (Madzwamuse, 2010).

At the national level, governments need to implement strategies that enhance the resilience of national economies to help them cope with the impacts of climate change. Local communities on the other hand must build their resilience by adopting appropriate technologies while making the most of traditional knowledge and

diversifying their livelihoods to cope with current and future climate stress. Success in adaptation must be measured in terms of impacts on the ground at the local level as much as in regional and international responses.

Similarly, the governance frameworks required for disaster risk reduction give governments a key role through coordination and participation mechanisms. This requires the definition of policy, establishment of robust institutions, local authority capacity-building, and partnerships between numerous stakeholders, including civil society, NGOs and private sector. In short it requires participatory management of disaster risk reduction (Diagne and Ndiaye, 2009).

The nature of governance is a major determinant of the success of an adaptation process to climate extremes (Finan and Nelson, 2009). Successful adaptation to climate change will require the active participation of local communities in the process of and that institutional adjustments will inevitably focus on community reorganisation and initiative (Adger, 2003, IPCC, 2007). Lebel and Sinh, (2005) further elaborate this approach and identify participation, deliberation, decision-making diversity, justice and accountability as key attributes of an 'adaptive' governance system.

Where forms of governance preclude effective community participation and discourage co-management practices, local resilience tends to be low and adaptive capacity limited (Finan and Nelson, 2009). On the other hand, a more resilient socio-ecological system operates in a multi-nodal, well articulated decision-making context where knowledge production and learning are dynamic and stocks of social capital generate bonds of trust (Gaventa, 2002). Given this key relationship between governance and successful adaptive management, it appears logical that the support of appropriate governance institutions would constitute a priority element in an overall adaptation strategy.

5 Methodology

The study relied on the use of primary and secondary data. In Cape Town, primary data were obtained mainly from the result of interviews with key informants at the community level and also visual observations were used to determine the physical vulnerability of the selected community. The secondary data were sourced from literature on communities from the City of Cape Town relevant department especially those related to flooding. Relevant officials of the City authorities were interviewed as part of the primary data collection process. Officials that were interviewed were from the Informal Settlements Unit in the Department of Housing of the City of Cape Town office. This is the department charged with the responsibility of managing risks in the informal settlements. Interview was also conducted with some members of the Disaster Mitigation for Sustainable Livelihood Programme (DiMP). Also data and literature were sourced from relevant bodies, including DiMP and African Centre for Cities (ACC), both of the University of Cape Town.

In Ilorin, the study utilized both primary and secondary data. The secondary data were collected mainly from the National Emergency Management Agency, Kwara State office. The data collected include the details of various disaster incidents in the State

between 2002 and 2007. Aside this, data were collected form households that occupied the properties destroyed by rainstorms and floods during the period under review.

For the primary data, the focus was on the disaster victims within the city. According to the Kwara State office of the National Emergency Management Agency (KWEMA), between 2002 and 2007, a total of 30 episodes of flood and/or rainstorm events occurred that affected different parts of Ilorin metropolis. These effects included collapsed buildings and damage to properties. About 4,012 households were reported to have been affected by the incidents (KWEMA, 2007). Out of these, the researchers were able to trace only 2100 households during the reconnaissance survey for the purpose of this study. The inability to reach all affected households was due to the displacement that followed rainstorm and flood events. This led to some households changing their residents more than once within a period of five years. Thus, a total of 110 households were sampled, representing 5% of the total number of households that were located during the preliminary survey.

A structured questionnaire was administered to them in addition to oral interviews and on the spot assessment of the victims' houses to determine the extent of damage to properties. The questionnaire elicited information on the socio-economic characteristics of the victims, their opinion of government handing of the situation, their coping mechanisms with the disaster incidents as well as their adaptation measures. The questionnaire also elicits information on how the disaster affected their livelihood systems. Furthermore, the victims were asked about their perception of the causes of frequent rainstorms and flooding incidents, and their understanding of climate changes issues. Data were collected on the characteristics of the victims' houses and neighbourhood characteristics.

6 The study areas

6.1 Cape Town, South Africa

Cape Town lies in the Western Cape, the second most urbanised of South Africa's nine provinces, where urbanisation levels are estimated at 90 percent (City of Cape Town, 2005, 2007). It is home to an estimated 3.27 million people and has seen among the highest urban growth rates of any city outside of Guateng province, South Africa's economic and administrative heartland.

It is a city of sharp contrasts. Wealthy, lush surburbs nestle around the mountains surrounding the city bowl, while the majority of the city's poorer residents live on the Cape Flats, an inhospitable, spatially and topographically disadvantaged plain on the eastern outskirts of the city, far from commercial and residential centres (Pharaoh, 2009). This development is rooted in both apartheid planning and the continued 'peripheralization' of informal settlements and low-income housing in the post-apartheid era (Mahin, cited in Pharaoh, 2009). Under apartheid, segregation allowed non-whites only restricted access to the urban areas. Thousands of people were either forcibly removed or restricted access to living in the poorly serviced socially excluded black and coloured townships of the Cape Flats and other designated non-white area-initially in housing projects, but overtime increasingly in informal settlements.

Cape Town has had it own fair share of the problem of urbanisation just like any other South African city. The city has experienced significant economic growth in the past

decade, with improvements in the provision of basic services, such as water, waste and electricity, and rising tourist numbers, which have contributed to a growing economy. However, like many other cities in the developing world, Cape Town is struggling with the problem of urbanisation, which places considerable pressure on the City's ability to provide housing, services and infrastructure, and on the city's economy to provide employment for all its residents (City of Cape Town, 2009).

The number of people living in informal settlements in the city is growing (23 000 families in 1993, to approximately 109 000 families in 2007) – overcrowding is increasing and household size declining. This contributes to an increasing housing backlog, from around 150 000 in 1998, to approximately 300 000 in 2008. The balance of those in need comprises 'backyarders' and others within the formal urban fabric. The growing housing backlog has the potential to undermine social stability, slow down economic expansion, and even deter future investment (City of Cape Town, 2008a).

The rapid growth of informal settlements in urban areas poses significant challenges to both National Government and municipalities. The current housing delivery mechanisms cannot cope with the increasing demand, and it is unlikely that the demand for housing will be appropriately addressed within the next 25 years. New strategies are thus required to reach more people within the constraints of state resources. Figure 2 is a map of Cape Town.

