

The Environment & Risk Reduction: Focus on Urban Risk

Draft Input Paper Prepared for the IUDF Panel of Experts

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Summary

Urban areas are increasingly recognised as hotspots of disaster risk. They concentrate people, buildings and infrastructure, increasing exposure to hazards such as floods, fires, droughts or disease. Rapid urbanisation puts pressure on infrastructure and frequently outpaces both urban planning and service delivery, amplifying the potential for hazard events to become disasters. Where they occur, they are tremendously costly. Disasters result in human losses, destroy livelihoods and infrastructure and erode developmental gains, undermining fundamentally sustainable urban development. The stakes are especially high in light of anticipated global environmental change, which stands to extend and exacerbate urban risks.

This paper examines the nature of the urban risk environment in South Africa, the relevance of risk to urban development and the challenges of integrating risk issues into the urban agenda. It shows that urban populations experience a range of natural and human-induced threats, from poor sanitation and disease to dwelling fires, seasonal flooding and crime and violence. They also face a range of emerging threats, including communal violence and unrest, water scarcity, acid mine drainage and food insecurity, with inevitable GEC likely to extend and compound drive many of these problems. As elsewhere, it argues that these are likely to reduce and erode developmental gains.

Given the prospect of more and more severe losses, there is an urgent need to reduce vulnerability in South Africa's urban areas and build their resilience to both disasters and the implications of GEC. Overall, the findings highlight four broad conclusions and potential action points in developing an overarching urban development framework:

- **It is essential to de-silo risk reduction and climate change.** Reducing urban risk is critical to achieving broader developmental objectives in urban areas. Proactive action to address risk is not an ad-on; it is integral to creating sustainable urban growth. It is also important to address both disaster risk reduction and climate change adaptation as part of a single, interconnected urban risk domain.
- **Addressing urban risk requires a strong emphasis on prevention.** Although it is necessary to ensure that cities and towns plan for, manage and respond effectively disasters and emergency events, both international and domestic good practice emphasises proactive risk reduction to mitigate the likelihood of disasters. It is often difficult to harness commitment and funding for potential outcomes – the disasters that do not happen – but the costs of failing to do so are likely to be very high.
- **Urban risk concerns must be incorporated into short, medium and long-term planning across sectors.** Development must be sensitive to disaster and climate risks, while strategic risk management needs to be a development priority. Ameliorating institutional and financial constraints, particularly visibility and authority of risk reduction institutions and response-oriented funding arrangements, could help to improve the prospects for effective risk reduction.

- **It is vital to draw out and promote the linkages between risk reduction and sectoral concerns.** Role-players from other sectors frequently have limited understanding of the urban risk environment, or their role in reducing risk. It is essential to begin making these connections and initiating, even if only conceptually the relevance and importance risk reduction to the larger urban picture.

1. Introduction

Disasters stand to fundamentally undermine development in South Africa. The National Development Plan (NDP) aims to reduce poverty and inequality, grow the economy and enhance government's capacity to develop and transform society. Without actions to mitigate their effects, however, hazards such as droughts, floods, storms and fires cost lives and livelihoods, destroy economic and social infrastructure and cause environmental damage (UNISDR, 2002) - all of which threaten South Africa's developmental prospects. Disaster losses also impact the private sector and can discourage both local and foreign investment.

This is particularly so in urban areas. Urbanisation frequently serves to drive and amplify the risk of disasters. Urban areas concentrate people, homes and other buildings and infrastructure. This increases exposure to hazards such as floods, earthquakes, infectious diseases, crime, fires, and transport and industrial accidents. Urban sprawl extends settlements into ecologically fragile and risk prone areas, such as wetlands or slopes, while rapid population growth stresses available infrastructure, and frequently outpaces both urban planning and service delivery. Mark Pelling argues that cities are:

... hotspots of disaster risk. Risk 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) (2007:1).

GEC, and its sub-component climate change, adds another layer to the urban risk landscape. Environmental change is likely to exacerbate risk, while damage to infrastructure, livelihoods is likely to increase vulnerability to GEC. Vulnerability to disasters also signals underlying susceptibility to environmental change. This connection is increasingly recognised internationally. There is a growing acknowledgement that efforts to adapt to climate change must be aligned with disaster risk reduction objectives and strategies. The Intergovernmental Panel on Climate Change (IPCC), for instance, stresses the linkages, while in 2010 signatories to the United Nations Framework Convention on Climate Change (UNFCCC) agreed to the Cancún Adaptation Framework. This calls for "climate change-related disaster risk reduction strategies" (UNFCCC, 2010, cited in UNISDR, 2011).

This paper examines the urban risk environment in South Africa, the relevance of risk to the urban agenda and the challenges of integrating risk issues into the urban agenda. It explores the changing character of urban risk in South Africa and the core factors driving its accumulation. Drawing on international and domestic good practice, the paper locates South Africa's experience in global discussions on disaster and climate

change-related risk and its mitigation. The paper also discusses the degree to which risk issues are currently incorporated into sectoral planning and action, and the constraints to incorporating these into a more integrated, responsive approach to urban development. It begins by elaborating on the linkages between urban risk and development, as well as prevailing thinking on the conceptualisation and response to risk. It next discusses the urban risk landscape in South Africa and emerging issues that are likely to shape it in the future. It then examines the policy framework for urban risk reduction, and the factors currently impeding effective risk reduction. It concludes by making recommendations on strategic priorities for intervention.

2. Development, disaster and global environmental change

Key points:

- Disasters and development are intimately linked; inadequate or poorly managed or conceived development increases the risk of disasters while disasters undermine developmental gains
- GEC is likely to magnify the threat of disasters
- Addressing vulnerability to disasters and GEC protects development and allows progress in the face of hazards

The relationship between development and risk is complex and multi-dimensional. The impact of hazards is bound up with developmental concerns. Disasters triggered by natural hazards put development gains at risk, while poverty and other symptoms of underdevelopment drive risk. Hazards such as severe weather, extremes of rainfall or earthquakes are not innately damaging, but become so where there are people or communities vulnerable to their effects. As the UNISDR observes:

...a natural hazard event is not itself a disaster. But it may become so if a settlement is badly sited in a flood plain, or houses near a fault line are poorly constructed, or no warning system is in place. Disasters arise from the combination of hazard events and human vulnerability (no date,1).

Development also has the potential to increase the risk of disasters, particularly in urban areas. Economic growth may encourage in-migration and urban sprawl, for instance, which if poorly managed, can drive poverty and the expansion of settlements into unsafe areas. However, the development-disaster nexus is complex and often difficult to predict. The United Nations Office on Disaster Reduction (UNISDR) notes that disaster losses are accelerating globally, with economic losses growing twice as fast as mortality. They observe:

The main driver of this trend is rapidly increasing exposure. As countries develop, and both economic conditions and governance improve, vulnerability decreases but not sufficiently rapidly to compensate for the increase in exposure, particularly in the case of very rapidly growing low-income and low- to middle-income

countries. When economic development stabilizes and slows down, the rate may decelerate and be overtaken by reductions in vulnerability, leading to a lowering of risk (2009:5).

Disasters erode and destroy development gains, incurring human and financial losses at all scales. Thailand provides an example of the potential macro-economic implications of disasters. Flooding in Bangkok in late 2011 is estimated to have shrunk Gross Domestic Product (GDP) by 1.7%, with the Federation of Thai Industries estimating losses of US\$ 6.2 billion (Setboonsarng, 2011) – rolling back years of economic growth. It is calculated that 10,000 factories were damaged and 660,000 jobs lost. The floods also ruined farmland (Gupta, 2011).

GEC, and its sub-component climate change, are likely to increase the risk of disasters (see Box 1). The UNISDR (2009) argues that even small increases in hazard levels due to GEC will magnify substantially disaster risk. The magnitude of the impacts will ultimately depend the steps taken globally to mitigate and adapt to its effects, but GEC is likely to result in changing temperatures, more variable less predictable weather and rising sea levels. However, the UNISDR argues for caution in representing these effects. It notes:

The contemporary tendency to characterise all weather-related disasters as manifestations of climate change underplays the role of the underlying risk drivers, and may point policy and planning in the wrong direction (UNISDR, 2011:11).

Reducing the risk of disasters, and by extension GEC, helps to protect development investments and enables societies to accumulate wealth in spite of hazards (UNISDR, 2009). In this respect, the UNISDR argues that disaster-proofing development is one of the most cost-effective investments in poverty reduction that a country can make, noting that “investments in disaster risk reduction can help to protect both the population and the national coffers from such losses” (UNISDR, no date:4). As the UNISDR observes:

Time and again, the poor fall victim to, or see schools, hospitals, homes and whole livelihoods destroyed by floods, earthquakes or other natural hazards. Yet this reversal and destruction of development gains is mostly avoidable. Wise investments in disaster risk reduction can largely protect both the population and the national coffers from such losses (UNISDR, no date:4).

Box 1: Understanding GEC

GEC is a broader concept than Climate Change. It comprises two components:

- Slow-onset changes such as increasing temperatures, shifting rainfall patterns and sea-level rise
- The increasing frequency and severity of extreme events such as droughts, floods and tornadoes (Simon, 2010)

Climate change constitutes a sub-component of GEC, in that it refers specifically to long-term shifts in weather patterns. Climate change is defined as an ongoing trend of changes in the earth's general weather conditions as a result of an average rise in the temperature of the earth's surface, often referred to as global warming (Government of South Africa, 2011)

Parnell and colleagues (2007) argue that changing environmental conditions are likely to have a greater long-term impact on more people than climate change alone. These consequences include inundation of low-lying coastal zones, reduced water levels in catchment areas, desiccation and salinisation of the water table. Slower changes may also exacerbate a range of other dynamics, such as where coastal inundation reinforces pre-existing vulnerabilities like poor access to infrastructure and resources. They argue that it is:

...the interaction of these different components of GEC that poses the greatest hazard: increasingly frequent and severe extreme events on a trend of rising sea level and atmospheric temperatures in degraded environmental contexts aggravated by a range of socio-economic pressures (Parnell et al, 2007:359).

3. Counting the cost: The imperative of risk reduction as an urban agenda

Key points:

- Disasters are costly, both economically and in terms of human losses
- Looking just at economic costs, analysis of just eight severe weather events in one province alone between 2003 and 2008 resulted in losses to government and the private sector of R 2.5 billion
- Risk reduction may be expensive in the short-term, but the benefits substantially outweigh these costs in the long-term

Data from various sources illustrates the cost of disasters. Table 1 shows the ten countries affected most by natural disasters between 2000 – 2010. The table is based on data compiled by the Centre for Research on the Epidemiology of Disasters (CRED) for its International Disaster Database. South Africa appears as number 10 on the list, with an estimated 15.3 million people thought to have been affected by disasters. The economic cost of relief, response and recovery is estimated at just over US\$ 866 million (Kellett and Sparks, 2012). Figure 1 shows the costs of the top ten most serious disasters for South Africa alone over the last 20 years. It shows that these have cost over US\$1.5 billion. It is likely, however, that these figures represent only a portion of the costs incurred. The CRED data captures a very specific range of incidents. It includes only events where ten or more people are reported killed; a 100 or more people need to be evacuated, provided with humanitarian assistance or otherwise affected; or the authorities declare an emergency or call for international assistance.

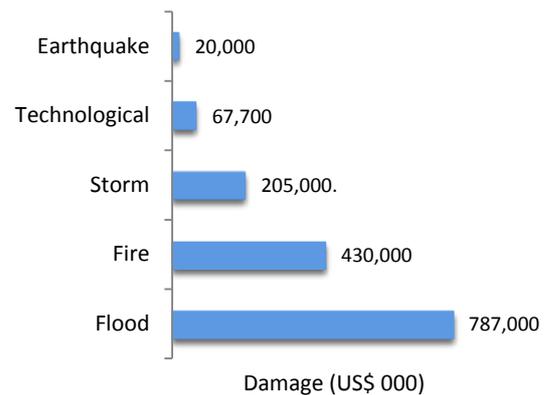
The costs of climate change

The Stern Review, a leading international assessment of the effects of climate change on the global economy, estimates that damages from unmitigated climate change could range between 5% and 20% of global Gross Domestic Product (GDP) annually by 2100. It argues that without effective adaptation responses, damages will threaten and even reverse many development gains made in South Africa (Government of South Africa, 2011)

Country	No. of people affected (millions)	No. of disasters	Economic costs (US\$bn)
China	1321.4	311	205 654 128
India	602.9	204	25 88 285
Bangladesh	73.2	90	5 884 000
Philippines	52.9	160	2 543 118
Thailand	43.6	57	2 433 613
Pakistan	32.8	74	17 134 648
Ethiopia	29.2	48	9 400
Vietnam	21.8	89	5 759 905
United States	20.7	257	353 414 290
South Africa	15.3	42	866 305

Source: EMDAT CRED, cited in Kellett and Sparks (2012).

Table 1: Financial costs of disasters (top 10 countries affected by disasters, 2000-2010)



Source: EMDAT CRED.

Figure 1: Damage top 10 most costly disasters (1983 – 2013) in South Africa

Analysis by the Disaster Mitigation for Sustainable Livelihoods Programme (DiMP) provides an indication of the cumulative costs of events not reflected in the CRED database. Table 2 summarises the direct damage losses incurred by national and provincial departments, municipalities and the private sector over the course of eight severe weather events that occurred in the Western Cape between 2003–2008. The first column shows the total, absolute losses and the second the losses adjusted for inflation, standardised to 2005 values (see Appendix 1 for full tables).¹ It indicates that the total economic costs for the eight events incurred an absolute cost of just over R 2.9 billion, which when adjusted for inflation, amounts to losses of a little over R 2.5 billion.

Figure 2 shows the proportion of the total, adjusted losses incurred by the national and provincial government, municipalities, parastatals and the private sector, comprising mostly payments by insurance companies. The bulk of the costs were incurred by the provincial government, and to a lesser extent, municipalities. National departments and parastatals sustained direct damage losses exceeding R 221 million. The South African National Roads Agency Limited (SANRAL) alone incurred losses of R 84 million. Provincial departments reported direct damage costs of R1.8 billion for these storms and associated floods, with the bulk sustained by the departments of agriculture, provincial roads and housing. Damage costs reported by local and district municipalities for the same events totalled R 513 million. The majority of municipal costs stemmed from flood-damaged roads and storm-water infrastructure (DiMP, 2010).

Figure 3 graphs the losses incurred over the course of the eight events. It illustrates a rising loss trajectory for severe storms, even when reported damage costs are adjusted for inflation. Although some storms were more damaging than others, overall the data suggests that losses are becoming more common and severe.

¹ In order to control for inflationary pressures, all costs were converted to 2005 values by applying inflation adjustment factors derived from national accounting data published in the Quarterly Bulletin of the South African Reserve Bank (<http://www.reservebank.co.za>). In consultation with Provincial Treasury, a Gross Domestic Product (GDP) deflator computed from the real/nominal GDP was applied to damage costs reported for each severe weather event. See the Risk and Development Annual Review (DiMP, 2010) for more information.