Figure 2: Map of Cape Town

6.2 Ilorin, Nigeria

Ilorin, the capital city of Kwara State, Nigeria, is the setting for this study. The city is located on latitude 8^0 10'N and longitude 4^0 35'E marking a divide between the southern forest Zone and the Northern grassland of Nigeria. The vegetation, in most parts, is guinea savanna interspersed by trees of different species. The dominant

streams are Asa, Aluko, Okun, Amule, and Agba. The Asa River is of particular influence on the direction of growth of the city. The situation of the city between the dry North and the wet South of Nigeria gave Ilorin the apt description as the "gate way" between the North and the South of the country" (Adedibu, 1980). The climate is therefore tropical wet and dry characterized by a distinct wet and dry seasons. The mean annual temperature is about 26.80^0c with five hours average daily sunshine. The mean annual rainfall is about 125mm. It is important to note that the above locational and physiographic characteristics possess (sometimes significant) implications for human health on one hand and economic and social development on the other.

Ilorin is a typical traditional African city whose urban history predates colonialism in Nigeria. The city therefore falls into the category of third world cities described as reputed for their dualistic internal structure (Mabogunje, 1968). The physical development of Ilorin also translates into significant change in the population of the city. For instance, from 36,300 inhabitants in 1911, Ilorin has a population of about 208,546 in 1963, 532,088 people in 1991 and a projected population of about 765,791 by the year 2006 at the rate of 2.84% annually. The facts of urbanization, development of the modern commercial/industrial economy and the multiplier effects of these factors on natural increase had combined to produce the changes in population described above. Figure 3 is a map of Kwara State showing Ilorin.

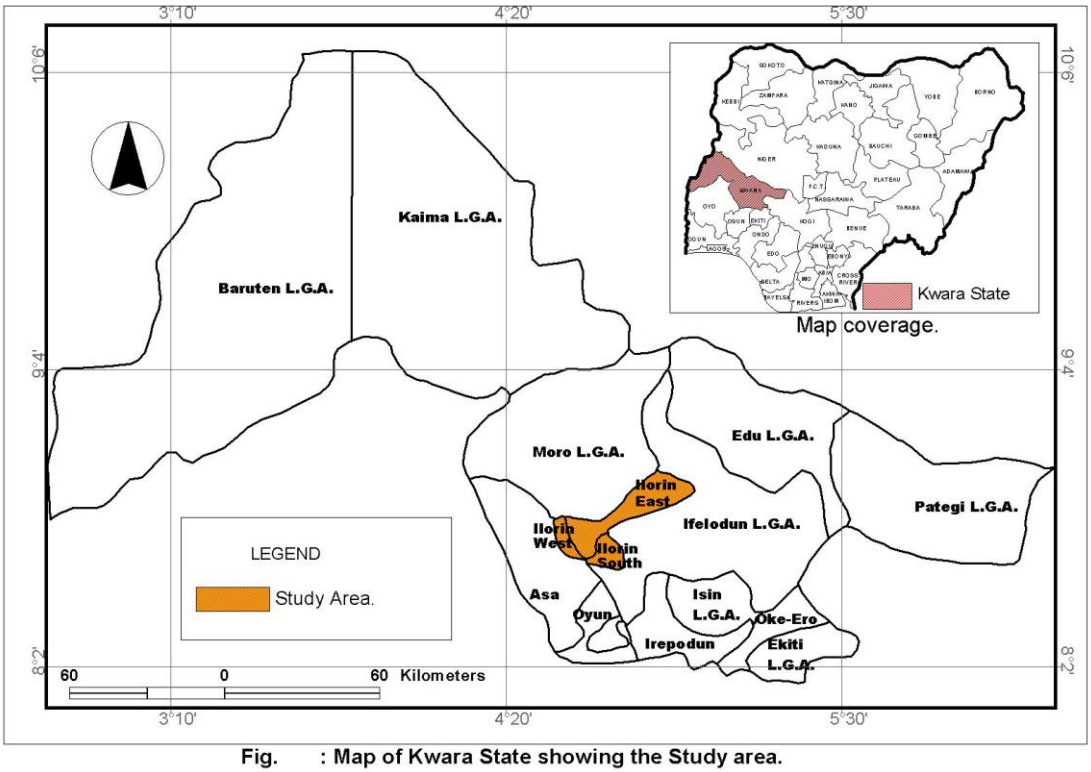


Fig. : Map of Kwara State showing the Study area.

Fig.3: Map of Kwara State showing the Study Area (Inset: Map of Nigeria).

Frequent rainstorms and flooding in Ilorin has made it one of the most vulnerable cities in Nigeria in the recent past. The number of such incidents has been on the increase in the last few years. As shown in Table 1, apart from the fact that the number of incidents have increased, so also has the severity which translates into extensive damage to properties and the livelihoods of the people. Plates 1 and 2 show informal dwellings along river Asa.

Table 1: Rainstorm and Flooding Incidents in Ilorin, 2002-2007

Year	Rainstorm/Flooding Incidents	Severity*
2002	4	High
2003	2	Moderate
2004	4	Moderate
2005	6	High
2006	6	High
2007	8	High
2008	7	High

* Severity in terms of number of people affected and economic losses

Source: Kwara State Emergency Management Agency's records

7 Discussion of Findings

7.1 Summary of Findings from Ilorin Study

An analysis of the Data obtained from NEMA office shows that the impacts of the flooding/rainstorm disaster incidents were more in the traditional, core areas of the city going by the number of properties damaged. Figure 4 is a map of Ilorin showing the severity of the disaster incidents between 2002 and 2008.

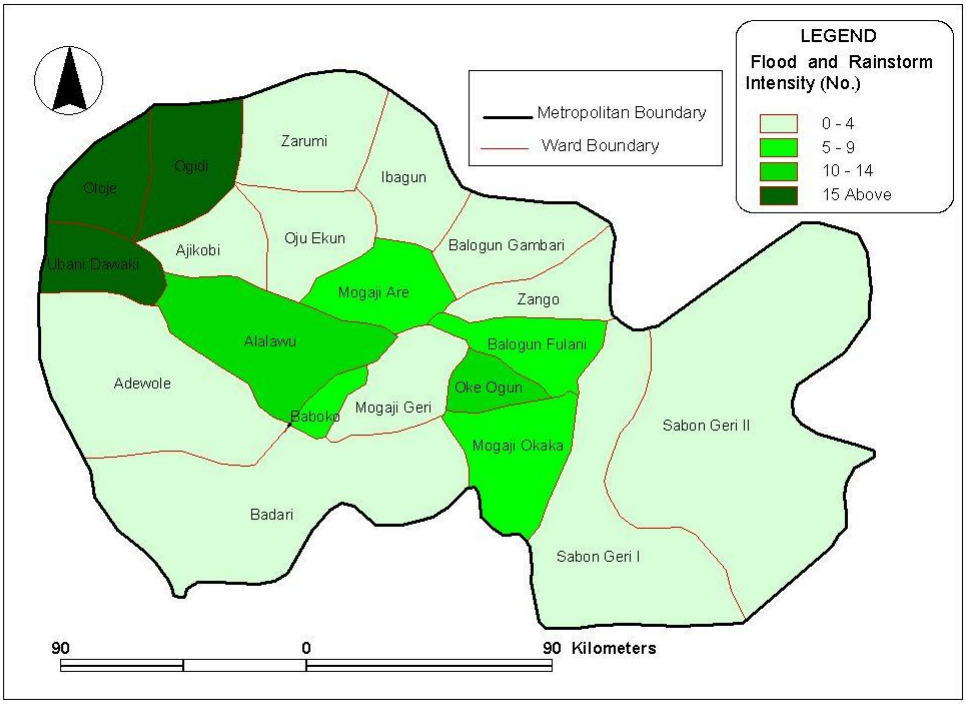


Fig. : Map of Ilorin Metropolis showing the Severity of Flood and Rainstorm intensity.

It should be noted that the traditional, core areas of the city are characterised by high population and the people in these areas are most at risk of all environmental emergencies. This is because basic infrastructures are either not available or old and weak. The houses are also too old or are made of low quality materials. The existing

situation has increased the anxiety on the part of the people that future incidents will continue to have higher impacts. The next section which discusses the characteristics of the affected buildings from data collected from the field further confirm the fact that most of the buildings in most parts of the city especially the core, indigenous areas cannot withstands rainstorm or severe flooding whenever they occur.

7.1.2 Impact of Flooding on Livelihood Systems

Flooding and rainstorm, apart from causing destruction to lives and properties often cause significant damage to livelihood systems of the victims. When asked the various ways by which the flooding and rainstorm disasters have eroded their livelihood systems, pauperisation and health problems appear to be the major dimension. For instance, as lamented by some respondents, the incidents generally caused disruption of electricity in some areas for months affecting trading and crops washed away on farms, especially among those in the suburban. It should be noted that when electricity supply is unavailable for some time, it slows down economic activities among the traders and the artisans which, incidentally, constituted the highest proportions of those affected. Furthermore, the disasters are associated with a number of health problems including bodily injuries as well as the attendant psychological trauma. According to one of the victims, "when one's health is affected by disaster incidents, it becomes difficult, if not impossible, to continue with one's means of livelihood". According to him, this is the singular most worrisome aspect of disaster impact". The post disaster adjustment would have been easier if relief comes from government and non-governmental organisations on time.

A number of women in the inner city and Frontier Native areas depend on irrigated vegetable farming around the flood plains of Asa, Aluko and Amule- the three dominant streams that flow in most parts of the metropolis. During flood events, vegetable farms are washed away and the land remain flooded for a long time after. Women are rendered unemployed for upwards of three months when they can start all over. To worsen this situation, poor urban women's economy is not diversified and thus entrenching the regime of poverty.

7.1.3 Coping Mechanisms Employed by Victims

In terms of coping and adjustment, findings show that by and large, support from friends and relatives and personal savings accounted for the way large proportion of the victims cope with the immediate impacts of the disaster. Even though government support came for most of them, many of the victims said the support did not come on time and it did not measure any closer to the degree of loss suffered. This calls to question the level of disaster response in Nigeria. It is a fact that the agency charged with disaster management in Nigeria (NEMA) has demonstrated some low level of capability in managing the various disasters that has occurred in Nigeria in recent years. A major problem has been in the areas of funding and lack of modern equipment to respond to disasters in the country. According to some of the victims, many of them did not get relief materials until after six months especially those that have to do with materials to repair or rebuild damaged properties. The coping mechanisms employed by victims as presented in Table 1.

Table 1: Coping mechanisms employed by flood victims

	*Frequency	Percent
Personal savings	29	23.7
Support from friends and relatives	50	41.0
Borrowing from local money lenders	11	9.0
Borrowing from banks	6	4.9
Government donations	26	21.3

*** multiple sources of coping mentioned by respondents**

Source: Author's Analysis

At present the structure of disaster risk management in the City does not give room for particular emphasis to be placed on flooding and related extreme weather events like rainstorm. As obtained in all the states of the federation, the agency charged with disaster management, the National Emergency Management Agency (NEMA) and the counterparts at the state level are burdened with so many responsibilities. The Kwara State Emergency Management Agency is not an exception. No specific programmes or trained personnel are on ground to prepare for or deal with flood disasters whenever the incidents occur.

7.2 Vulnerability of Cape Town's Informal Settlements to Flood Risk

Informal settlements exhibit complexity in other ways. Smit (2006) identified some of the issues that contribute to the complexity of informal settlements in Cape Town: "the physical form of the settlement, poverty and vulnerability, social problems within the settlement and rural-urban linkages". The physical layout of informal settlements is closely linked to social networks as well as economic activity and this contributes to the apparently chaotic layout of such settlements. This informality is magnified by the impermanent structure of dwellings and the low level of service provision. A great degree of social differentiation can also be identified within informal settlements, although the majority of inhabitants are unemployed or have very low household incomes. Community schisms have also been identified by Smit (2006) and these factions may be delineated according to politics or the length of time of occupation.