Event	Loss Per Event (Rand)	
	Absolute	Adjusted to Inflation of 2005
March 2003	212,422,663.00	238,253,258.82
December 2004	54,883,115.00	57,868,756.46
April 2005	8,850,561.37	8,850,561.37
August 2006	510,469,497.56	479,177,717.36
June 2007	128,302,851.90	111,328,384.59
November 2007	957,565,816.61	830,879,859.07
July 2008	71,688,510.71	56,956,521.76
November 2008	995,957,439.14	791,288,185.40
Total	2,940,140,455.29	2,574,603,244.83

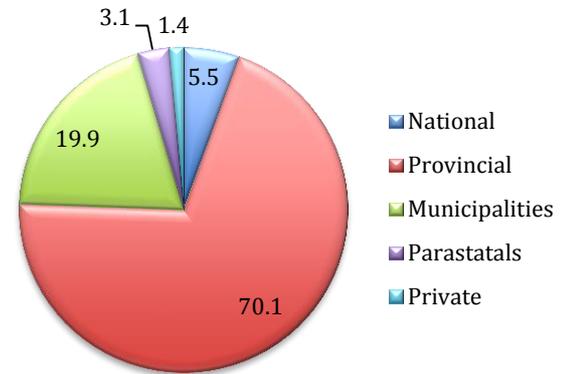


Table 2: Direct economic losses due to cut-off lows

Figure 2: Proportion of costs by actor (adjusted)

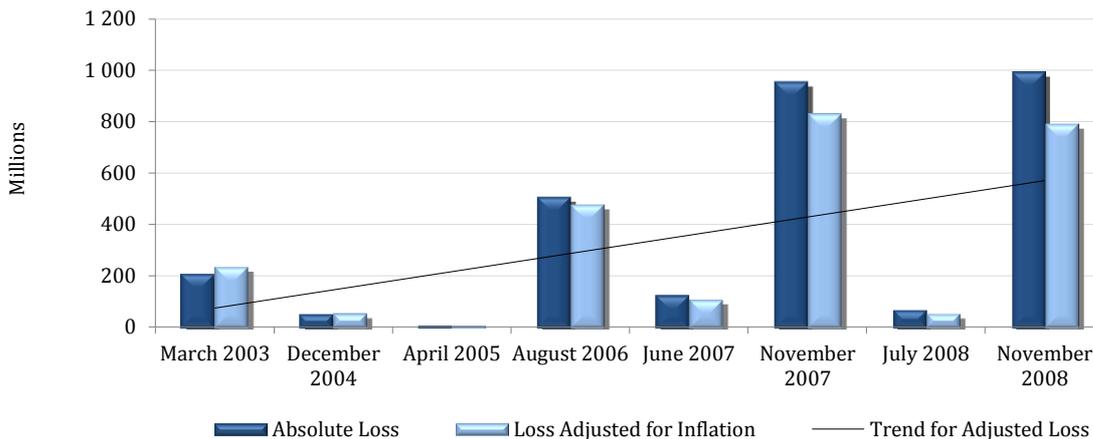


Figure 3: Trend of escalating losses between 2003 and 2008

Taken together, the analysis in this section illustrates the importance of risk reduction to the urban agenda. There are costly developmental consequences to reacting to disasters ‘after the fact’, rather than managing them proactively and strategically (DiMP, 2010). It is simply too costly not to invest in risk reduction. As noted by the UNISDR’s 2009 Global Assessment Report (GAR):

...investments in risk reduction produce benefits in terms of reduced future losses and avoided reconstruction that considerably outweigh the costs, even without accounting for indirect benefits to health, human development and productivity...it costs far less to avoid the configuration of risk in the first place than to correct it once it exists, or to compensate for it once it is realized (GAR, 2009:16).

4. Conceptualising and responding to risk and disasters

Key points:

- It is increasingly recognised that hazards such as floods or fires are not inherently damaging, but become so where people and infrastructure are vulnerable to their effects. Best practice emphasises not only responding to disasters but also proactively reducing vulnerability
- It is also acknowledged that ‘disasters’ span not just catastrophic incidents but also less visible ‘small’ and ‘everyday’ incidents that affect primarily the poor. Many now distinguish between rare *intensive risks* such as earthquakes or tsunamis and *extensive risks* resulting from more common, but smaller and more widespread events such as mudslides, dwelling fires and low-intensity flooding
- Extensive risks often signal an underlying potential for more intensive disasters. Responding to these early warnings and addressing the underlying vulnerabilities can help to prevent escalation to more severe events
- Vulnerability to disasters and GEC are rooted in largely the same issues, and should be addressed together

Harnessing the benefits of development and reducing risk requires the integration of both disaster mitigation and climate change into the overall development framework. Risk and its management must become part of the development process (RCC, 2010). Although disaster and climate concerns are often presented and discussed as separate issues, they are rooted in largely the same dynamics and should be addressed in concert. As noted in a recent report on integrating disaster risk reduction and climate change “whilst there are some political and physical distinctions between the scope of each field, there is a key area of similarity – a focus on vulnerability reduction and the enhancement of resilience”. Managing development on coastal shores, for instance, reduces both the risk of flooding due to storm surges and helps to mitigate the effects of rising sea levels. The authors argue that a common approach is essential, as “the current disconnected ways of working have thus far failed to make significant headway towards vulnerability reduction” (Gero et al, 2010:8).

This focus on vulnerability and the related concept of resilience recognises that risk has an important societal component. Although discussions on both disasters and the climate change often focus on the physical parameters hazards such as their frequency, duration and magnitude, this approach sees these as only part of the problem. Risk comprises both the physical threat and pre-existing vulnerability to its effects. Vulnerability is often rooted in poverty, or poorly managed and conceived development activities. Reducing risk thus requires tackling the development challenges that shape

Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009)

Vulnerability: refers to a propensity or susceptibility to suffer loss and is associated with a range of physical, social, political, economic, cultural and institutional characteristics. For example, unsafe, poorly built housing or infrastructure increase people’s physical vulnerability to hazards (UNISDR, 2009).

Resilience: is the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner (UNISDR 2011).

the accumulation of vulnerability. It is also necessary to build people or systems' capacity to cope with hazards.

This in turn has influenced thinking on how best to tackle risk. The traditional approach to disaster management sees disasters as unavoidable and the purpose of intervention to assist the affected, but best practice increasingly emphasises prevention. It recognises that while it is necessary to prepare for disasters and ensure that we are able to respond effectively, it is also critically important to address the dynamics that prefigure disasters. This shifts the emphasis from disaster management, or the organisation, management of resources and responsibilities for dealing with emergencies (Holloway, 2003), to disaster risk management, which encompasses both response and risk reduction.

There has been equally important evolution in disasters are conceptualised. Discussions on disasters often emphasise human and physical losses. The UNISDR, for instance, defines a disaster as:

A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (2009:9).

Commentators who believe that cumulatively, smaller 'everyday' events cause comparable, if not greater, losses increasingly question this approach, arguing that these should be included in any definition of a disaster. They maintain that it is the "risks of daily life" (Wisner 1993, cited in Pelling and Wisner 2009:38) that pose the greatest threat to poor communities in many parts of the developing world, particularly in urban areas (for example, Dodman et al, 2009; Wisner and Pelling, 2009b; Pelling and Satterthwaite, 2007; Morrissey and Taylor, 2006; Bull Kamanga et al, 2003; Pelling, 2003). As David Sanderson observes:

For millions of poor urban dwellers, managing disaster is an everyday occurrence, less noticed by outsiders but just as insidious. This may include the fires that wipe out squatter neighbourhoods, the devastation brought by HIV, the cumulative health problems resulting from poorly ventilated shelter or the long-term effects on children of pollution. Such less noticeable disasters erode livelihoods and cost lives (2000:95).

In this view, there exists a continuum of risk, particularly in urban areas. Disasters span acute but infrequent events that have a large impact on cities' infrastructure and kill, or injure large numbers of people, to far more common events that have a low impact on cities overall, but serious implications for those affected (Figure 4). The injury of even one person in a low-income household, for example, can have dire consequences if it reduces the money available to meet its members' basic needs (Dodman et al, 2009). This is particularly so because events are largely invisible; while the costs of conventional disasters are born primarily by governments, and receive the most political and policy attention, it is usually the poor who carry the social and economic costs of 'small' and 'everyday' disasters.

Figure 4: Comparing disasters, 'small disasters' and everyday risk in urban areas

Nature of event	Disaster	Small disasters	Everyday risk
Frequency	Infrequent	Frequent	Everyday
Scale	Large: 10+ injured, 100+ seriously injured	3-9 people killed, 10 or more injured	1-2 people killed, 1-9 injured
Impact	Can be catastrophic; low overall contribution to illness, premature death & injury	Significant; underestimated	Main cause of illness, premature death & injury
An integrative framework	Large impact for city	Continuum of risk	Small impact for city
	Low frequency		High frequency

Source: Bull-Kamanga et al, 2003

The UNISDR and others now distinguish between intensive and extensive risk. Intensive risk arises from rare, acute but potentially destructive events such as earthquakes or tsunamis, while extensive risks comprise the potential for harm resulting from more common and widespread events such as mudslides, fires and low-intensity flooding - small disasters in the risk continuum. Extensive risks are driven by poverty and include poor sanitation, pollution disease and overcrowding, crime, unemployment and underemployment (UNISDR, 2009).

These linkages are illustrated in Figure 5, below. Risk is driven by both global and local factors. Global factors such as economic development, urbanisation, climate change and international governance condition poverty and disaster risk at the local level. Risk drivers such as weak urban risk governance, vulnerable livelihoods and damaged ecosystems serve to translate poverty and every day risks, such as traffic accidents, poor sanitation or unfit housing into extensive risks that affect larger numbers of people, particularly the poor. Ongoing exposure to disease pathogens, for instance, may incrementally lower people's thresholds of physical resilience (Kasperson et al, cited in Pelling, 2003). Similarly, frequent small-scale disasters may reduce people's willingness to prepare for major hazards, as risk becomes an accepted and normalised feature of life (Blaikie et al, 1994). Thus, although it is often the short-term impacts of disasters, such as deaths or direct economic losses that receive the most attention, both extensive and intensive risks serve to increase poverty and undermine development in the long and short term (UNISDR, 2009). The UNISDR notes:

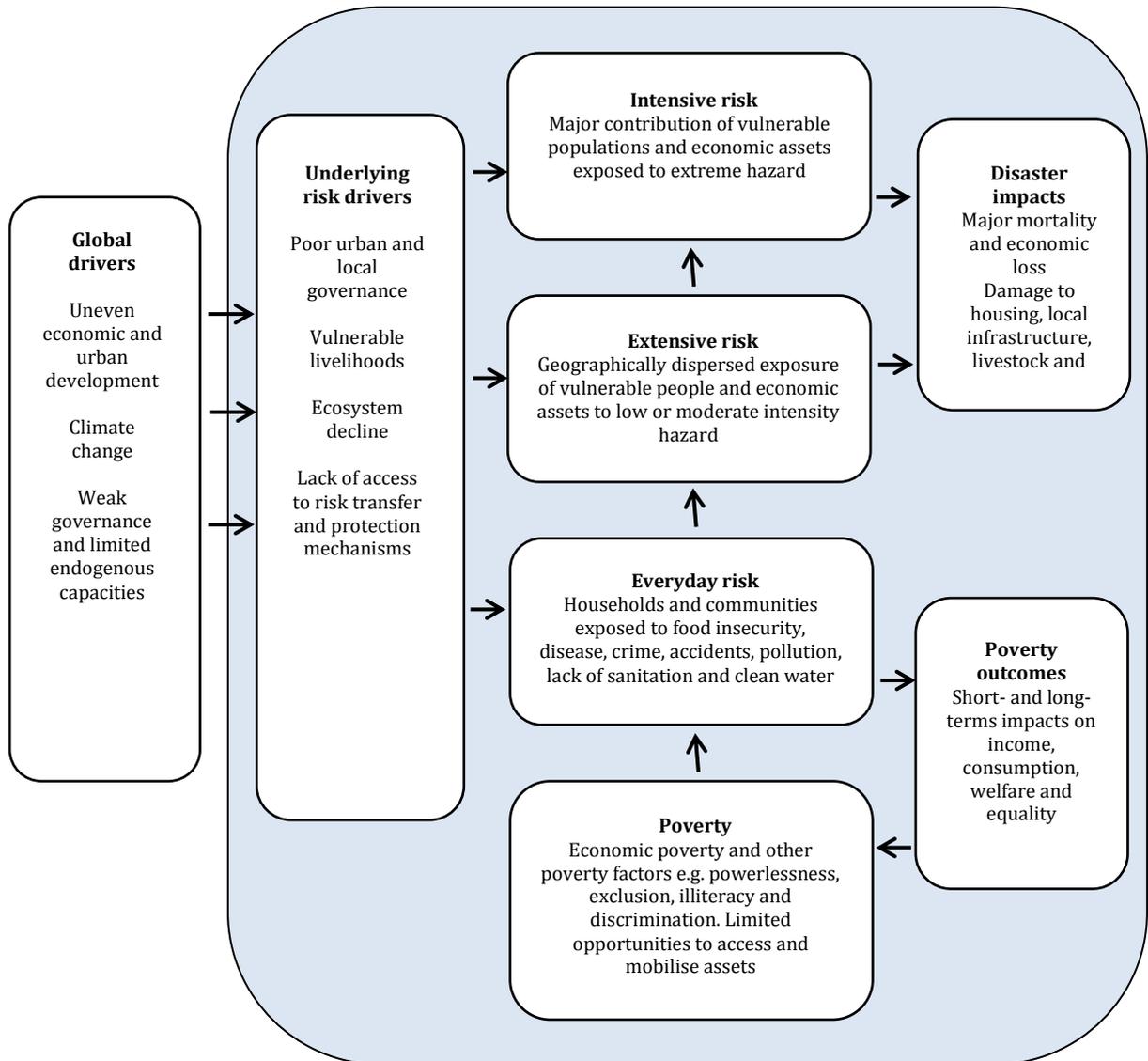
Extensive risk: the widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts.

Intensive risk: risk associated with the exposure of large concentrations of people and economic activities to intense hazard events. Can lead to potentially catastrophic disaster impacts involving high mortality and asset loss (UNISDR, 2009)

While the losses associated with intensive risk often overwhelm household, local and even national coping capacities in poor countries, the more frequent and low-intensity losses associated with extensive

risk undermine resilience over time. Both kinds of risk, therefore, have a critical influence (UNISDR, 2009).

Figure 5: Risk drivers and poverty outcomes



Source: UNISDR, 2013

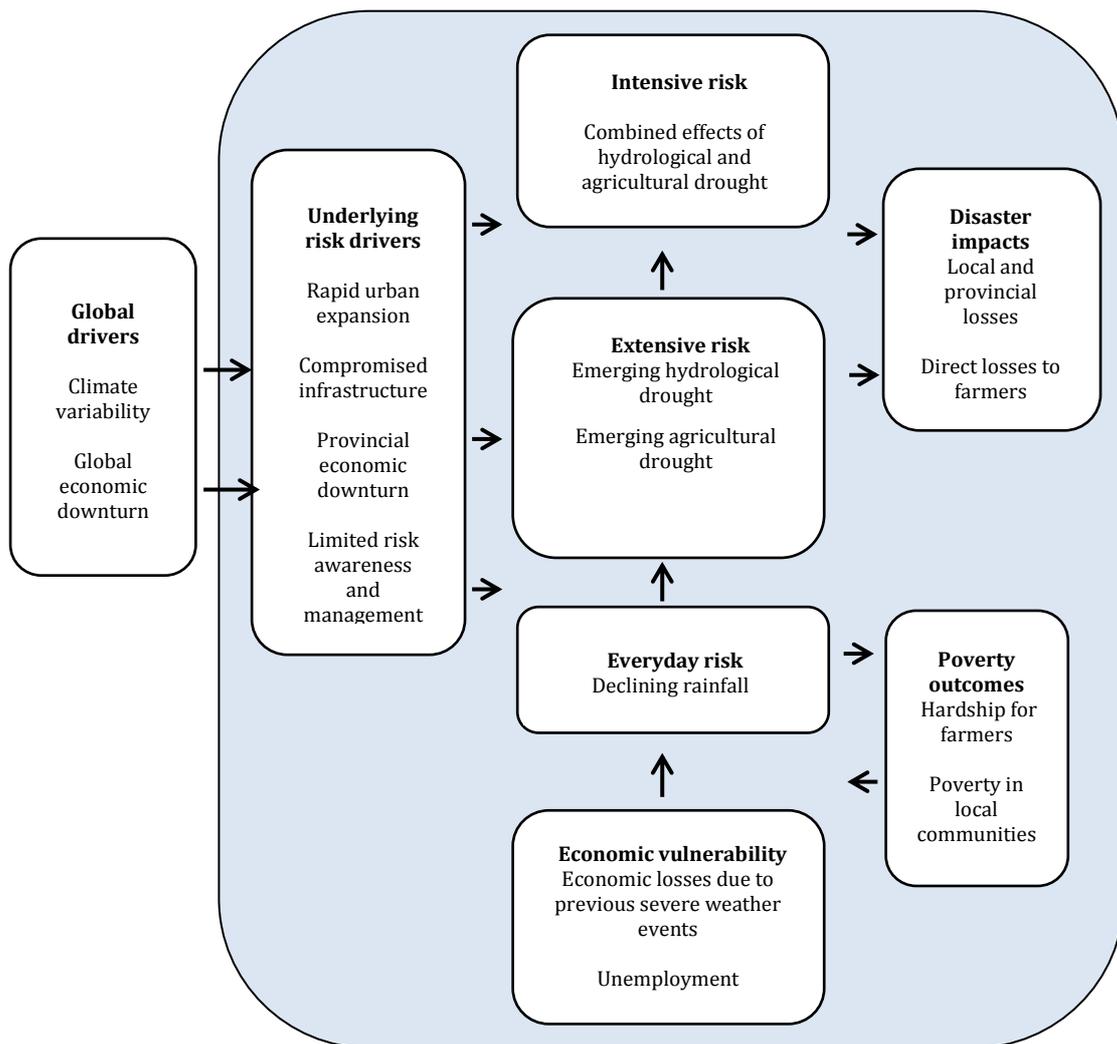
This progression of vulnerability is illustrated by the 2009/2011 drought in the Western Cape. Between 2009-2011 municipalities located in the Eden and Central Karoo Districts of the Western Cape experienced varying degrees of drought, with disasters declared in both locations. Urban water supplies reached critically low levels in many areas, including George, Knysna, Mossel Bay and Beaufort West. A post-event assessment carried out by DiMP found that these shortages were partly the result of decreased rainfall, but were also driven by a series of concatenating risk drivers that progressively served to amplify the effects of the meteorological conditions (DiMP, 2012).