Poverty, a key component of the flooding problem in Cape Town is perhaps one of the most important underlying factors of vulnerability. The economic situation of the residents is perhaps even more debilitating than the geographic situation of the Cape Flats. Their poverty can be attributed to the remnants of apartheid, which was in place from the late 1940s until the early 1990s and was designed to repress black South Africans through segregation. This segregation forced black South Africans to live in designated areas, which eventually evolved into the informal settlements of the present day. While the formal system of apartheid no longer exists in South Africa, its legacy is very much alive.

The City suffers from relatively heavy rainfall every year during the wet months of winter. While most of the City has established sophisticated and fully functional stormwater infrastructure, the poorer areas located in the Cape Flats, such as Khayelitsha and Philippi, lack sufficient modern stormwater infrastructure

While most of these townships do not have formal catchment systems, there is a basic level of service provided by the City, which includes retention ponds around the area,

drains around paved roadways, and formal trenches. However, in many cases, these basic services are ineffective due to consistent blockages. There are three main types of blockages which are common to these systems: silt accumulation, man-made blockages, and rubbish build up (Bourchard et al, 2007). Silt accumulation can be attributed to the grey water, which accrues within the trenches. Residents dispose of wash water and latrine contents in these areas, resulting in large amounts of grey water. Man-made blockages are also frequent within settlement areas. The City places pipes through locations in the area to transport the water to retention ponds, and many times residents block these pipes with various materials so that they can settle in those areas. This results in the pooling of water and consequent flooding during the winter months. Rubbish blockages are perhaps the most debilitating to the catchment system. The lack of skips or improper location of skips (rubbish collection bins) within these areas results in residents disposing of their rubbish in retention ponds, trenches, and streets. This trash subsequently ends up in the drains and causes blockages.

Another aspect which contributes to flooding is the fact that flood risk management is often not a priority at household and community levels (Bourchard et al, 2007). Though this is not the case for all residents, many are primarily concerned with being relocated or being provided housing. There is little motivation for residents to properly protect their homes from flooding because often they believe that if they are the worst affected, they will be the first ones to be relocated. While some do have the means to prevent flooding within their homes, others lack the means and knowledge of how to do so. The location of townships also plays a large part in increasing the risk of flooding. The informal settlements are situated in the Cape Flats, an area of lower elevation in comparison to the surrounding mountainous terrain, making them susceptible to the accumulation of water. Though the area is unsuitable for living due to this risk, there continues to be a great influx of residents, primarily from the Eastern Cape. These new residents move to the Cape Flats during the summer months when there is no flooding, find an open location, and unknowingly settle in an area of high flood risk. There is little to no control over how many people move into an area or where they settle in that area.

A notable danger associated with the flooding in the informal settlements is the detriment to the health of the residents. The floods create large bodies of stagnant water that pose several health concerns. When the rainfall occurs on a steep gradient (e.g. mountainous terrain), the duration of the flooding is relatively brief. However, when the terrain is flat, the duration is extended because the water drains far more slowly (Miller, 2007). There are many times when the Flats experience multiple storms over the course of a week, which can prolong the period of time it takes for the water level to lower. The period of the flooding is dependent upon both the amount of water and the gradient of the flooded stream.

During a flood, this runoff combines with human wastes from sewers, drains, and latrines and spreads throughout the homes and streets of the settlements. These wastes carry bacteria, viruses, and parasites that are responsible for a wide number of gastro-intestinal infections, including diarrhoea (which kills over three million children around the world per annum), typhoid, cholera, and intestinal worm infections (Kolsky, 1998).

Unfortunately, the City is limited in their ability to resolve the problem due to a lack of manpower, inadequate land availability and potential political conflicts that may arise between the government officials and settlement groups. However, the City cannot overlook the importance or necessity of action in the affected areas to provide a better living environment for the people in the settlements. Table 2 shows the broad sources of flood risk in the informal settlements and their effects.

Table 2: Sources and Effects of Flood Risk in the informal settlements

Broad Source of hazard	Hazard	Factors Increasing risk	Effects
Poor drainage	Ponding	• Poor drainage around communal water taps • Shallow, hand dug informal drains between houses • Blocked drains • Clogged drainage ditches	• Health problems, particularly among children who play in the water, and related costs • Missed school or work days
	Surface runoff	• Inadequate drainage alongside hardened surfaces such as roads • Structures in close proximity to hardened surfaces	• Health problems, particularly where waste is washed into homes, and related costs • Missed school or work days • Damage to structures • Damage to and loss of assets, documents and possessions
Structural problems	Seepage	• Structures in close proximity to wetlands and water bodies • Home foundations below ground level • Poor building materials • Inadequate weather proofing	• Damage to and loss of assets, documents and possessions • Health problems, as people become ill from damp and cold conditions, and related costs • Missed school or work days
	Leaks	• Poor building materials • Inadequate weather proofing	
Flood exposure factors due to locations and			• Injuries and death and related medical costs • Homes completely or partly washed away

surroundings		• Damage to and loss of assets, documents and possessions • Damage to and loss of infrastructure • Negative effects on businesses and industries, particularly in the tourism sector
Riverine/estuarine flooding	• Structures in close proximity to water bodies • Structures built in dry water courses • Disturbance of natural water drainage and flow patterns	• Isolation of communities as bridges and roads are damaged or washed away • Injuries and deaths and related costs • Homes completely or partly washed away • Damage to and loss of infrastructure • Damage to and loss of assets, documents and possessions • Negative effects on businesses and industries

Source: Holloway & Roomaney, 2008

7.3 Flood Risk Management in the Informal Settlements

"It is important to understand that for reasons of resources and practicality, it is not feasible to completely eliminate flood risk in the City. It can however be managed to acceptable levels through appropriate planning, design, construction, operation and maintenance of stormwater infrastructure as well as proactive development management and disaster planning in collaboration with all stakeholders". "The solution to the informal settlements flooding problems is a simple one, technically: Move the people out of their present locations and do some upgrading to reshape the land. But this has never happened. And it may never happen" (Interview with city officials Johan Gerber and Barry Wood on 05/10/09). This sums up the complicated nature of flood risk management in the informal settlements of Cape Town, especially those located in the Cape Flats. This is because it is practically impossible to move people out of their present locations. The germane questions are; where do you move the people to? Are the people themselves willing to move? What are the rational alternatives? *"The people are not willing to risk leaving their present camp for fear that it may become impossible for some of them to come back. For now the emphasis is providing social services to informal settlements located on government lands. What of those that are not living in government lands?"*

Flood risk management plan are primarily focused on relocating the residents and restricting migration into these dangerous areas (Bourchard et al, 2007). Nonetheless, the city recognises people with limited means will continue to live for some time in flood-prone areas, and that the emphasis in international flood management ―has moved away from [relying only on] physical control and engineering construction (structural measures) towards reducing human vulnerability through non-structural approaches (Smith, 1992). The city‘s flood risk management plan thus addresses four broad domains (Figure 4) to address a range of issues inhibiting faster progress, among which are ineffective communication between various stakeholders, the lack of available City resources, the absence of community involvement in the City‘s flood risk management scheme, and the nonexistence of a method to prioritise the areas most devastated by flooding (Bourchard et al, 2007).