This illustrated in Figure 6, below. The underlying risks driving the drought included rapid urban expansion (see Box 2), damage to infrastructure, particularly farm dams caused by a flooding in 2007 (one of the storms examined in the previous section), and governance failures. The drought also occurred within the context increasing climate variability worldwide, and most significantly, the global economic slowdown. Provincial growth rates dropped from 6.4% in 2007 to 4.3% in 2008 and 0% in 2009 (Western Cape Provincial Treasury, 2010, cited in DiMP et al, 2012). Growth rates fell at comparable rates in both Eden and the Central Karoo. These declines resulted in job losses and decreased income for farmers. They also limited the resources available to the province to help mitigate the effects of less rain on farmers, communities and affected municipalities. These dynamics were exacerbated by a lack of drought monitoring or systematic drought risk management planning that could have allowed for early signal detection and action.

The confluence of these factors increased vulnerability to escalating drought conditions. Data from the South African Weather Service (SAWS) shows that the areas were already moderately dry in 2008, with diminished rainfall in 2009 leading to an agricultural drought where crops and vegetation die. This agricultural drought was compounded by limited storage capacity in many farm dams, which had been damaged during floods the previous year. However, there was a lag between diminished rainfall levels and the emergence of the agricultural drought, suggesting that proactive action at the first signs of the impending water shortages could have prevented the emergence of more severe drought conditions. The continuing meteorological drought, alongside growing water demand and increasing agricultural extraction as dams dried up, led to a hydrological drought where reduced water in rivers, groundwater and reservoirs affected non-agricultural users in cities and towns. Again, there was a lag in these effects, with the hydrological drought signaling an emerging crisis, which could have been mitigated to at least some degree at this 'extensive' stage – before the drought emerged as an intensive disaster.

The drought ultimately incurred enormous losses for the authorities and those affected. The response cost a little over R 572 million. The bulk of this money (R 495 million) was spent on improving urban water supply infrastructure, while R 76.9 million was allocated to agricultural relief. Overall, the National Treasury provided R 287.2 million while municipalities co-funded an estimated R 89.3 million. PetroSA spent a further R 92.5 million. Smaller amounts from the Regional Bulk Infrastructure and Municipal Infrastructure Grants totalled R 24.2m, while the Eden District Municipality contributed R 1.8 m (DiMP, 2012). Farmers also incurred huge losses, and the drought resulted in a spike in unemployment. Statistics South Africa (StatsSA) estimates that 51 000 people lost agriculture-related jobs, a figure that does not capture livelihood losses amongst those indirectly dependent on agricultural sector.

Figure 6: Linking everyday, extensive and intensive drought risk



This example underscores the importance of risk reduction and the direct and indirect costs of unmanaged risk. It illustrates the interconnectedness of everyday, extensive and intensive events. It also highlights points of intervention; addressing and building resilience to everyday and extensive threats helps to prevent the escalation of risk and mitigate the effects of intensive risks. In this respect, everyday and extensive risks provides an early warning of potentially larger scale, and from a governmental perspective more costly, outcomes.

Box 2: Drought, development and water management in the Western Cape

The post-event assessment showed that the drought was driven by human action. The water shortages were partly the result of decreased rainfall, but the acute scarcity experienced in Beaufort West and the coastal towns were also due to a concatenating range of planning and management failures.

The research (DiMP, 2012) showed that the scarcity of water was due in large part to increased local demand, which progressively escalated the risk of a wide-spread water shortages. These increasing demands were the product of two simultaneous processes:

- **Rapid urban expansion.** Mossel Bay, for instance, experienced a 64.8% growth in population between

2001 and 2007. This was attributed to rapid increase in retirement and tourism developments, which not only stimulated the real estate industry but resulted in a rapid influx of people seeking employment opportunities. George saw similar growth with the number of tourist-beds rising by 4,750 between 2004 and 2006 (Urban-Econ: George, 2009, citing in DiMP, 2010).

- **Increasing service provision.** Steady growth in service delivery to both informal settlements and new low-cost housing developments added to these pressures. The research showed that the roll-out of service provision also had the unintended consequence of promoting further in-migration from under-served areas.

The study showed that water resource development failed to keep pace with rising demand. Rapidly expanding user requirements were accompanied neither by rigorous water demand management, systematic investment in water infrastructure, nor the technical capacity required to manage water supplies sustainably. The roll-out of basic services was also not accompanied by the necessary upgrading of municipal water supply and monitoring infrastructure and services.

The study also identified other weaknesses, particularly under-investment in Integrated Water Resource Management (IWRM) and capacity constraints. Rather than using a range of water sources, including groundwater supplies, for instance, municipalities relied heavily on surface water sources. Many also lacked skilled technical personnel and capacity to manage water infrastructure and services, upgrade water infrastructure, or access to alternative water conservation technologies. These dynamics are not unique to the case study areas. The authors note that effective IWRM is currently hampered by a lack of adequate capacity as well as a lack of technical skills at all scales, from national departments through to local municipalities (DWA, 2011).

These risks were exacerbated by a lack of systematic drought risk management planning. There was no uniform definition of 'drought', nor were there accompanying indicators that would have allowed for early signal detection and possible early action. There were also no indicator-linked contingency plans in place which could have triggered an earlier, more pre-emptive response.

Source: DiMP (2012).

5. The risk environment in South Africa

Key points:

- South Africa faces numerous risks. Urban populations experience many chronic, extensive risks associated with marginal living conditions and poor service delivery, from poor sanitation and disease to dwelling fires, seasonal flooding and crime and violence
- Research suggests that urban populations will increasingly face a range of emerging risks including communal violence and unrest, water scarcity, acid mine drainage and food insecurity, with inevitable GEC likely to drive and exacerbate many problems
- Given the prospect of increasing risk, there is an urgent need to reduce the vulnerability and increase the resilience of South African towns and cities. It is not enough simply to respond to and manage disasters, South Africa must proactively seek to address risk
- This requires the integration of risk reduction into planning processes, including land-use planning and management, water resource management, infrastructural developments and building design and construction

South Africa experiences a range of potentially disaster-triggering everyday, extensive and intensive hazards. These include floods, droughts and dam failures, urban and rural fires, mining-induced earthquakes and sinkholes, epidemics, transportation accidents and industrial hazards such as the spillages of hazardous waste (IFRC, 2012). According to the data collected by CRED, South Africa has experienced over 65 natural and industrial disasters over the last 20 years (Table 3). Floods are by far the most common (23), followed by storms (19). South Africa has also seen several technological disasters, particularly transport-related events such as road, aircraft, rail and vessel accidents (107), as well as industrial accidents (13) and miscellaneous incidents, such as building collapses or fires (9).

These figures, however, underestimate the scope and prevalence of hazard events in South Africa. CRED only records data on events where ten or more people reported killed, 100 or more people need to be evacuated, provided with humanitarian assistance or otherwise affected; or states declare an emergency or call for international assistance. This conceals the diversity of the hazard landscape in South Africa, which experiences a far broader range of small and everyday hazards.

Table 3: Disasters in South Africa (1983 – 2013)

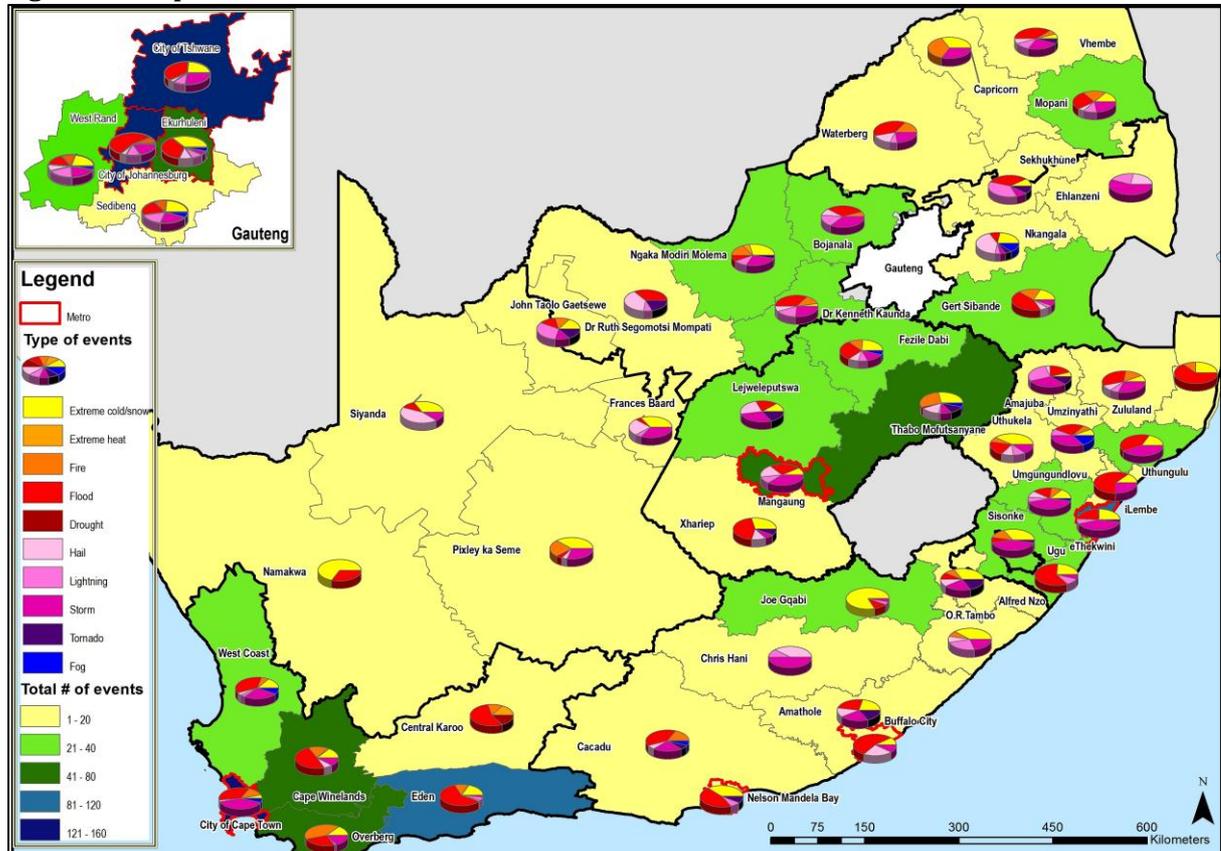
Type	No. events	No. killed	No. affected
Natural	65	1,137	16,098,442
Flood	23	473	483,965
Storm	19	154	140,945
Fire	8	123	7,380
Epidemic	7	336	112,385
Extreme temperature	3		53,663
Drought	2		15,300,000
Earthquake	2	17	104
Landslide	1	34	
Technological	129	2,519	18,731
Transport Accident	107	2002	3,964
Industrial Accident	13	261	13,285
Miscellaneous accident	9	256	1,482
Total	193	3,656	16,098,460

Source: EM-DAT: The OFDA/CRED International Disaster Database

Figure 6 illustrates this diversity. It shows the frequency and geographical distribution of weather-related hazards in South Africa. It presents data from the South African Weather Service's Caelum dataset on weather related hazards. The shading shows the overall, cumulative frequency of hazard events in each municipal district in South Africa, while the graphs show the types of hazards experienced. It shows that Western Cape, Gauteng and KwaZulu Natal experience the greatest number of severe weather events, with the Central Karoo District (157), and most pertinent to urban risk, the Johannesburg (157), Cape Town (156) and Tshwane (136) metropolitan areas experiencing the most events. The map shows that all municipalities experience a range of severe weather events, with extreme heat, cold, flooding, fires and storms the most common in the majority of municipalities. Hail and tornadoes become more frequent as

one moves northwards, with the Northern Cape, Free State, Northwest, Gauteng and Mpumalanga showing the most events.

Figure 6: The prevalence and distribution of natural hazards in South Africa



Source: Caelum dataset, SAWS.

Urban populations also face a range of other hazards rooted in socio-economic conditions. Households living poor areas experience a range of chronic, everyday risks associated with marginal living conditions and poor service delivery, particularly (although not exclusively) in informal settlements. These include inadequate access to safe drinking water, sanitation and waste removal, communicable disease such as Tuberculosis, HIV/AIDS and measles and high levels of crime and violence. They also often experience new configurations of hazards such as flooding and fire. In addition to veld fires, for instance, shack fires are common in informal settlements. Flooding also takes on new forms. In Cape Town, for instance, the high water table on the Cape Flats results in low-intensity, ongoing flooding during the winter as the ground becomes waterlogged and the table rises. Settlements also frequently experience localised flooding due to inadequate or poorly functioning drainage infrastructure.

Unfortunately, there is little data available on the extent and frequency of these hazards. Some, such as fires, are recorded by municipal fire services, but this information is not collected systematically, is collected in a format that readily supports analysis, and is not collated at either a provincial or national level. Other events such as flooding are recorded by the SAWS, but this data is not readily disaggregated to the urban level. Data collected on fire incidents in Cape Town, however, provides some indication of scale and frequency of these predominantly everyday and extensive risks. Figure 7 and 8 present data on the number and types of fires recorded in the City of Cape Town's Emergency

Services System (ESS) between 2005 and 2012. Figure 7 shows the number of fires by type over this period. There were 23 519 fires altogether, with residential fires by far the most common. These include 8 635 fires in formal (the pink bars) and 8 876 fires in informal dwellings (the light blue). A closer look at just these residential fires suggests some interesting changes over time. Figure 8 shows just residential fires over the period. It illustrates that while the number of informal dwelling fires has declined, the number of formal dwelling fires has increased, overtaking informal dwelling fires in 2009.