Despite the efforts of the City, the countless impacts of flooding in the informal settlements are still very much apparent (Bourchard et al, 2007). The existing stormwater infrastructure in these affected areas is often ill-maintained, which exacerbates the problem. The flooding has left many areas of the informal settlements uninhabitable for various reasons including health risks and physical dangers. There has not yet been a thorough assessment of the habitability of the affected areas. Although many of them are hazardous, many residents continue to live there, not only because they lack the economic means to move elsewhere but also because they are largely unaware of the dangers associated with flooding. Previous efforts have not been entirely successful in minimising the impact of flooding at the household and community levels (Wood, 2007). In other words, there was a lack of involvement by and collaboration with the residents of the informal settlements about flood risk management.

According to the City officials interviewed, “the informal settlements have become increasingly difficult to manage even with some level of upgrading and service provision as it becomes difficult to control the influx of people. So any meagre achievements in these two areas are soon wiped off by overpopulation”. Two major factors aggravating flood disasters, as explained by the City officials include building too low to the ground and leaking roof. These are the lingering physical dimensions of vulnerability in the informal settlements. Infact some residents through their actions encourage flooding to attract government attention and sympathy. This now makes the situation both social and political. In other words, flood risk in the informal settlements in the City has now gone beyond engineering and service provision to a complex web of social and political issue. There is need for communities, therefore, to take initiatives to reduce the risk of flooding. These can be done in several ways;

1. There are general works that people can do to improve building structures: again, the issue of having resources to do this comes in.
2. Sometimes people have resources to do some simple things but they prefer to wait for government believing that government is there to solve all their problems.

All the recent flooding events have prompted an ―emphasis [that] has moved away from physical control and engineering construction (structural measures) towards reducing human vulnerability through non-structural approaches (Smith, 1992). In accordance with this movement, the City of Cape Town is now moving from a reactive to proactive approach for handling the flooding. In May 2007, the Catchment,

Stormwater & River Management Department (CSRM) established objectives to improve existing conditions in the settlements. With the help of WPI students, the City raised awareness among the residents about the dangers associated with flooding as well as proper self-sustaining stormwater management techniques (City of Cape Town, 2007, 2008).

A key component of the City‘s overall flood risk management strategy is the Master Plan, which entails the upgrading of all 226 informal settlements within the metropolitan area. Nearly 25% of the settlements were affected by the flooding of 2007, compared to 80% seven years ago. ―The improved situation can be attributed to Cape Town‘s pro-active cleansing operations, upgraded drainage systems, and ongoing community education programmes (Hendricks, 2007).

As far as other long-term actions, Cape Town‘s plan includes a technical assessment of all flood occurrences, education on better house building techniques, stricter enforcement against migration into high risk areas, and the acquisition of land adequate for the relocation of people residing in areas of great flood risk (Wood, 2007).

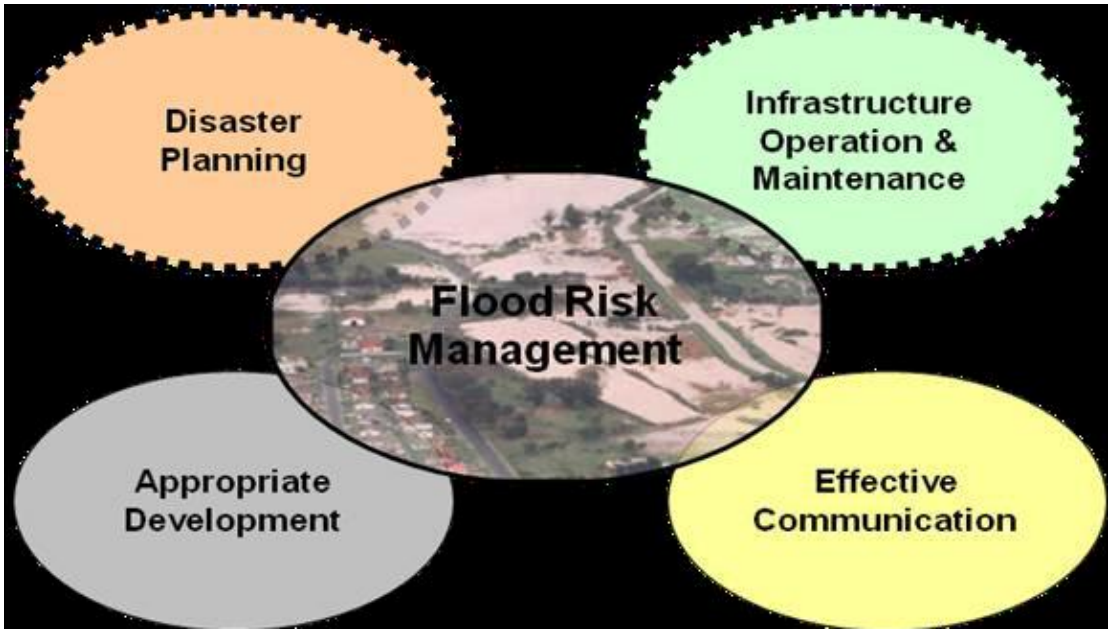


Figure 4: Cape Town‘s strategic approach towards flood risk management (Source: Wood, 2007)

The need for improved stormwater management in Cape Town is partly due to the fact that the City as a whole is rapidly growing. This extreme urbanisation has increased the extent of hardened surfaces, which has caused more stormwater runoff to be directed into catchment systems instead of being absorbed by the ground. Additionally, silt accumulates in the limited drainage systems present in the informal settlements. These obstructions in the drains contribute to flooding particularly during the winter months.

As of 2006, certain strategies were implemented by the City in order to improve its stormwater management policies. One initiative included an ongoing monitoring and warning system, which relied on monitoring stations. Flood retention ponds and weirs (small, overflow type dams) were also developed to strengthen the stormwater

infrastructure in place. The City also looked to increase the flood event return period (the time interval between flood events) for which the infrastructure was designed. Also, there was an effort to maintain the infrastructure by relieving the drainage systems of built-up sand and debris. And lastly, mostly pertaining to the informal settlements of Cape Town, the City looked towards ―the development of resilient infrastructure to include appropriately designed and constructed low-income homes, storm-water drainage and sewage treatment installations to cope with flash-floods (Mukheibir, 2006).

In accordance with the City‘s 2007 Winter Readiness Programme, an additional series of measures was taken relating to stormwater and river cleaning. These measures included a metro-wide proactive stormwater piping cleaning programme, a solid waste area cleaning, and regular inspection and monitoring of critical catchment systems. The solid waste area cleaning is the main task outlined by the readiness programme, as it is an ongoing process for the City that aims to prevent the ingress of litter and other solids into stormwater systems.

The City of Cape Town‘s approach to spreading awareness of the consequences of flooding is the execution of their communication and awareness programme. The aim of the programme is to educate the residents in the Cape Flats as to the actions they should be taking so as to lessen the effects of flooding. The key activities of this programme include: a community capacity building programme, media briefings, information collation and reporting, and regular media releases and public advisories (Wood, 2007).

A community capacity building programme involves brochures, tips, workshops, and flood risk education, including notification to informal communities within flood prone areas. As far as collation and information reporting, the City broadcasts weather warnings as well as regular flood incident reports. The City has also undertaken a number of initiatives to assist the community in their response to flooding. One of the ongoing measures is the use of public call centres, which ensure that complaints and requests for assistance are dispatched to the appropriate department(s). Furthermore, the City aims to better coordinate the reporting of flood incidents within the informal settlements. Regarding public wellbeing, the health directorate is responsible for providing primary and secondary healthcare service and education to the public.

The City has constituted a disaster risk management team (http://www.capetown.gov.za/en/MediaReleases/Pages/CityDisasterRiskManagementTeamReadyForStorms.aspx). The team is a joint effort between the City of Cape Town, Provincial Government and Non-Governmental Organisations (NGOs). The Major Flooding and Storms Plan includes the unblocking of stormwater drains, the upgrading of stormwater systems, regular inspections of retention ponds, a public education programme and an emergency plan to handle possible disasters. The City has also signed an agreement with the Trauma Centre to assist victims of storms or floods with psychological assessment and support. “The City has pro-actively identified and mapped high flood risk areas. We have introduced special flood risk reduction measures, such as improved drainage and preventative maintenance of existing stormwater systems by Roads and Stormwater teams,” says Councillor Dumisani Ximbi, Mayoral Committee Member for Safety and Security. “Our ongoing public education programme in partnership with environmental training provides residents with practical tips on how to raise floor levels, channel flood waters, as well as reduce health hazards associated with standing water,” he says.

The City’s emergency plan is co-ordinated at a Joint Operations Centre (JOC) where a

multi-disciplinary rapid response team manages and executes contingency plans. It also acts as a central information point to inform the public on the situation at hand through fast and effective communication during emergencies. One of the best practices in flood disaster preparedness and vulnerability risk assessment as demonstrated in the case of the informal settlements are presented in Appendices I and II

According to Wood and Gerba, "Once the SA Weather Service issues a severe weather warning, the City will immediately communicate the news directly to the areas at risk. "We have also identified various emergency shelters to help minimise disruption of lives and community activities. People will be encouraged to first try and find alternative accommodation with neighbours, friends or families before being housed in community facilities. The City's emergency plan provides for the response team to, together with identified NGOs, disseminate blankets, food and basic necessities to alleviate the trauma usually experienced by flood victims and to provide for the immediate, basic needs of affected communities. It also provides specific information with regard to health issues, the registration of victims and emergency shelters.

There are some challenges in the City's efforts to manage flood risk in the City. There is no flood warning for specific communities except the general weather forecast from the South African Weather Services. Therefore it is difficult to predict area that flooding is to occur at a particular time. When there is dumping on drainage channels the City council may not know on time because of accessibility problems in many informal settlements. Also, debris do come down from mountains to block the drainage channels especially those settlements very close to table mountain. These situations have become a big challenge for disaster management in the area of early warnings.

The percentage of flooded settlements has remained fairly stable in the past few years. As part of the City strategy to combat flood risk and other hazards in the informal settlements, there is now a decentralised management system whereby different departments are now charged with different aspects of managing flood risks in the informal settlements. Some of the departments in charge of flood risk management in the informal settlements include department of housing, sanitation, stormwater, basic services department etc

8 Governance of Disaster Risk and Climate Change in the two Cities: A Comparison

Climate change is a global problem that requires global solutions, but the nature of the problem and its impacts require the active involvement of multiple national and local-level stakeholders in shaping and implementing the solutions. Adaptive capacity is dependent on policies and strategies that are put in place to respond to the needs as well as enhance the resilience of the most vulnerable systems and groups in society. A lack of appropriate policies and legislative frameworks may present barriers to the implementation of adaptation responses, and possibly increase the vulnerabilities of certain groups such as women and the poor. Inadequate institutional support and inappropriate policies can act as a constraint to adaptation and limit access to much

needed natural resources by communities dependent on such resources for both survival and adaptation to environmental change and climate variability.

Reducing the vulnerability of people to floods and enhancing their adaptive capacity to deal with floods are crucial governance issues. Any assessment of vulnerability to floods requires not only at potential changing bio-physical changes, but also at the social, political and economic factors that create vulnerability among different social groups. It requires looking at the interplay among different perspectives, power structures and lobbies, which influence the politics and discourses on vulnerability to floods and risk reduction interventions. Moreover, it requires the effectiveness and fairness of institutions and processes by which the interests of various stakeholders, especially the poor, are incorporated in policies and programmes to manage flood risks. Stakeholder participation may be explored to strengthen and widen the range of adaptive strategies accessible to the poor.