Figure 7: Types of fires recorded in Cape Town’s Emergency Services System (2005-2012)

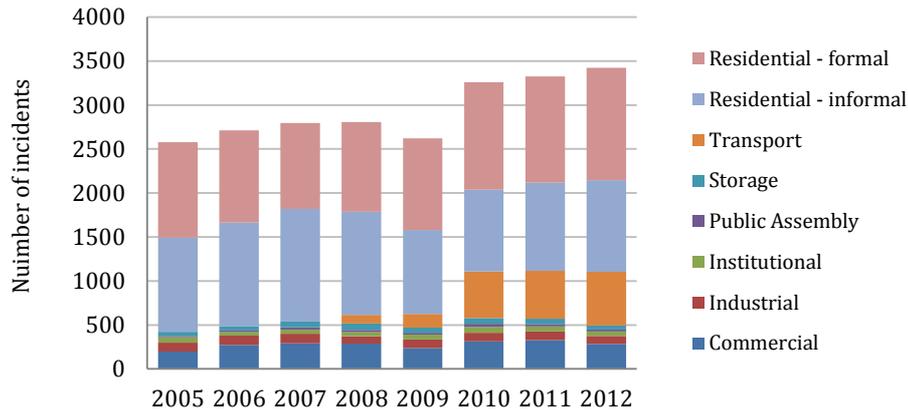
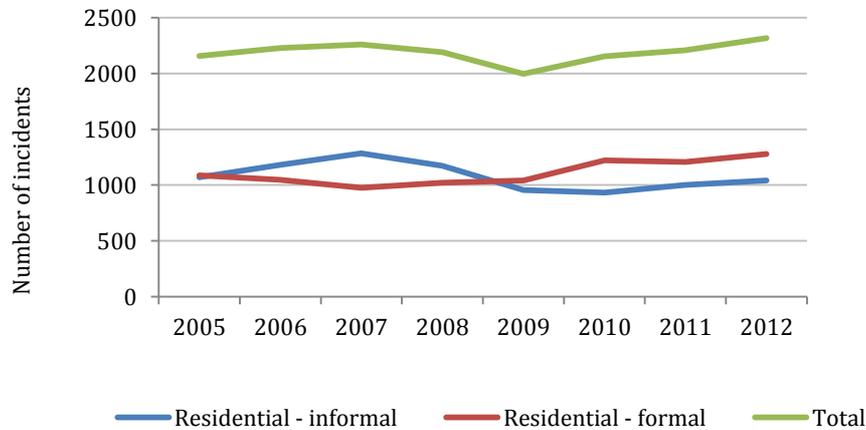
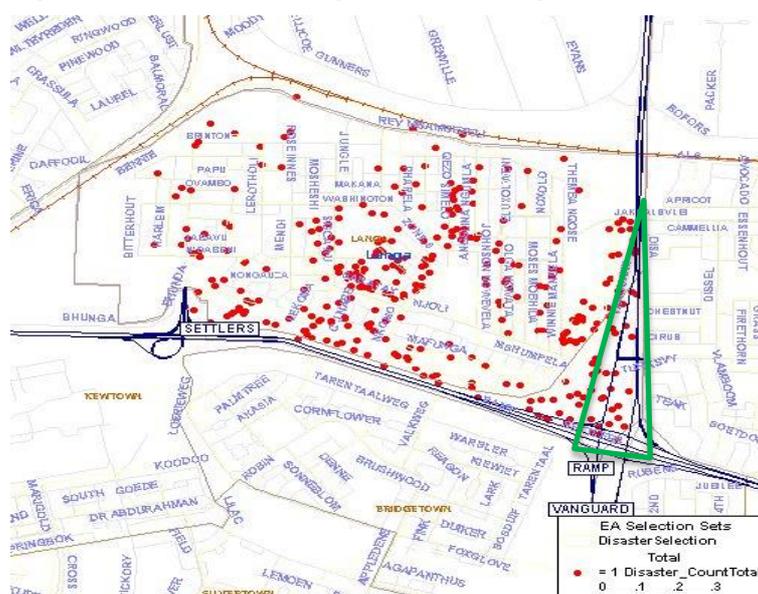


Figure 8: Trends in residential fires (2005 - 2012)



Data from elsewhere suggests that this may be due to the proliferation of backyard dwellings. Research in Langa, in Cape Town, in 2006 (DiMP, 2006) showed high numbers of fires in informal dwellings within formally planned areas. Figure 9 illustrates these findings. It shows the distribution of fire incidents in Langa and the adjacent Joe Slovo informal settlement between 1995 and 2005. The triangular area between the lines on the bottom right corner (marked by the green triangle) encompasses Joe Slovo informal settlement. The remainder of the map covers the ostensibly formal area of Langa. As shown on the map, large numbers of ‘informal dwelling’ fires occurred well beyond the boundaries of the informal settlement.

Figure 9: Informal dwelling fire losses, Langa-Joe Slovo 1995-2005



Source: DiMP, 2006

This tentative finding aligns with a small but growing number of studies highlighting the accumulation of risk in poor formal areas. While research and policy tend to focus on informal settlements, these suggest that households living in subsidised housing also face a range of hazards, and may be even more vulnerable in some respects. Risk in subsidised housing areas is largely unstudied and represents a blind-spot in research and practice, suggesting that the vulnerability amongst households in low-cost areas may be exacerbated by their current exclusion from the urban risk landscape. As discussed in Box 3, risk may also be compounded by assumptions about the nature and form of low-cost housing developments (Box 3). These findings suggest that the low-cost housing needs to be incorporated into the urban risk agenda in South Africa. Risk accumulation processes in these areas need to be better understood and incorporated into planning.

Box 3: Low-cost housing areas as sites of risk

In addition to fire, studies highlight other emerging risks in low-cost housing areas. Although discussions on risk in South Africa tend to focus on informal settlements, this small but growing body of research shows that communities living in low-cost housing face a range of other hazards typically associated with informal settlements.

Research in Cape Town, for instance, identifies a range of health risks in subsidised housing settlements. A 2009 study on the living and sanitation conditions in four low-cost housing settlements found high levels of communicable diseases, particularly diarrhoea (Govender et al, 2011a and b).² Almost one out of every three (32%) of the sampled residents reported one or more bouts of diarrhoea in the two weeks preceding the survey. The authors attributed the high levels of illness to the poor conceptualisation of living spaces. For instance, dwellings had only a single tap, located above the kitchen, leaving household members with not other option but to use the kitchen sink to wash their hands after visiting the toilet, cleaning and washing clothes. Drainage facilities were also inadequate and drains overflowed with sewerage-laden water. Research on flooding in Cape Town also highlights the production of risk in low-cost housing areas. Research in five low-cost housing areas in 2010, found that the combination of design failures such as the lack of guttering, insufficient roof overhangs and poor construction and finishing led to severely damp and

² The research was conducted in 4 settlements. Structured interviews were administered in 336 households, capturing the experiences of 1080 people.

mouldy conditions in many dwellings. Although the study did not examine the health implications in depth, the findings suggested that these conditions contributed to a range of respiratory illnesses (Pharoah, forthcoming).

Research also suggests that the proliferation of backyard dwellings – arguably partly due to housing policies that fails to recognise people’s poverty and understandings of land and property (Baumann, 2003; Napier, 2007, cited in Lemanski, 2009) – is recreating risks associated with informal areas. Research in Westlake in Cape Town shows that the ‘informalisation’ of subsidised housing drives environment health problems.³ It found that backyarders’ access the toilet and bathing facilities inside the main dwelling was tightly controlled and restricted by their landlord, often leaving them with no choice but to urinate, defecate, bathe and dispose of greywater outside. Both this research and that by Govender and colleagues also found that infrastructure designed for single families was unable to cope with higher user volumes and was often blocked or broken. The conceptualisation of housing exacerbates these problems. Charlotte Lemansky observes, low-cost housing areas are simply not designed to accommodate backyard dwellings:

...[subsidised housing areas] are designed exclusively for formal lifestyles, and thus have no provision (e.g. communal ablutions) for households living in informal conditions. Indeed, the government vision to eliminate informality ensures that there is no consideration for the needs of informal households when planning RDP settlements, as no such households should exist (2009:477).

She argues that the relative voiceless of those living in backyard dwellings compounds this. Citing Jo Beall and colleagues (2002), she notes that:

The ‘invisibility’ of backyard housing as a collective force ensures that local community groups and government bodies communicate exclusively with registered owners and rate payers rather than tenants of any sort, but particularly those in informal housing (2009:478).

These findings suggest a need to acknowledge and focus on risk in both informal and low-cost housing areas, and to plan accordingly. They also highlight the potential for poorly thought through development initiatives to increase risk, underscoring the need for integrated, risk-aware planning that incorporates disaster management perspectives.

6. Emerging risks

The research also suggests a number of emerging issues that are likely to contribute to urban risk in the future. These include communal violence and unrest and food insecurity, which although reasonably well studied in other sectors, are not typically included in discussions on disaster risk reduction in South Africa, as well as new problems linked to urban and industrial change and increasing climate variability.

6.1. Protests, unrest and social violence

Although there is very little data available to help quantify the extent of violence, there is a growing literature on xenophobic violence in South Africa (for example, Crush, 2001, Masuku, 2006; Crush 2008; Opfermann, 2008). Much takes the form of isolated attacks against individuals, but these also occur on a larger scale. The well-documented xenophobic violence that spread across South Africa in May and June 2008 killed over 60 people, and displaced between 80 000 and 200 000 people from their homes and communities (Igglesden, et al, 2009), primarily in Johannesburg, Pretoria and Cape

³ The research was conducted in 2006, with questions administered to 100 households, including interviews with both home-owners and their backyard tenants.

Town.⁴ These events represented an escalation of a long-standing problem, with other attacks recorded over the last decade. In 2006, for instance, the United Nations High Commissioner for Refugees (UNHCR) estimated that 29 Somalis were killed in xenophobic violence in Cape Town (IRIN, 2008). Incidents in De Doorns in the Western Cape at the end of 2009, and continuing, sporadic attacks against foreign-nationals and their businesses elsewhere, also suggest that there remains the potential for xenophobia-related violence.

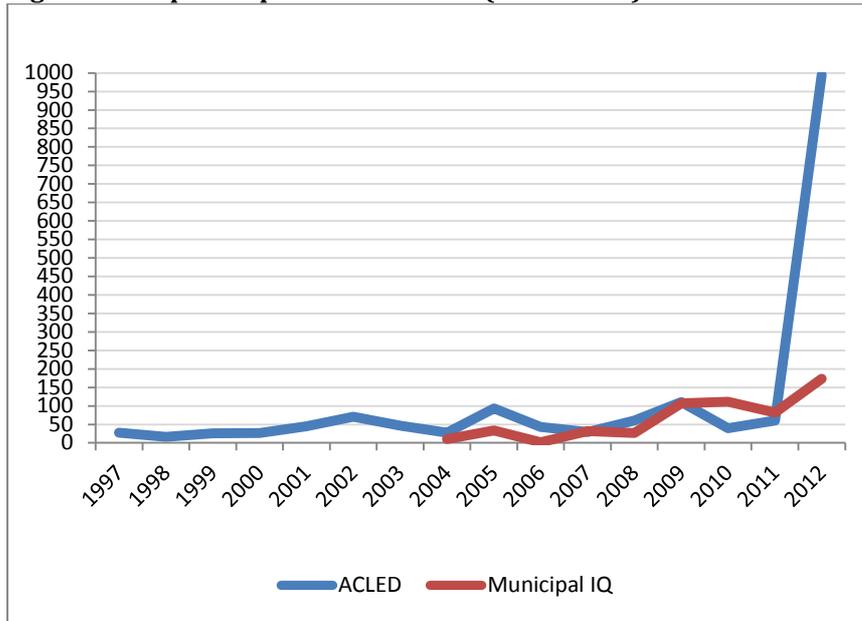
Protests and civil unrest may also be becoming more common. Again there is very little data available to assess their extent and frequency. However, data compiled by researchers from Trinity College (Dublin) for the Armed Conflict Location and Event Dataset (ACLED), suggests that protest actions and riots are becoming more frequent. This information, collected from media reports, humanitarian agencies and research publications (Clionadh et al, 2010), shows a steady increase in the number of protests and riots over the last decade, with a dramatic spike in incidents in 2012 (see Appendix 2 for full table). Other data collected by Muncipal IQ, based primarily on media reports since 2004, also suggests that they are becoming more frequent. As illustrated in Figure 10, this data (the red line) shows a far less dramatic increase in events in 2012, but tracks comparably to the ACLED data for other years, showing a rising trend overall.

Collective violence: refers to violence perpetrated by groups. While the concept is generally used in the context of war, inter-group conflict and gang violence, but in this paper it is taken to include xenophobic attacks, riots and protest actions resulting in damage to property or interpersonal violence.

It is not clear how accurate these numbers are. Given that both datasets rely heavily on media sources, these increases could reflect greater media coverage and reporting. The very steep increase in incidents in the ACLED data should be treated with caution, and may conceivably reflect growing media interest ahead of the 2014 elections, or changes in the way data retrieved or archived. These concerns noted, however, the data begin to make a case for protests as an emerging dynamic in South Africa's complex risk environment. The data suggests a need to better understand the prevalence and nature of these events, and build capacity to respond effectively.

⁴ These estimates reflect the number of people thought to have sought shelter in government facilities at the height of the crisis. There is no record of the number of people who left South Africa, or of those who moved in with friends and family, or found alternative private accommodation.

Figure 10: Reported protests and riots (1993-2012)

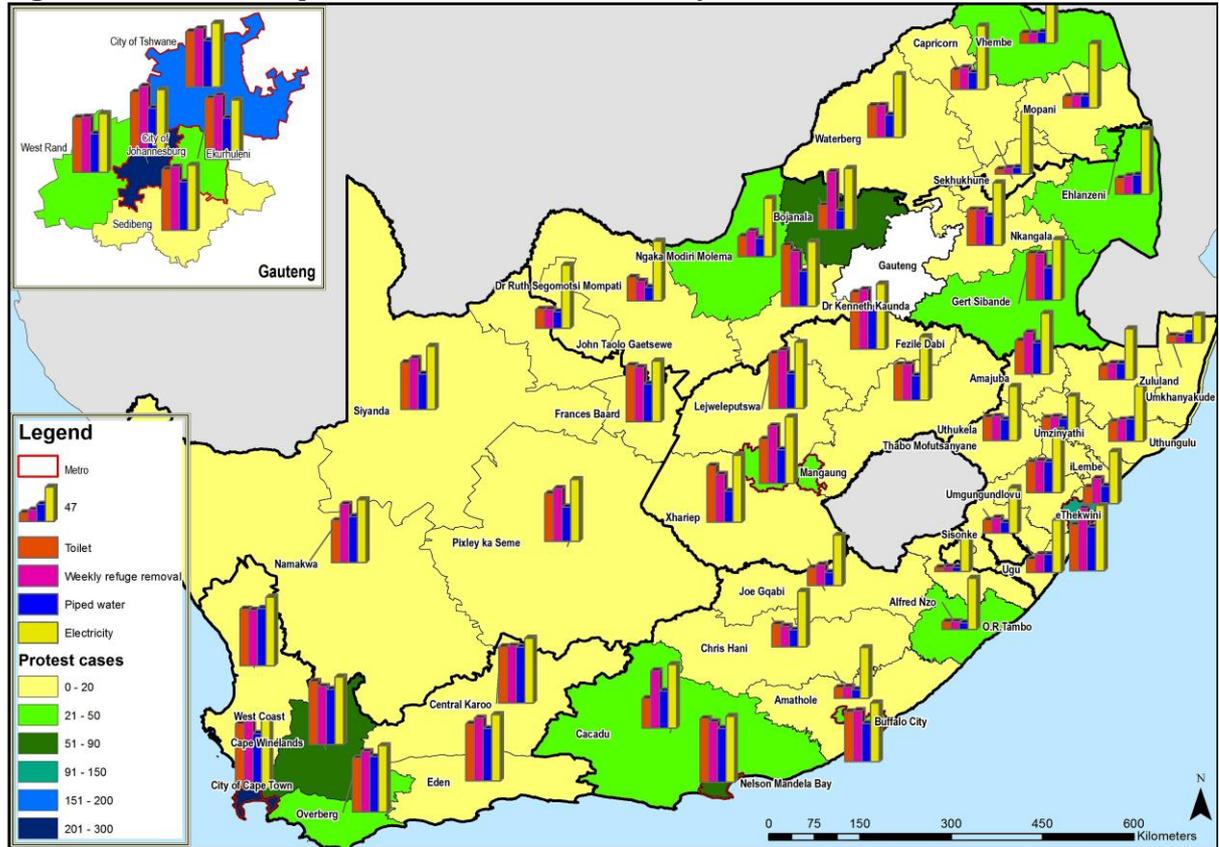


Source: Municipal IQ (2013); ACLED

The dynamics surrounding these protests are poorly understood. Although they are widely referred to as service delivery protests in the media, commentators increasingly question the service delivery hypothesis (Tapela, 2012). Peter Alexander (2013) argues that the varied nature of protests make them difficult to diagnose and quantify – although he takes a broader perspective than Municipal IQ and ACLED, adding mass meetings, drafting memoranda, petitions, boycotts, forced resignations and chasing unpopular individuals. He argues, however, that in addition to housing backlogs and service delivery, they reflect disappointment with the fruits of democracy, frustration with local leaders and socio-economic exclusion. Research by the Centre for Violence and Reconciliation (CSVR) makes a similar point. The authors note that violence is often instigated by young men (and increasingly young women) who feel unable to participate as full citizens in either the economy or society (Holdt et al, 2011:3). Others suggest that protests reflect poor communication between government officials and communities, with protests often occurring after unsuccessful attempts by community members to engage with local authorities (Sinwell et al, cited in Tapela, 2012).