It seems increasingly accepted (although not consistently implemented) that disasters shouldn't be dealt with through humanitarian relief interventions alone. There is some evidence to support the argument that disaster management response in the city of Ilorin, just like in other areas in Nigeria, should shift away from this traditional response approach to focus increasingly on addressing the causes of vulnerability in order to mitigate the effects of disaster. However, the approach tends to address only the visible signs of vulnerability, such as poor access to services, and generally fails to make a deeper analysis based on the maintenance of sustainable livelihoods by vulnerable people. Vulnerability is seen as a physical problem which can be addressed mainly through technical solutions such as infrastructure development which may not even be provided at the appropriate time. However, this approach generally fails to take into account the views, capacities, knowledge and priorities of local people and is thus limited in effectiveness in truly reducing vulnerability. For all practical purposes, there are many lapses in the management of flooding in the city. Governance is not an issue yet. A summary account of flood risk management and governance issues in the two cities is presented in Table 4.

On the other hand, a major achievement of the City of Cape Town administration in the management of flood risk is that the percentage of flooded settlements has remained fairly stable in the past few years. As part of the City strategy to combat flood risk and other hazards in the informal settlements, there is now a decentralised management system whereby different departments are now charged with different aspects of managing flood risks in the informal settlements. Some of the departments in charge of flood risk management in the informal settlements include department of housing, sanitation, stormwater, basic services department etc.

Given the fact that many risks in the physically vulnerable settlements are strongly rooted in social and economic vulnerability, along with unstable sources of livelihood, closer cooperation and confidence between settlement residents and local authority representatives as well as other stakeholders can improve municipal service delivery, infrastructure development as well as strengthen local responsibility for recurrent risks. The City is currently addressing many of these issues within the context of governance of disaster risk and long term climate risk posed by climate change.

Table 4: Managing Flood Risk and long term Governance of Disaster Risk and Climate Change: A Comparison

	Cape Town	**Ilorin**
Weather Information	Cape Town weather data, CSAG	None at the city level
Response timing	Before and after vents response,	After event response
Response type	Preparedness, early warning, relief	Post disaster relief
Management structure	Disaster management Unit of the Department of Housing (informal settlements)	Kwara State Emergency Management Agency
Long term plan	Upgrading/relocation	None
Governance of disaster Risk (flooding)	Multiple sectors of administration at various levels, horizontal and vertical, stakeholders involvement	No evidence on ground
Long term climate risk governance	Multiple sectors of administration at various levels, horizontal and vertical, stakeholders involvement	No evidence on ground

Source: Author's analysis

9 Summary and Conclusion

The major problems promoting the vulnerability to flooding in the two cities as revealed in this study are physical vulnerability and socio-economic vulnerability. For example, some of the issues identified that contribute to the complexity of informal settlements in Cape Town include the physical form of the settlement, poverty and vulnerability, social problems within the settlement and rural-urban linkages. The physical layout of informal settlements is closely linked to social networks as well as economic activity and this contributes to the apparently chaotic layout of such settlements. This informality is magnified by the impermanent structure of dwellings and the low level of service provision. A great degree of social differentiation can also be identified within informal settlements, although the majority of inhabitants are unemployed or have very low household incomes.

The Ilorin study brings out the important issue of vulnerability, coping and adaptation to disasters caused by extreme weather events among the urban poor. It examined in some detail the strategies adopted by poor neighbourhoods as disasters impact on their livelihood systems and the sequence of responses which they employ over time as they struggle to cope. The study revealed that the indigenous coping mechanisms employed by the poor may become less effective as increasingly fragile livelihood systems struggle to withstand disaster shocks. Also, many of these long-term trends

are rendering indigenous coping strategies less and less effective and thus are increasing the vulnerability of the poor.

The Nigerian urban areas exhibit many characteristics associated with urban decay which makes them some of the most highly vulnerable cities in the world with frequent negative impacts of environmental emergencies and extreme weather events. Without major changes in the ways that governments at various levels work in urban areas these impacts will rise. Three initial lessons which were summarized in the study by Mehrotra, Claudia, Natenzon, Omojola, Folorunsho, Rosenzweig and Rosenzweig (2009) that included Lagos are very relevant for the Nigerian situation. First, a multidimensional approach to risk assessment is a prerequisite to effective urban development programmes that incorporate climate change responses. Second, mismatches between needs and responses are occurring with regard to who should mitigate, how much to adapt, and why. Cities need climate change risk assessments in order to decide for themselves what the right mix between mitigation and adaptation measures will be. Third, the vertically and horizontally fragmented structure of urban governance is as much an opportunity as an obstacle for introducing responses to climate change.

The lessons learnt from the South African study is expected to be useful in designing appropriate institutional interventions capable of transiting victims from being painful victims to developing adaptive capacity to live with recurring floods in Nigeria. Most studies indicate, with sufficient evidence, that climate will continue to change with far reaching implications on the environment and human livelihood (Olorunfemi, 2010). Strategies to reduce vulnerability should be rooted in vulnerability analysis and greater understanding of both household-level and macro response options that are available to decrease the poor's exposure to climate risk. Increasing the response-capability of Nigeria will require information on seasonal forecast to enable the preparedness to climate variability as well as longer term climate prediction data to ensure that strategies to reduce vulnerability also reflect the underlying longer-term climate trends.

The rationale for integrating adaptation into development strategies and practices into urban management in Nigeria is stressed by the fact that many interventions required to increase resilience to climatic changes generally benefit development objectives. Adaptation requires the development of human capital, strengthening of institutional systems, and sound management of public finances and natural resources. Such processes build the resilience of countries, communities, and households to all shocks and stresses, including climate variability and change, and are good development practices in them. Adaptations are successful if they reduce the vulnerability of poor communities and poor people to existing climate variability, while also building in the potential to anticipate and react to further changes in climate in the future. Adaptation to climate change requires local knowledge, competence and capacity within local governments. It needs households and community organizations with the knowledge and capacity to act. It also requires a willingness among local governments to work with lower-income groups. All things considered, the long-term effects of disasters seriously affect the country's prospects for development. This calls into question at least two aspects related to a country's development strategy: first, an understanding that resources earmarked for preventing and mitigating the impact of natural

phenomena are a very high-yield investment, both in economic, social and political terms in line with long-term growth.