The ACLED data provides support for a more nuanced understanding of protests. Figure 11 compares the number of recorded protests against levels of service delivery. The graphs show the proportion of the population in each municipal area with access to toilet facilities, weekly refuse removal, piped water and electricity, while the shading indicates the number of recorded protests (see Appendix 2 for full tables). It shows first that protests are most frequent in the Cape Town, Johannesburg and Tshwane metropolitan areas, and second that there is no obvious relationship between levels of service delivery and incidents. All three metros show amongst the highest levels of service delivery (over 75% access to all services in Cape Town, and to all services except for piped water in Johannesburg and Tshwane, where over 64% have access), while municipalities with far lower levels of provision show few incidents.

Figure 11: Protests compared to levels of service delivery



6.2. Water shortages

Water shortages are likely to become a growing challenge throughout South Africa. Although the country currently has sufficient water resources to meet national needs overall, many areas are already operating at the limits of their available resources. Several rely on expensive water transfer schemes to meet water demands (DWA, 1999, cited in Mhlongo et al, 2012; DWA, 2004, cited in CSIR, 2010; Tapela, 2012). There are also limited prospects for new sources of supply. It is estimated that more than 95% of South Africa’s freshwater resources were already allocated by 2005 (CSIR, 2010). The CSIR notes that surface water resources are well developed, raising questions “over how many more dams can be built and how much water can be transferred between river basins to provide enough water for future needs” (CSIR, 2010:5). There are opportunities to expand groundwater extraction, but to an insufficient degree to meet demand. They argue:

South Africa is facing a water supply crises caused by a combination of low rainfall, high evaporation rates, an expanding economy and a growing population whose geographical demand for water do not conform to the distribution of exploitable water supplies (CSIR, 2010:8).

Population and industrial expansion in urban areas are likely to place increasing pressure on the available resources, while at the same time undermining the quality of the water through pollution. Large metros, including Johannesburg, Tshwane and Cape Town already face water deficits, with Johannesburg and Tshwane already relying on

international water basin transfers from the Lesotho Highlands Project (Mhlongo et al, 2012). Although well-endowed with water resources, eThekweni and several other towns in KwaZulu Natal are also experiencing shortages, with eThekweni considering imposing a moratorium on large developments (IFRC, 2012). Pollution is a key concern. In this respect, the CSIR notes that the “biggest threat to sustainable water supply in South Africa is not a lack of storage, but the contamination of available water resources through pollution” (CSIR, 2010:5).

The water situation in cities and towns will also have knock-on effects for other areas. Effluent discharges from urban and industrial areas, as well as seepage and discharges from mining areas, affect water quality elsewhere. Much of the sewage from urban areas is not treated properly prior to discharge, because the sewer systems are incomplete or broken, or sewage treatment plants are overloaded or poorly managed – with this particularly the case in small towns (CSIR, 2010). These effects are compounded by the location of many urban centres. Most of the metros are located on the watersheds of river catchments that supply water to other areas, with the effect that dams downstream of urban and metropolitan areas have become progressively more contaminated (CSIR, 2010). In this respect, the CSIR notes:

South African river and reservoir systems have deteriorated over the last twenty years. In some areas...water quality poses serious health risks to humans and livestock that drink the water over many years. With a growing population and increased urbanisation, coupled with the apparent inability of most local authorities to effectively treat urban and industrial effluents to the promulgated effluent standards, the situation will continue to worsen (2010:13)

Given the limited prospects for further supply, it is clear that South Africa needs to make more efficient and balanced use of its water (and other) resources (CSIR, 2010). Moreover, without a radical improvement in water quality management approaches and treatment technologies, progressive worsening of water quality will continue to decrease the benefits and increase the costs associated with use of the country’s water resources (CSIR, 2010). In keeping with these concerns, the Department of Water Affairs has prioritised Water Demand Management (WDM), which stresses the efficient use of existing supplies rather than the development of new water resources. Municipalities are considered the key implementers of WDM and water conservation programmes (DEAT, 2010).

This is currently a challenge. Although some municipalities are performing well, in many instances infrastructure is old, poorly maintained and overburdened, and “is not in a fit state to continue delivering high quality and reliable water services” (CSIR, 2010:41). Limiting factors include poor leadership, a lack of qualified staff and insufficient investments in water infrastructure. While it is relatively easy for municipalities to obtain funding from national government for capital expenditure, for instance, operational budgets for service delivery and funding for maintenance is frequently inadequate. Many municipalities are also expected to do more with less. While shifts in municipal boundaries mean that many municipalities must deliver, operate and maintain services over larger distances and for more people, these extended mandates have not corresponded with increases in technical staff (CSIR, 2010). The drive to achieve universal access for water and sanitation, while necessary, adds to these pressures – particularly where cost recovery options are limited. Thus, the challenge is to supplement current infrastructure to address the backlogs from the past, while maintaining both new and old infrastructure, and upgrading or replacing infrastructure that is in disrepair, overloaded or obsolete (CSIR, 2010).

Municipalities face range of different issues. Smaller towns and rural areas face the challenge of rolling out services to previously serviced communities, while larger towns and metros must focus on the growth and rehabilitation or replacement of infrastructure (CSIR, 2010). Urban areas also have varying levels of capacity and resources. While larger towns and metros frequently have greater resources and capacity and provide high quality water, smaller urban centres frequently struggle to provide comparable services. Capacity assessments carried out by the Municipal Demarcation Board in 2007/2008 showed, for instance, that 37% of South Africa's local municipalities had insufficient capacity to fulfil their obligations with respect to sanitation services (cited in CSIR, 2010). Planning has exacerbated the challenges in some areas. The CSIR notes, for instance, that short-sighted planning in some settlements has:

...resulted in bucket eradication schemes actually causing deterioration in service provision. For example, in some free State settlements, replacement of bucket sanitation systems with waterborne systems left residents with no sanitation at all since the water supply was insufficient to flush their toilets. In other instances, the large increases in sewage inflow volume led to overloading of wastewater treatment works and pollution of downstream river systems (CSIR, 2010:43).

Box 4: Linking water, infrastructure, management and disease in Delmas

The town of Delmas in Mpumalanga has seen repeated outbreaks of typhoid since the early 1990s. It recorded outbreaks in 1993, 2005, 2007, with at least 20 deaths and thousands requiring treatment or hospitalisation. Research on the outbreaks (Nealer et al, 2009) showed that the outbreaks were linked to water management in the area.

Water scarcity is an ongoing challenge for the town. Despite piping in additional water from Rand Water in Gauteng, the municipality struggles to provide sufficient potable water, with leaks in the reticulation system partly to blame for water losses. The town has only two wastewater treatment facilities. These are overloaded and generally fail to adequately treat storm water and waste water before it is released into streams in the area, with water shown to exceed the allowable limits prescribed in the facilities' licence agreements. Groundwater is often a key source of water in small towns, as it is less contaminated by surface run-off and requires less treatment to make it safe for human consumption (DWAF, 2004, cited in Nealer et al, 2009). However, ground water in Delmas is impaired by salinization, linked to the discharge of industrial effluent, urban run-off and irrigation returns; algal growth due to the release of sewerage; and faecal pollution.

6.3. Acidification

The acidification of water sources constitutes another emerging concern, particularly in Gauteng. Although the sources of acidification are not confined to the mining sector, and include industrial effluents and acid rain (CSIR, 2010), acidification is most prominently linked to acid mine drainage (AMD). Acidification results from the chemical interactions between groundwater containing heavy metals from mining waste, rock strata and oxygen (CSIR, 2010; IFRC, 2012). It is becoming more common as marginal mines close and the pumping operations that keep water out of the underground works ceases (IFRC, 2012). AMD contaminates ground water as it moves toward the surface and causes severe environmental and health impacts on the receiving water environment and downstream communities (IFRC, 2012). Of the three basins that underlie the

Witwatersrand, the Western Basin began filling in 2002, while the Central and Eastern Basin are starting to fill. Whilst the flooding of the Western Basin has occurred largely in peri-urban areas to the north of Krugersdorp and Randfontein, the flooding of the Central Basin will affect parts of Johannesburg, including parts of the central business district (IFRC, 2012). There is the potential for even more severe AMD from coal mining in areas such as Middleburg and Witbank (CSIR, 2010).

The government has taken steps to address the issue of acidification due to mining, although these are in their infancy. Although this problem was flagged in the mid-1990s, a comprehensive response to the issue only took shape in 2011, with an allocation of R225 million to address the problem and the appointment of the Trans-Caledon Tunnel Authority to pump water out of shafts (IFRC, 2012)

6.4. Food insecurity

Urban food security constitutes another emerging concern. Food insecurity is primarily viewed as a rural issue, but it is evident that urban food insecurity is on the rise (van der Merwe, 2011; Frayne et al, 2009; de Klerk et al, 2004) The International Institute for Environment and Development (IIED) notes: “food security is a primary concern for all those who rely on buying, rather than producing, food. This includes a large proportion of rural residents but also the vast majority of urban dwellers” (2013:1). This insecurity is rooted not inadequate food production, but the degree to which poor households are able to afford food. Bruce Frayne and colleagues (2009) argue that food insecurity has several sources. These include shifts in the locus of poverty from rural to urban areas, sharp increases in food prices and the implications of the global economic downturn, which has led to job losses. Discussing the findings of the Urban Food Security Baseline Survey conducted in 2008 in Cape Town, Msunduzi and Johannesburg⁵, they note that on average 70% of the households surveyed were food insecure, with 42% insecure in Johannesburg, 80% in Cape Town and 87% in Msunduzi.

Food security: can be defined as physical and economic access to sufficient, safe and nutritious foods which meet an individual’s dietary needs and preferences for an active and healthy life (Kennedy, 2003, cited in van der Merwe, 2011).

Addressing food insecurity will require new approaches to food sourcing. While increasing agricultural production is generally presented as the primary policy prescription for addressing insecurity (International Institute for Environment and Development, 2013), urban areas will need to become more self-sufficient. Rural agriculture will remain important to food security in coming decades, but cities will also need to find ways to combat poverty and hunger (Frayne et al, 2009). As Frayne notes, “cities are no longer there to be fed; cities must start feeding themselves” (2009:9). Fostering urban agriculture is one option for improving self-sufficiency, although it should be seen as only one safety net amongst many for the urban poor (Rogerson, 2000, cited in van der Merwe, 2011), including expanding income-earning opportunities (van der Merwe, 2011).

Urban agriculture agricultural production is an important resource in many African cities, including Nairobi, Lusaka and Harare, but several factors currently hamper its prospects in South Africa (de Klerk et al, 2004). These include limited access to land,

⁵ The survey included interviews with 996 households in Johannesburg (households in the inner city, Alexandra and Organge Farm), 1060 in Cape Town (Occean View, Philippi and Khayelitsha) and 556 in Msunduzi. The baseline was collected in 11 Southern African cities, including the three South African sites.

zoning in urban areas, sufficient water resources and a range of other challenges, such as capacity constraints and people's attitudes (de Klerk et al, 2004; van der Merwe, 2011). There are also no clear, coherent policies to guide implementation at either the provincial or the local level (de Klerk et al, 2004; van der Merwe, 2011). Cities such as Cape Town, Tshwane and Buffalo City already provide some support for food gardens, but the scale of urban agriculture remains limited (de Klerk et al, 2004).

7. Global environmental and climate change

As elsewhere, GEC will add another dimension to the already multi-dimensional risk environment in South Africa's towns and cities. It is likely that hazards and severe weather will become more common, while sea rising levels poses a threat to water resources, infrastructure and the built environment. Environmental change is likely to result in bigger losses more often, and have long-term consequences for human settlements already facing a range of developmental stressors (Parnell et al, 2007). We are likely to see a "strange new urban world" (IFRC, 2010, cited in van Niekerk, 2012:1), increasingly at risk of disasters that challenge authorities' experience and capacities (ICLEI, 2010, cited in van Niekerk, 2013).

Climate change projections suggest more extreme and variable weather, with drying in some areas and wetter conditions expected in others. Future warming is projected to be greatest in South Africa's interior. Assuming moderate to high growth in Green House Gas (GHG) concentrations, the coast is likely to warm by around 1 to 2°C by mid-century, and the interior by around 2 to 3°C. Depending on the international mitigation effort, the level of warming could reach as high as 3 to 4°C along the coast by 2050, and 6 to 7°C in the interior (DEA, 2011). Future rainfall projections are less clear, as rainfall-generating processes and land surface-atmosphere interactions are still not fully understood. Projections suggest lower levels of rainfall in winter-rainfall areas, with slight increases possible in summer rainfall areas. Rainfall projections for eastern reaches of the summer rainfall region are likely to see increased rainfall (DEA, 2011). Sea levels are also expected to rise by 1.47 mm and 2.74 mm per year on the south and eastern coasts respectively (DEA, 2011). The White Paper on Climate Change Response (Government of South Africa, 2011) argues that the implications of such changes could be profound. It observes:

...life as we know it will change completely: parts of the country will be much drier and increased evaporation will ensure an overall decrease in water availability. This will significantly affect human health, agriculture, other water-intensive economic sectors such as the mining and electricity-generation sectors as well as the environment in general. Increased occurrence and severity of veld and forest fires; extreme weather events; and floods and droughts will also have significant impacts. Sea-level rise will negatively impact the coast and coastal infrastructure. Mass extinctions of endemic plant and animal species will greatly reduce South Africa's biodiversity with consequent impacts on eco-system services (Government of South Africa, 2011:9).

Urban areas may face a variety of challenges. As illustrated in Table 3, below, environmental change stands to increase stress on physical infrastructure and alter the natural environment. These changes could have a range of potential impacts from illness, rising food prices and livelihood impacts, to energy disruptions and water shortages

(Baker, 2012). Some of these dynamics are fairly obvious, such as the potential for severe weather to overburden or damage infrastructure, but other are less so. For example, respondents interviewed for this study noted that heat stress could become a particular challenge in informal areas, where dwellings are built primarily from corrugated iron, or in subsidised housing, where dwellings are generally poorly ventilated, regulate heat poorly and are not designed with warming in mind. These effects underscore the wide-reaching and diverse implications of GEC, and the importance of a multi-sectoral perspective in planning for an adapting to climate change.

Table 3: The potential impact of climate change on urban populations

Incremental impacts on urban systems	Impacts on urban residents
<p>Built environment</p> <ul style="list-style-type: none"> • Stress on building foundations • Road washouts • Stress on storm-water and sewage systems • Stress on water treatment systems • Changing disease vectors • Disruption to shipping and ports • Increased energy demand • Increased road surface damage • Increased demand for water 	<p>Impacts</p> <ul style="list-style-type: none"> • Illness—heat stress, stroke, malnutrition, water-borne disease, asthma, physical and mental disability • Exposure to elements from substandard construction • Disruption of basic service provision and access to supplies • Housing instability • Property loss and relocation • Loss of livelihoods • Community fragmentation • Exposure to flood-related toxins and wastes • Disruption in availability of potable water, food, and other supplies • Water shortages • Food shortages; higher food prices • Disruptions of electricity
<p>Natural environment</p>	
<ul style="list-style-type: none"> • Coastal erosion, altered ecosystems and wetlands • Salinization of water sources • Slope instability • Groundwater depletion • Reduction in green space and growing conditions, including urban agriculture • Changes in fish populations • Increased runoff contamination • Increased heat island effect • Increased air pollution 	

Source: Baker (2012).