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Appendix I

Yearly Corporate Winter Readiness Programme

Plan Component	Key Activities	Responsible City Directorate/External Body	Lead Agent	Target completion Date	Comments
Programme management	Project Management	Service delivery integration	Development services	End Winter	Ensure integrated delivery of programme by the various line functions to ensure a reasonable level of preparation
Informal settlements	Warn residents within designated "high" and "Above Average" flood risk settlements about the possibility of flooding and encourage relocation/raising dwellings	Housing	Informal settlements	End April 2008	Good practise in terms of the regulations attached to the disaster management act
	Ensure no further encroachment into high flood hazard areas such as stormwater ponds, watercourse	Housing/safety and security	Informal settlements	On-going	Crucial to prevent more people placing themselves at risk
	Updating and review of upgrade priorities contained in the Framework for Informal settlement Upgrading Master Plan	Service delivery integration/transport, roads and stormwater	Development services	End may 2008	Ensure flood risk is more adequately considered in the incremental phased upgrading approach for informal settlements
	Priority infrastructure interventions	Housing/service delivery integration/transport, roads and stormwater	Informal settlements	June 2009	In most cases filling of low lying ares (subject to access) appears to be the most feasible solution, temporary relocation of dwellings is required
Stormwater and river cleaning	Metro wide proactive cleaning programme	Transport, roads and stormwater	Roads and stormwater	End winter	Undertaken primarily by external service providers under management of the eight roads and stormwater operational districts.
	Solid waste areas cleaning	Utility services	Solid waste	On-going	Ensure integration with R&S cleaning programmes (particularly intake cleaning/channels in informal settlements) to prevent ingress of litter and other solids into stormwater

					systems
	Regular inspection and monitoring of critical stormwater systems	Transport, roads and stormwater	Roads and stormwater	End winter	Focused mainly in and around informal settlements and other high flood hazards areas (viz. stormwater, ponds, etc)
Community assistance and flood response	Public call centres	Utility services and corporate services	Disaster risk management	On-going	Ensure complaints and requests for assistance are conveyed to the correct service
	Flood incident response	Transport, roads and stormwater, human settlements, safety and security	Incident dependant	On-going	Disaster risk management to coordinate incident response within informal settlements given the frequent request for humanitarian and social assistant and relief
	General mutual assistance agreements	All Cape peninsula national park	All	May 2008	Emergency unblocking of drains, traffic deviations, debris removal, health advice, additional vehicles and plants etc
	Public health and safety advice	City health	City health	End winter	Health directorate to render primary health care service including environmental health education
	Services interruptions	All services	All services	End winter	To ensure emergency and standby service, in the likelihood of service interruptions and to prepare emergency contingency plans in order to minimise the impact of service to communities
General communication and awareness	Community capacity building	Safety and security, human settlements	Disaster risk management	May/June 2008	Brochures/tips/workshop, education
	Pre-emptive media briefings	Corporate services	Communication	May/June 2008	Publicise City's readiness programme
	Information collation and reporting	Transport, roads and stormwater, safety and security	Roads and stormwater, disaster risk management	End winter	Includes dissemination of weather warnings, regular flood incident reports etc
	Regular media releases and public advisory	Corporate services	Communication	End winter	Weather dependent
Major flooding and storms plan	Update and improve 2007 plan	All directorates, NGOs, provincial and national government	Disaster risk management	April 2008	Plans include provisions for humanitarian and social relief, policing, safety, security, law enforcement, rescue and emergency services as well as post disaster assessments as per legislative requirements

Appendix II

Community Participation in Flood Risk Reduction and Management: Useful Participatory Risk assessment tools

Three major assessment tools were suggested by Holloway et al (2008) to help manage and reduce the risk of flooding in the informal settlements

Hazard mapping

Hazard mapping helps establish the sits and specific nature of flood risk. However, as flooding is more likely to be seasonal associated with the wet winter months, flood risks may not be as obvious if the community risk assessment takes place in summer. In other words, CRA should be done during the winter.

Hazard mapping for flood risk

Pointers for hazard mapping	Questions to ask
Always gather information on sanitation and the management of solid waste. Even minor flooding can create health problems where water is contaminated with raw sewerage or by the chemicals released by decomposing solid waste. **Differentiate between flooding of dwellings due to inadequate drainage, and flooding due to leaky roofs**	• Where are the main access roads, rivers, mountains, wetlands etc located? • What places or areas in the settlement are most at risk of flooding? Why? • Where are the main drains or drainage ditches? • Where are the toilets that residents use? • Where are the taps that the communities use? • Who is most affected by flooding? Why? • What infrastructure and resources are most likely to be damaged or affected by flooding? • Is it possible to identify and map examples of positive actions taken to reduce the risk of flooding?

Table : Seasonal calendar of flood risk

Pointers for seasonal calendars	Questions to ask
A seasonal calendar shows the month when flooding occurs and when it is most severe **Certain illnesses, such as influenza, chest infections, rashes and diarrhoea are often associated with flooding**	• During which months do you or your children get sick most often? What kinds of illnesses do you get? • In which months is flooding most severe? Why? • When are the effects of flooding least severe? • Why?

Transect walk

A transect walk can help identify measures taken by the community to reduce the likelihood of flooding. Community members may not mention what measures they have taken during a mapping exercise, as they often take these actions for granted.

Flood risk reduction measures that residents can take
• **Raising structures above ground level using sand, wood or silts** • **Using cement rather than wooden or sand floors** • **Using metal sheeting or sandbags to divert or hold back water** • **Digging channels to draw water away from dwellings** • **Building away from bodies of water or roads**

Risk management capacities matrix

This tool helps to explain why some people adopt mitigation measures and others do not. This is useful for later development of a local flood risk management strategy.

Pointers for risk management capacities matrix	Questions to ask
• **This matrix will help you to identify who is taking steps to reduce risk, and the effectiveness of these steps** • **It also helps identify barriers that limit local risk reduction measures**	• What actions are being taken to reduce flood risks? • Who uses them? • When are they used? • How effective are they? • Why do some people not use them? • What can make them more effective/increase their use?