As indicated in the Table, environmental change is likely to compound many of the existing risks identified in this section. These include:

- **Water scarcity:** Less rainfall and higher temperatures are likely to reduce both levels of surface and ground water, while an increase in storms and other severe

weather stand to damage infrastructure and storage facilities. They are also likely to impact on the quality of water in river systems and water storage reservoirs. Warmer water temperatures may encourage the proliferation of bacteria and algae (CSIR, 2010). The inundation of low-lying of coastal zones could also result in the salinisation of the water table (Parnell et al, 2007).

- **Food security:** Drying and greater climate variability stands to impact negatively on agricultural production, potentially pushing up the price of food. Drought and extreme weather events such as floods also impact negatively on livelihoods and household income as people lose assets. Floods also have the potential to disrupt transport infrastructure, potentially increasing food costs and making it more difficult for poor people to access markets. Water-borne diseases such as cholera, dysentery and skin infections are also likely to increase, especially in areas with poor sanitation, which could also increase malnutrition (IIED, 2013).

Even assuming South Africa takes steps to address climate change, as elsewhere, the country is already locked into some climate change outcomes. Although both global and domestic efforts to address climate change through reductions in greenhouse gas emissions and energy consumption are essential to avoid the worst climate change impacts, inertia in climate and environmental impacts and the damage already done mean that some change is unavoidable. There is thus a need to strengthen the resilience of our society and economy to climate change impacts and to develop and implement policies, measures, mechanisms and infrastructure that protect the most vulnerable (Government of South Africa, 2011).

Planning for resilient cities involves adapting to changing conditions over the long haul (Collins, 2009, cited in van Niekerk, 2013). Sue Parnell and colleagues (2007) argue that policy and action need to support long- and medium-term changes to standard practices of settlement management to reduce human vulnerability. This implies:

...structural changes in how urban societies are run and it is in this regard that the GEC community will be compelled to challenge urban disaster management practice as well as the wider wisdom on urban planning (Parnell et al, 2007:360).

Responding to GEC and the range of other current and emerging risks requires new approaches to urban planning and management. As highlighted at the beginning of this paper, urban development has the potential to reduce risk, but disjointed, poorly managed and poorly thought through initiatives can also fuel disaster risk and the negative effects of climate change. Preventing these negative effects requires integrated, risk-aware planning and action; the goal of resilience needs to be built into the day-to-day practices of urban planning (van Niekerk, 2013). Risk concerns need to be incorporated into:

- land-use and urban planning;
- water and environmental management;
- infrastructural maintenance, design and planning;
- building design and construction (UNISDR, no date).

Land-use planning, risk-proofing the built environment and infrastructural management provide particularly important opportunities mitigate the likelihood of disasters (UNISDR, no date). As the Department of Cooperative Governance and Traditional Affairs (CoGTA) notes:

Risk exposure can be significantly reduced through the application of land use management and building codes. Legislation on land management and urban planning needs to specify that disaster risks be considered in land and development planning. This includes a multi-stage approach, knowing what the multi-hazard risks are through risk and vulnerability mapping, using this knowledge as the basis for developing plans and policies for land management and ensuring that the local institutions, especially local and in some cases regional governments, are sufficiently capable to implement plans and policies (CoGTA, 2012:8).

8. The policy framework for risk reduction and climate change

Key points:

- South Africa has a well-developed legislative framework to guide and support disaster risk reduction. The framework for climate change is less established, but the government is in the process of developing a national policy on climate change response. Both emphasise integrative, cross-sector planning
- There exist a range of other legislative instruments relevant to risk reduction and climate change, with the environmental and water resource management and servicing, land use planning legislation, and the building code the most relevant
- The National Environmental Management Act (NEMA) and South Africa's water policies provide some alignment points for achieving risk reduction, but land use and building frameworks provide less support for more integrated planning

The policy framework for building resilience is reasonably well established, although some sectors perform better than others. South Africa has a strong legislative instrument to guide and support risk reduction, and is in the process of developing policy on climate change. There are also various other sectoral policies that align with hazard management and the risk reduction agenda, but there are few congruencies in legislature guiding building design. The framework for land use planning is also highly fragmented and complex, posing challenges for integration.

8.1. The framework for urban risk management

South Africa's approach to disaster management has been substantially revised over the last decade, reflecting evolving international good practice. As elsewhere, South Africa historically adopted a response-oriented approach that focused on emergency preparedness and response and providing humanitarian assistance to those affected by disasters. Reflecting the changing international discourse on how best to tackle disasters, the Disaster Management Act (DMA) and its accompanying National Disaster Management Framework (NDMF) promulgated in 2002 and 2005 respectively, promote a holistic response that aims to both reduce the likelihood of disasters and better manage those that do occur.

The DMA emphasises measures to reduce the vulnerability of disaster-prone areas, communities and households. In keeping with the Act, the National Disaster Management Framework (NDMF) emphasises the reduction of risk through development. The Framework establishes four key performance areas, including:

- developmentally-oriented disaster management planning; and
- the development of coordinated policies to ensure effective disaster response, recovery and rehabilitation planning (Government of South Africa, 2005).

The DMA calls for the involvement of diverse stakeholders in reducing risk, including traditional authorities, technical experts, most governmental line functions and at-risk communities. It also establishes several institutional mechanisms to help mainstream risk reduction into planning processes. These include:

- The Intergovernmental Committee on Disaster Management (ICDM), which aims to encourage cooperative government at the highest political levels. This includes establishing joint standards of practice between the different spheres of government and between government and external actors (IFRC, 2012).
- A National Disaster Management Forum (NDMF), with provinces and municipalities allowed the option of establishing create forums at their own discretion. The NDMF provides a platform for consultation and coordination between officials from all three spheres of government, inter-governmental organisations and representatives from a range of other stakeholder groups.

The National Disaster Management Centre (NDMC) and provincial centres are responsible for coordinating and promoting disaster management and risk reduction activities. Municipal disaster management centres must be established in each metropolitan and district municipality. Local municipalities are not required to establish centres, although they should work in concert with district disaster management centres.

The Act also requires the development of risk management plans at different scales, as well as the integration of disaster management plans and concerns into local planning tools. The provinces, and metropolitan and district municipalities are required to develop frameworks and plans, with the latter focusing on implementation. Local municipalities are also required to develop plans. Importantly, the Act stipulates that risk reduction should be incorporated into all integrated Development Plans (IDPs).

Box 5: Terminology as a constraint to risk reduction and disaster prevention

South Africa's progressive legislation has been applauded internationally and the Act is considered an example of best practice (Pelling and Holloway, 2006). However, an area of weakness in the legislation is the terminology adopted. Despite the conceptual shift in emphasis from disaster management to disaster risk management, the Act and Framework use the term 'disaster management'. As discussed in the next section, this may contribute to the persistent perception that the disaster management function is entirely responsive, hampering the integration of risk reduction into prospective planning and activities. However, the Act is currently under review, and this issue may be resolved in the amendment bill.

8.2. The framework for climate change

The framework for climate change response and adaptation is less established. The National Climate Change Response White Paper, of 2010 (Government of South Africa, 2011) outlines government's vision with respect to building South Africa's resilience to climate change. The White Paper is guided by the principles set out in the National Environmental Management Act (NEMA), the Millennium Declaration and the United Nations Framework Convention on Climate Change. The White Paper identifies priorities for both climate change adaptation and mitigation, and aims to support:

- Effective management of inevitable impacts of climate change through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- South Africa's contribution to global efforts to stabilise change-inducing greenhouse gas emissions in order mitigate the extent of climate changes.

It prioritises the need for a risk-oriented process to identify and prioritise short- and medium-term adaptation interventions to be addressed in sector plans, as well as responses that require coordination between sectors and departments. It identifies several departments that need to be involved in South Africa's response to climate change. These include those concerned with water management, agriculture and forestry, health, biodiversity and human settlements. It also draws out the linkages between resilience to climate variability and extreme weather events and disaster management, noting that climate change considerations will form the basis for South Africa's future approach to disaster management (Government of South Africa, 2011).

Table 4 illustrates some of the activities most pertinent to urban development – many of which speak directly to the issues raised in this paper. While couched in terms of climate change, most of these activities would also serve reduce disaster risk. For example, improved land-use planning and enforcement would help to reduce settlement in high-risk areas, as would establishing higher setback and high-tide demarcations that take into account rising sea levels and the potential for more severe storms. It is crucial, however, that the necessary linkages are made between disaster risk reduction and resilience to climate change. As discussed in the next section, these connections are currently relatively weak; although working on overlapping issues, there is often limited interaction between officials involved in climate change responses and disaster management.

Climate change mitigation: refers to measures aimed at reducing the rate at which climate is changing to levels that occur naturally, especially reducing the atmospheric concentrations of GHGs (Government of South Africa, 2011).

Climate change adaptation: involves measures aimed at responding to the adverse effects of climate change. Adaptation is closely aligned with risk reduction and includes efforts to increase physical and societal resilience to climate change.

Table 4: Sector activities outlined in the National Climate Change Response White Paper

Sector	Activities
Water	<ul style="list-style-type: none">• Optimising catchment and water management practices, including investment in water conservation and water-demand management• Exploring new and unused resources, particularly groundwater, re-use of effluent, and desalination.• Reducing the vulnerability and enhancing resilience to water-related impacts of climate change
Health	<ul style="list-style-type: none">• Improving air quality and ensuring full compliance with National Ambient Air Quality Standards• Ensuring that food security and sound nutritional policies form part of an integrated approach to health adaptation strategies• Develop and roll-out public awareness campaigns on the health risks of high temperatures, and design and implement “Heat-Health” action plans• Strengthen information and knowledge on the linkages between disease and climate change• Strengthen the awareness programmes on disease outbreaks
Biodiversity and ecosystems	<ul style="list-style-type: none">• Conserve, rehabilitate and restore natural systems that improve resilience to climate change impacts
Urban human settlements	<ul style="list-style-type: none">• Leverage opportunities presented by urban densification to build climate-resilient urban infrastructure and promote behavioural change• Ensure that low-cost housing settlements have access to affordable lower-carbon public transport systems, incorporate thermal efficiency into designs and use climate-resilient technologies• Strengthen and enhance decision support tools and systems such as the Toolkit for Integrated Planning• Encourage water-sensitive urban design and ensure that urban infrastructure planning take into account supply constraints and impacts of extreme weather-related events• Ensure that land-use zoning regulations are enforced and that urban land-use planning considers the impacts of climate change and the need to sustain ecosystem services
Coastal human settlements	<ul style="list-style-type: none">• Ensure that planning accounts for sea-level rise and intense weather, particularly high-water marks and coastal set-back lines that demarcate the areas which cannot be developed• Protect and rehabilitate natural systems that act as important coastal defences
Disaster management	<ul style="list-style-type: none">• Continue to develop and improve its early warning systems for weather and other events populations timeously.• Collaborate with social networks including community and non-governmental organisations and others to raise awareness, transfer technology and build capacity• Develop mechanisms for the poor to recover after disasters, including micro-insurance

The Paper also promotes the mainstreaming of climate change considerations and responses into all relevant sector, national, provincial and local planning instruments, such as the industrial policy action plan, integrated resource plan for electricity generation, provincial growth and development plans, and IDPs. It also proposes the

formation of an Intergovernmental Committee on Climate Change (IGCCC) to assess that state of climate-oriented activities within various government departments' sector plans. Using the results of this analysis, adaptation strategies will be integrated into sectoral plans, including the:

- National Water Resource Strategy, as well as reconciliation strategies for particular catchments and water supply systems
- Strategic Plan for South African Agriculture
- National Biodiversity Strategy and Action Plan, as well as provincial biodiversity sector plans and local bioregional plans
- Department of Health Strategic Plan
- Comprehensive Plan for the Development of Sustainable Human Settlements
- The NDMF

Box 6: Provincial and city-level instruments for addressing climate change

Some provinces and municipalities have developed their own climate change adaptation plans. The Western Cape finalised a climate change strategy and action plan in 2008. Several cities have or are in the process of developing instruments. These include Cape Town, which has developed a Framework for Adaptation to Climate Change (City of Cape Town 2006), and Johannesburg and Ekurhulani that have developed climate change strategies. eThekweni is in the process of developing a strategy, although as discussed later in the paper, it has been engaging with climate change issues for several years.

8.3. Other pertinent frameworks

There exist a range of other legislative instruments relevant to risk reduction and climate change. As summarised in Table 5, these include policies relevant to managing and addressing specific issues such as fires, agricultural risks and public events with the potential for mass casualties, as well as assessing and mitigating environmental and mine-related hazards. Most related to this paper are the National Environmental Management Act (NEMA), the National Water Resources and the Water Services Act, land use planning legislation and building codes and standards. NEMA and South Africa's water policies provide points of intervention for achieving risk reduction, but land use and building frameworks challenge more integrated planning.

8.3.1. Environmental management

The NEMA was promulgated in 1998 and provides a framework for integrated and sound environmental management. It recognises that sustainable development requires the integration of social, economic and environmental factors in the planning, implementation and evaluation of decisions. The Act emphasises sustainable forms of development, and stipulates that those designing and implementing developments avoid anticipate and prevent negative impacts on the environment and on people's environmental rights, or where this is not possible, minimise them. It argues that the disturbance of ecosystems, loss of biological diversity, pollution and environmental degradation are to be avoided or minimised.

The Act obliges developers to carry out environmental impact assessments (EIAs) prior to listed activities, including new housing developments, and the construction of electricity generation facilities and roads. Although the Act and the EIA process do not explicitly require an assessment of disaster risk potential, they do require that the

assessments describe and evaluate the probability that developments will impact on the environment and the extent, nature and duration of these effects. EIAs must also establish measures to address these (IFRC, 2012). Other sections touch on risk reduction issues. These include section 28, which specifies that the relevant parties must take either proactive or reactive measures to address pollution or environmental degradation caused by developments or activities; section 29 which protects whistle blowers; and section 30 which describes responsibilities with respect to emergency incidents.

8.3.2. Water resource management and service delivery

Water management in South Africa is guided by two pieces of legislation: the National Water Resources Act (NWA), which regulates the use of resources such as rivers, dams and estuaries, and the Water Services Act (WSA) which focuses on the provision of potable water by municipalities.

The NWA emphasises the integrated management of water resources. It calls for water resources to be managed at the catchment level and the establishment of Catchment Management Agencies (CMA) to achieve this – although DEAT currently manages these resources. At a more localised level, the NWA calls for the establishment of water user associations (WUA), which can drive and undertake water-related activities for users' mutual benefit. These could foreseeably include protecting water sources, supervising usage and reducing degradation due to land-use (IFRC, 2012). Of relevance to risk reduction, CMAs and WUAs are expected to timeously identify and make information available on potential and actual natural hazards, including water levels, infrastructural failures and any threats in terms of water quality posed by dams or other infrastructure. The Act also expects municipalities to ensure that development does not occur in areas exposed to flooding, and that structures are above the 1:100 year flood lines established under the NWA, although this requirement is poorly implemented in practice (IFRC, 2012) (see Box 7).

The WSA establishes water standards and sets out the rights and duties of the State water services providers in monitoring water services and ensuring effective water resource management. Under the Act, municipal governments are expected to ensure efficient, affordable, economical and sustainable access to services for all and are expected to incorporate water service plans into their IDPs.

Box 7: Challenges in implementing policies: 1:100 year flood lines

The 1:100 year floodline marks the area likely to be inundated during major flooding (of a magnitude expected once every 100 years). It applies to both flooding from rivers or other water bodies and coastal flooding due to high tides and storms.

Research conducted on behalf of the International Federation of the Red Cross and Red Crescent (IFRC) (2012) shows that municipalities often struggle to enforce the ban on settlement below the 1:100 year flood line. This is demonstrated in George, in the Western Cape. The research showed that flood lines were not mapped properly and that officials misunderstood the law. In many instances, personnel reported that it was their responsibility to establish the floodlines, not to prevent development below them. In many cases, settlements develop on land below the floodline, either because conditions have changed, or because they simply do not adhere to planning regulations. This is particularly the case with informal settlements established through illegal land invasions. Climatic change, catchment conditions and other factors also affect the relevance of the lines. The IFRC report, for instance, notes that the increase in extreme weather events in recent years and project climate change stand to make existing 1:100 year flood lines obsolete - and inappropriate benchmarks for determining the appropriate location of flood risk-averse development.

8.3.1. Land use planning

The framework for land use planning is far less supportive. It is highly fragmented and often contradictory, making it difficult to work with. In addition to various town planning ordinances, there are a wide variety of Acts impacting on land use planning including the Less Formal Townships Establishment Act (LFTEA, 1991), the Development Facilitation Act of 1995; the Municipal Systems Act of 2000 and the Land Use Management Bill tabled in 2006. None of these instruments specify explicit actions relevant to risk reduction, but the greater challenge lies in the flaws in the legislative framework. In this respect, Margo Rubin notes that although there has been a proliferation of instruments:

South Africa's towns and cities continue to develop without an adequate framework for managing land development in a way that supports the goals of democracy, equity, efficiency and sustainability (citing Ovens, et al, 2007, 2008:12).

In Johannesburg, for instance, the authorities apply 12 different Town Planning Schemes across the metropolitan area. The majority of the town planning applications that the City of Johannesburg processes are dealt with in terms of the Town Planning and Townships Ordinance (1985), LFTEA and the DFA, 1995. The City and the Gauteng Provincial Government have also added further policies and plans that attempt to respond to the changing demands of residents and developers, and the aims and goals of a post-Apartheid society. These include the Human Development Strategy (HDS), Jo'burg 2030, the Growth and Development Strategy (GDS), the Johannesburg Integrated Development Plan (JIDP), and the Spatial Development Frameworks for each region. Although many of the intentions in the mountainous documentation are broadly similar and some do align, planning has become prohibitively complex (Rubin, 2008). As Rubin observes: "land management systems have become difficult to navigate and only the most seasoned professionals with a great deal of experience have been able to attain the land and the approval that they need" (2007:14).

One of the primary instruments, the DFA, is associated with a host of weaknesses, including assigning exclusive municipal powers to the provincial governments. The Bill came into force in 1995 and was introduced in order to fast track development while local government structures transformed under the new administration. While local

government is typically responsible for planning decisions, the Act created a parallel land use planning authority administered at the provincial level. This created confusion and allowed for conflicting decisions by local and provincial authorities (IFRC, 2012; Van Niekerk, personal communication, 2013). A judgment by the Constitutional Court in June 2010 ruled parts of the Act unlawful, and gave government two years to develop a new policy. The Spatial Planning and Land Use Management Bill (LUMB) is tagged to replace the Act, but has yet to be finalised. The LUMB aims to provide a uniform, effective, efficient and integrated regulatory framework for land use and land use management, but its progress through parliament has largely stalled (IFRC, 2012), suggesting the land use planning will remain challenging.

8.3.2. Buildings, design and construction

Although the NDMC recognises that appropriate building codes can serve to reduce risk, the National Housing Code regulates building and construction. Section ten of the Housing Code provides municipalities with the authority to prevent the erection of buildings on land prone to hazards such as flooding (IFRC, 2012). The Code also frames the design and construction of dwellings and other buildings, such as the size and physical requirements of low-cost housing. However, it often lacks detail and lacks any sense of either weather-proofing or forward-looking design to address climate change concerns.

This is particularly that case with respect subsidised housing. For example, Wendy Crane and Mark Swilling (2008) note that of all possible material types, the block cement walls used in low-cost housing regulate heat and energy performance the worst. Research on flooding in low-cost housing areas also shows that the small roof overhangs stipulated in policy fail to prevent rainwater driving against external walls during heavy rain, while the use of only single skin walls allows water to penetrate dwellings (Pharoah, forthcoming). Crane and Swilling note that building regulations are also not conducive to innovation to achieve more resource-effective buildings, with the building council only prepared to certify dwellings using conventional materials and designs.

Table 5: Legislative instruments relevant to risk reduction and climate change

Sector	Issue	Legislation
Natural resources	Environmental management	National Environmental Management Act (No. 107 of 1998)
	Water resources	National Water Resources Act (No. 36 of 1998) Water Services Act (No. 198 of 1997)
	Hazard management	National Veld and Forest Fire Act (No. 101 of 1998) Fire Brigade Services Act (No. 99 of 1987)
		Mine Health and Safety Act (No.29 of 1996) Mineral and Petroleum Resources Development Act (No. 28 of 2002)
Built environment	Planning	Development Facilitation Act Land Use Management Bill
	Coastal management	National Environmental Management: Integrated Coastal Management Act. (No. 38 of 2009)
	Construction	Building Standards Act (No. 103 of 1977) National Building Regulations
Safety and security		Safety at Sports and Recreational Events Act (No. 2 of 2010)

9. Challenges to risk reduction

Key points:

- While there has been progress in achieving legislative requirements, integrating risk reduction and climate change into planning and practice is challenging
- Key constraints include perceptions of disaster management and the larger risk reduction agenda, limited human resources and technical capacity, as well as funding arrangements that fail to support proactive action to mitigate disaster and climate-related risks

Despite the enabling policy framework established by the DMA and NDMF and the clear commitment to climate change adaptation, reduction is challenging. Risk reduction, climate change mitigation and adaptation (and environmental issues more generally) have yet to be mainstreamed. All three are often treated as separate sectors, with environment-related concerns often receiving attention in the form of ‘green’ rather than cross-cutting issues (Sowman, and Brown, 2007) – or as “part of what the ‘environmental people’ do” (Faling et al, 2012, cited in van Niekerk, 2013:4). Discussions with officials working on disaster management and climate change issues and other stakeholders, as well as published literature identify several constraints. These include perceptions of risk reduction, human and technical capacities and funding arrangements.

9.1. Attitudes towards risk reduction and climate change

Knowledge and perceptions constitute a central constraint to risk reduction, particularly in the case of disaster risk reduction. On paper, the institutional and policy requirements stipulated in the DMA are largely in place. At the national level, the ICDM and NDMAF are functioning. As discussed in Box 8, provinces and municipalities have made considerable progress establishing disaster management centres, the various advisory forums aimed at fostering greater coordination (see Box 8). In practice, however, perceptions about disaster management and what it involves hamper both vertical, and to a much greater extent, horizontal integration. Role-players in other departments and functions continue to view disaster management in terms of emergency response and management and the provision of humanitarian relief to those affected by disasters (see too Hoogstad and Kruger, 2008; Roberts, 2010; Botha et al, 2011; van Niekerk, 2011; Faling et al, 2012; IFRC, 2012; van Niekerk, 2013). Role-players also frequently have a limited understanding of disaster risk and how risk reduction issues coincide with sectoral concerns. This hampers coordination at a range of levels, as actors fail to engage with disaster management institutions around planning and risk reduction.

This challenge is arguably compounded by the placement of the disaster management function within the government hierarchy, particularly at the local level. Disaster management is not a line function, but is instead a cross-sectoral coordinating one, requiring the authority to promote and harness action by a range of government institutions to reduce risk. International good practice positions disaster management within the highest political offices and structures, but disaster management in South Africa is placed within line-functions at the national, provincial and local level. In municipalities, it is usually placed within the emergency services, where it has limited visibility and influence (see too CoGTA, 2012; IFRC, 2012; Van Niekerk, 2011). This makes it difficult to promote or coordinate risk reduction. As Dewald Van Niekerk notes, the “functional application of disaster risk management (i.e. organising, leading, control,

finance provisions and coordination) and implementation of the DMA and the NDMF become constrained” (2011:10). He and other commentators argues that that risk reduction would be better enabled if disaster management was placed in the Presidency, and at the local level, the Mayoral Committees and other decision-making platforms.

Risk reduction and climate change are also hampered by the often intangible and long-term nature of both issues. Disaster risk may or may not translate into realised disasters, particularly at the intensive end of the spectrum; and where it does there may be years between events. The implications of GEC are just as uncertain. Although environmental change inevitable, it is unclear precisely what the nature and extent of the consequences will be. It is difficult to obtain buy-in to address these distant and uncertain impacts (Mather et al, 2010; Roberts, 2010; Simon, 2010; van Niekerk, 2013), particularly in the case of pressing and visible developmental concerns. Just as important, it is hard to see the results of effective intervention. As noted by Kofi Annan at the turn of the millennium, “building a culture of prevention is not easy. While the costs of prevention have to be paid in the present, its benefits lie in a distant future. Moreover, the benefits are not tangible; they are the disasters that did NOT happen” (Cited in UNISDR, 2002:1). It is nonetheless essential in order to avoid the human, and developmental costs of unmitigated risk.

Box 7: Progress in establishing the institutional framework for disaster management at the provincial and municipal level

The institutional framework stipulated in the DMA is largely in place. All provinces have established a dedicated Disaster Management Centre, as have all but one of the metros. All nine provinces and all the metros also have a disaster management framework and plan and have established an advisory forum. The municipal districts are also performing relatively well. Table 5 shows the proportion of districts in each province to have established these institutions and plans. The Northern Cape is the only province where all its districts have established centres, but more than half of all the Districts have established centres in all provinces except North West and the Free State. With the exception of the Northern Cape and Mpumalanga, all districts have formulated disaster management frameworks and the accompanying plans. Although not required by the Act, many districts have also established advisory forums.

Table 6: Proportion of district municipalities for institutional frameworks in place (2013)

Province	Disaster Centre		DM framework		DM plan		Advisory Forum		Total no. districts
	No.	%	No.	%	No.	%	No.	%	
Western Cape	3	60	5	100	5	100	3	60	5
Northern Cape	5	100	4	80	5	100	4	80	5
North West	2	50	4	100	4	100	4	100	4
Mpumalanga	3	100	2	67	3	100	2	67	3
Limpopo	3	60	5	100	5	100	5	100	5
KwaZulu-Natal	6	60	10	100	10	100	10	100	10
Gauteng	1	50	2	100	1	50	2	100	2
Free State	2	40	5	100	5	100	5	100	5
Eastern Cape	5	83	6	100	6	100	5	83	6

Source: DMRC, 2013

A scan of IDPs also suggests reasonable progress in fulfilling legislative requirements at the local level. Figure X, shows data from 37 IDPs from throughout South Africa. The IDPs chosen represent a convenience sample, of documents available online.

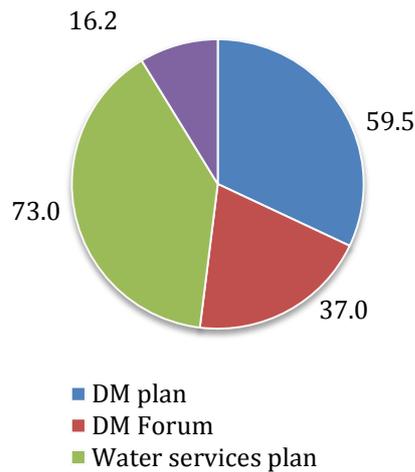


Figure 11: Proportion of municipalities with risk reduction & climate change-related plans & institutions

The sample includes 19 district or metropolitan municipalities, with the remainder drawn from local municipalities.

Although this is a very small sample, it provides an indication of the state of implementation within local government. It shows that two out of every three (60%) municipalities had a disaster management plan in place and incorporated into their IDP (the blue slice). Discounting the metros and district municipalities, almost two out of every five (37%) of the remaining local municipalities had established advisory forums (the red slice), even though not required to by the DMA. Only a handful had developed some variant of a climate change plan, although given the absence of regulatory framework or legal requirement to do so, this progress appears positive. A number envisaged developing a plan, while several had no specific strategy, but had various projects relevant to climate change.

Given the prospect of water scarcity in many areas, it is interesting to note that the majority (73%) have implemented some kind of water services and/or water management strategy.

9.2. Funding arrangements

Prevailing funding arrangements also hamper effective risk reduction. Funding mechanisms for disaster risk reduction, response and recovery do not currently support a proactive approach. This is partly due to a general lack of clarity about funding arrangements for risk reduction, response and recovery (CoGTA, 2012; Madubula and van Niekerk, 2012). While the DMA and DMAF establish an institutional framework, they provide little guidance on funding responsibilities, particularly at the local level (CoGTA, 2012). Existing funding mechanisms are also response-oriented. The primary funding mechanisms, such as conditional grants and disaster relief funds focus on emergency response.⁶ In a submission to the 2013/14 division of revenue process, the Fiscal and Financial Committee (FFC) argues that there is:

...inadequate funding for planning and prevention, as provincial and municipal budgets do not have the fiscal space for this purpose – conditional grants for natural disasters are [response] allocations. As disasters increase, public finance is unlikely to be able to cope with the reconstruction demands. Therefore, alternative measures must be

⁶The funding for community social relief has two main sources: general government funds collected through taxation and fund-raising activities in terms of the Fund-Raising Act 107 of 1978 (FRA). Several other funds have been established in terms of section 16 of the FRA: the Disaster Relief Fund, South African Defence Force Fund, Refugee Relief Fund, State President's Fund and the Social Relief Fund. (FFC, 2012).

considered to reduce the physical destruction caused by natural disasters. These measures include land-use planning, building standards that ensure a level of robustness against natural disasters, and developing and regulating domestic insurance markets, including introducing innovative market-based financing of disaster relief and recovery such as risk pooling, reinsurance, derivatives, micro-insurance and catastrophe bonds (Madubula and van Niekerk 2012:75).

The FCC also argues that sector departments do not integrate disaster risk reduction into their normal day-to-day operations. Very few sector departments fully understand their responsibilities with respect to disaster risk reduction or acknowledge their role in a proactive multi-sectoral approach. The FCC maintains that officials and politicians tend to view disaster risk management as solely the purview of the DRMCs, hampering the allocation of funding. Where funding is secured for risk reduction, the FCC argues that this is often coincidental rather than part of integrated, systematic efforts to reduce risk. They observe:

Most of the funding is masked as developmental projects (which it rightfully should be). However, the lack of knowledge and understanding of disaster risk reduction means that this integration happens almost by accident. Therefore, it could be argued that a crucial link to a new funding model is to develop and enhance the capacity of sector department officials to deal with disaster risk-reduction matters. Once the multi-sectoral and multi-disciplinary nature of disaster risk reduction is understood, evidence of disaster risk-reduction activities can be expected to appear in the various budgets, which will be financed by the Division of Revenue Act on an annual basis (Madubula and van Niekerk, 2012:76).

The conceptualisation of funding for capital expenditure is also constraining. It is widely recognised within the disaster risk management field that disasters provide a space to 'build back better'; while retrofitting is complex and expensive, damage to infrastructure provides space to rebuild in a way more resilient to future disasters. However, several of those spoken to during the course of the study noted that current funding mechanisms allow only for recreating infrastructure to the original specifications. They do not support innovation or adaptation, missing a valuable opportunity to reduce risk.

Box 8: Examples of innovative international funding arrangements for prevention

The challenge of resourcing risk reduction is common to countries across the globe, with many grappling with similar constraints. Strategies adopted elsewhere provide some examples of innovative resource mobilisation to support prevention activities.

The Philippines' new disaster management act, for example, stipulates that local government dedicate five percent of their income for disaster mitigation and response. 70% of this money is available for mitigation and preparedness measures and 30% to support rapid emergency responses. This policy represents a shift away from exclusively response-focused funding arrangement shift from prior rules, which only established "calamity funds" for contingency spending after a disaster had struck. The legislation also sets out the means for supplying that fund, including both local taxes and allotments from the national government (IFRC, 2011, cited in CoGTA, 2012).

The Indian disaster management act allows the central government to establish a National Disaster Mitigation Fund exclusively to support mitigation. All ministries and departments are required to allocate funding in their annual budget for carrying out the activities and programmes set out in its disaster management plan (India Disaster Management Act, 2005; India National Disaster Management Authority,

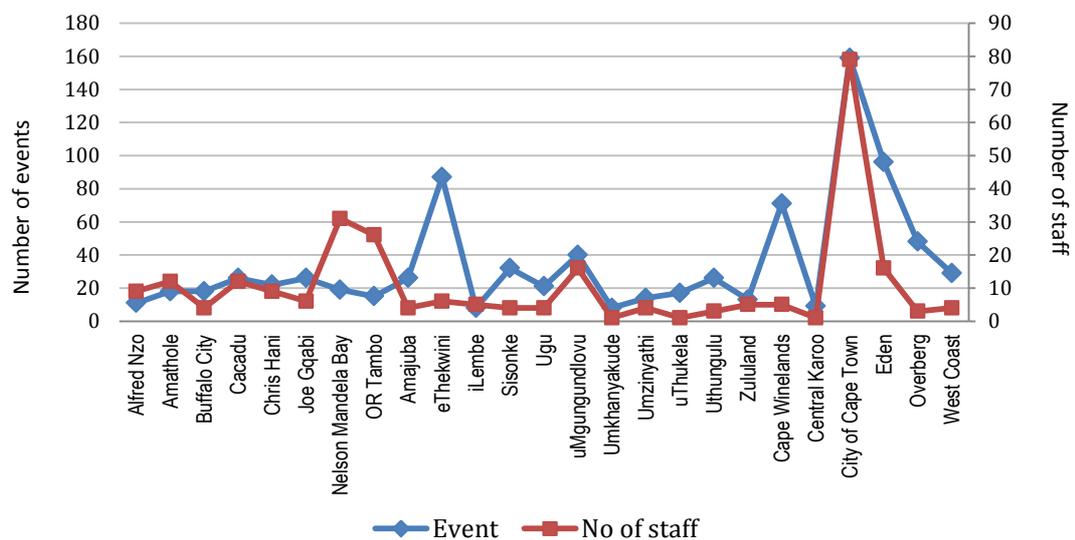
2009, cited in CoGTA, 2012). The Ministry of Finance allocates funds for strengthening disaster management institutions, capacity building and response mechanisms (India Ministry of Home Affairs, 2011, cited in CoGTA, 2013).

9.3. Limited technical expertise and capacity

Disaster management institutions also often have limited capacity to promote integration. The research suggests that this applies both with respect to horizontal coordination between disaster management and other government functions, and with respect to horizontal coordination within disaster management, particularly at the local level. There appears to be limited engagement or coordination officials working in other municipalities or districts, for instance.

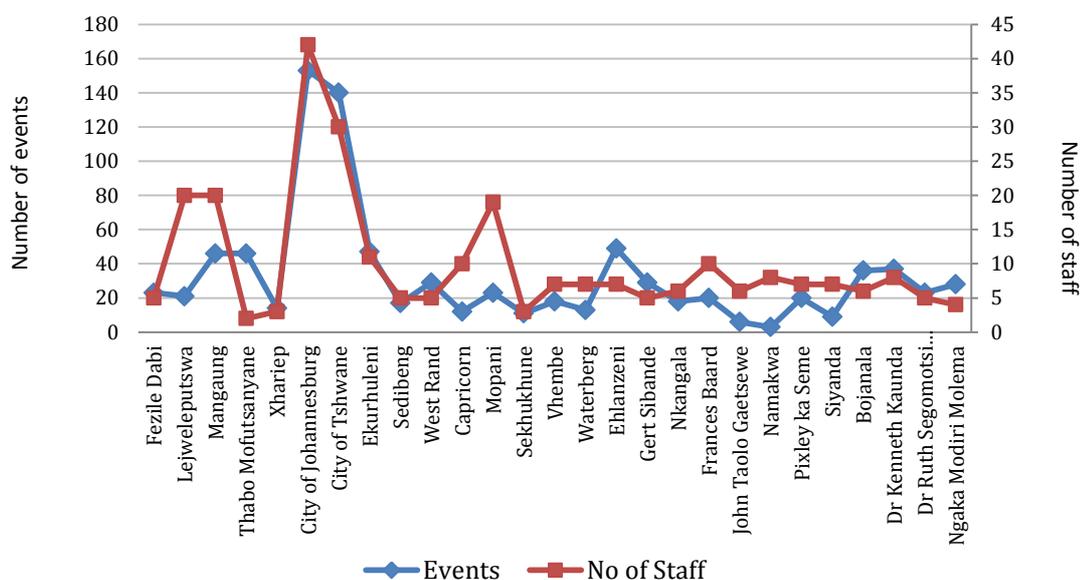
This is may be at least partly due to the limited human resources available. There is no readily available data on staffing with respect to posts filled compared to posts vacant or required, but a comparison between the number of disaster management personnel employed in municipalities and the cumulative number of hazard events provides some quantitative evidence on levels of human resource capacity at the local level. As illustrated in Figure 11 and 12, the number of staff (the red line) tracks well with the hazard burden (the blue) in many coastal and inland metropolitan areas and districts respectively. However, they also show that some areas with high hazard counts, such as the eThekwiini, Cape Winelands municipal districts, have few staff suggesting shortages of capacity.

Figure 11: Hazard events by disaster management personnel in coastal municipalities



Source: NDMC, 2013; Caelum

Figure 12: Hazard events by disaster management personnel in inland municipalities



Source: NDMC, 2013; Caelum

There is also often limited technical expertise available to design, guide and implement risk reduction measures. Writing on barriers to mainstreaming climate change adaptation strategies at the municipal level, Lorena Pasquini and colleagues (2013) note that municipal personnel often lack information on climate change, with few having the expertise to measure, predict or mitigate climate change concerns. Their study also found that staff frequently knew little about, or doubted the relevance and applicability of ‘soft’ mitigation measures such as protecting and restoring wetlands in order to mitigate flooding, preferring infrastructural solutions. Sowman and Brown (2007) attribute the limited success in mainstreaming broader environmental issues to both a lack of technical knowledge and financial resources, particularly in smaller municipalities. They note that although large metropolitan areas have units and personnel, very few smaller municipalities have a dedicated planner, let alone an environmental specialist on staff. As discussed earlier, municipalities face similar constraints with respect to water and stormwater management, as well as other sectors relevant to risk reduction and resilience.

10. Integrating risk reduction and climate change: A case study

Key points:

- Although challenging, it is possible to introduce a broad risk agenda into planning at the municipal level, although actual mainstreaming may be difficult
- Champions, dovetailing risk reduction into existing agendas and programmes, and tapping expertise both within and outside of government can help to drive and strengthen programmes
- It is essential to integrate disaster and climate risk reduction; the disaster management function has a core role to play in programmes aimed specifically at addressing climate

change, as do a range of other government departments

- Risk is transversal and interconnected. Activities to reduce risk in one area can increase it in others, making it essential to communicate, plan and implement across sectors

Efforts to integrate climate change adaptation into planning in eThekweni illustrate many of these challenges, as well as factors that can facilitate coordinated planning. The City's approach is considered an example of local best practice, and is strongly informed by the simultaneous desire to reap potential development-linked co-benefits and ensure that development gains are not undermined, lost or exacerbated by climate change (Roberts, 2010).

In 2004, eThekweni Municipality's Environmental Planning Department established a Municipality Climate Protection Programme (MCPP). In 2006, the programme launched its Headline Climate Change Adaptation Strategy (HCCAS). This identified municipal sectors likely to be impacted by climate change and highlighted adaptation options. These included human health, water and sanitation, solid waste, the coastal zone, biodiversity, infrastructure, food security, strategic planning, economic development and risk reduction. Building on this process, the third phase of the programme focused on developing an integrative assessment tool to evaluate long-term plans and policies concerning the impacts of climate change. In 2009, it developed municipal adaptation plans (MAPs) for three pilot departments. The fourth, ongoing phase involves the mainstreaming of climate change concerns into city planning and development and the establishment of the Climate Protection Branch (Roberts, 2010). Work has also begun on community-based adaptation and responses to slow onset disasters, food security and water constraints (Carmin et al, 2012).

Several factors have helped to establish the programme. These include the existence of champions to drive the climate change agenda, linking adaptation to existing departmental agendas and building on existing programmes, as well as drawing on expertise from within government, environmental non-governmental organisations, consultants and the research community (Carmin et al, 2012). As is often the case with advances in risk reduction programming generally, losses resulting from a series of storms served to generate interest in climate change adaptation, and particularly the attention of eThekweni's mayor, who was instrumental in organising a provincial summit to discuss ways of addressing climate change. This leadership was essential for creating and sustaining the necessary momentum for the programme. It has also benefitted from the expertise of a range of well-known and respected technical experts, who have been able to shape innovative and pioneering adaptation tools (Mather et al, 2010). A key feature of the programme's success has also been learning to provide stakeholders with relevant, understandable information that enables them to understand and make effective decisions to reduce risks associated with climate change.

In assessing the programme's effectiveness, Debra Roberts, a driving force behind the MCPP, highlights many of the challenges discussed in the previous section. She argues that although the HCCAS process helped to engage municipal actors, it did not result in substantial action. She attributes this to a number of factors including role-players' workloads, the prioritisation of other issues and a shortage of skills and funds, as well as the dominant perception that addressing climate change was the responsibility of the Environmental Management Department.

In an effort to address these weaknesses, the Department took the decision to develop and implement sector specific adaptation plans. These were aligned with existing business plans, development objectives and available funding and skills and were piloted in three sectors: health, water and disaster management. Roberts notes that although this sector-based planning was contrary to prevailing the consensus that adaptation should be integrated and cross-cutting, it represented the only practical means by which to “begin mainstreaming the process of adaptation planning a municipal environment dominated by competing and often conflicting sectoral and political interests” (2010:401).

The process of developing the HCCAS and adaptation plans highlighted several learning points. It showed that although some sectors such as water were well positioned to adopt adaptation measures, and were already undertaking activities that dove-tailed with adaptation initiatives, others such as economic development demonstrated limited awareness or prioritisation of climate change issues. Of particular relevance to this paper, it also highlighted both the importance of disaster management in climate change adaptation, although she argues that:

What was not fully recognized and understood at the time, however, was the centrality of the disaster management function to effective cross-sectoral and comprehensive climate change adaptation planning. Subsequent development of the adaptation work stream has highlighted the fact that without a strategically placed and fully functional disaster management system, local level resilience will ultimately be a pipedream (2010:401).

In keeping with the findings in previous section, Roberts argues that the disaster function has generally been undervalued and often overlooked within the municipal hierarchy in eThekweni, to the detriment of adaptation. This is partly due to a shortage of skilled and experienced staff. However, it is primarily due the perception of disaster management as a responsive function, which undermines its ability to effectively involve municipal departments in risk assessment, monitoring and response activities. She believes that this represents a “fatal flaw” in any attempt to create a more resilient city, concluding that:

The overall conclusion reached during the development of the disaster management municipal adaptation plan was that the municipality’s lack of recognition of the critical and strategic nature of the function means that Durban is currently poorly placed to deal with the challenges posed by incremental climate risk (2010:403).

The process also underscored the interconnectivity of sectoral actions. It showed that progress in disaster management needed to be matched with supportive action in the other pilot sectors. She argues, for example, that without the capacity of stormwater catchment and attenuation infrastructure to handle increased run off and rainfall, or an improved health care system able to deal with emergencies, gains in risk reduction will suffer as the scale and number of non-adaptable emergencies increases. Actions in one area are also likely to impact on others, underscoring the importance of effective communication across sectors. When it was proposed that rainwater tanks be installed in a new housing development to harvest rainfall, for instance, health officials warned that the malarial belt is expected to move southwards as conditions warm, and that with adequate insect control, the tanks could increase the threat of malaria, leading to changes in approach (Mather et al, 2010).

This case study shows that although challenging, risk reduction generally, and climate change specifically, can be introduced in innovative ways into the broader planning and development agenda. With political support, the right technical expertise and effective communication, “the roll-out of a successful adaptation plan can be achieved even in the context of limited resources and high level development processes” (Mather et al, 2010:562). It underscores close and reciprocal relationship between disaster risk reduction and climate change adaptation, and the importance of integrated action to address the broader, common urban risk environment. It also highlights the many obstacles involved in drawing diverse actors into activities, including the disaster management function. The key challenges are changing other stakeholders’ attitudes towards the role and relevance of disaster management and climate change amongst a range of role-players, mobilising and embedding both the commitment and capacity to respond.

11. Conclusion and recommendations

This paper illustrates that although disaster and climate-related risk are often viewed separately from developmental concerns, they are inherently developmental and transversal issues. Disaster risk is embedded in under, inappropriate and poorly managed development, while disasters stand to wipe out and erode development gains. Sustainable development hinges on successfully mitigating urban risk. This is particularly so in urban areas, which concentrate people, infrastructure and resources. The stakes are especially high given inevitable environmental change, which stands to increase losses in lives, livelihoods and infrastructure in the future. Given the prospect of more and more severe losses, there is an urgent need to reduce vulnerability in South Africa’s urban areas and build their resilience to both disasters and the implications of GEC.

This cannot be the responsibility of either the disaster management or environmental sectors. Urban risk is driven by multiple natural and human-induced factors and has implications for diverse resources, poverty reduction, human security, health, settlement design, infrastructural and other investments, and economic growth. These reciprocal linkages are interconnected and extend across sectors, with action in one area likely to impact on risk and risk reduction in others. This makes strategic risk management in urban areas is not only a transversal necessity, but also a nested sectoral responsibility. Risk accumulates and impacts in multiple spheres and must be addressed equally diversely.

Overall, the findings highlight four broad conclusions and potential action points to consider in developing an overarching urban development framework:

- **It is essential to de-silo risk reduction and climate change.** Reducing urban risk is critical to the achievement of broader developmental objectives in urban areas. Proactive action to address risk is not an ad-on; it is integral to creating sustainable growth pathways. It is also important to address both disaster risk reduction and climate change adaptation as part of a single, interconnected urban risk domain.
- **Addressing urban risk requires a strong emphasis on prevention.** Although it is necessary to ensure that cities and towns plan for, manage and respond effectively disasters and emergency events, good practice emphasises proactive risk reduction to mitigate the likelihood of disasters occurring in the first place. It is often difficult

to harness commitment and funding for potential outcomes – the disasters that do not happen – but the costs of failing to do so are likely to be very high.

- **Urban risk concerns must be incorporated into short, medium and long-term planning across sectors.** Development must be sensitive to disaster and climate risks, while strategic risk management needs to be a development priority. Ameliorating institutional and financial constraints, particularly visibility and authority of risk reduction institutions and response-oriented funding arrangements, could help to improve the prospects for effective risk reduction.
- **It is vital to draw and promote the linkages between risk reduction and sectoral concerns.** Role-players from other sectors frequently have limited understanding urban risk environment, and their role in reducing risk. It is essential to begin making these connections, and initiating even only conceptually the relevance and importance risk reduction to the larger urban picture.

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Appendix 1: Data tables for disaster losses

National, provincial, parastratal and private sector losses to Western Cape severe weather events (Figure 2, Figure 2)

Department/Municipality	Total for 8 events (March 2003 - Nov 2008)		Average Total for 8 events (March 2003 - Nov 2008)	
	Absolute	Adjusted for Inflation of 2005	Absolute	Adjusted for Inflation
National Departments				
Transnet	5,000,000.00	4,338,500.00	5,000,000.00	4,338,500.00
Dwaf	44,280,000.00	40,732,941.00	7,380,000.00	6,788,823.50
SanParks	13,600,000.00	11,928,520.00	6,800,000.00	5,964,260.00
SanRAL	89,813,693.02	84,017,352.39	29,937,897.67	28,005,784.13
National Dept. Total	153,283,693.02	141,017,313.39		
Provincial Departments				
Housing	112,587,338.37	100,171,726.86	28,146,834.59	25,042,931.72
Agriculture	1,241,749,496.74	1,052,695,720.82	177,392,785.25	263,173,930.21
Cape Nature	12,569,480.00	11,434,844.80	4,189,826.67	2,858,711.20
Education	4,848,350.00	4,826,949.50	1,212,087.50	1,206,737.38
Provincial Roads	694,564,975.00	620,724,134.77	99,223,567.86	155,181,033.69
Public Works	12,960,000.00	12,165,552.00	12,960,000.00	3,041,388.00
Social Dev.	1,959,000.00	2,092,861.50	391,800.00	523,215.38
Emergency Services	100,000.00	112,160.00	100,000.00	28,040.00
Provincial Dept. Total	2,081,338,640.11	1,804,223,950.25		
District and Local Municipalities				
West Coast				

Bergriver	14,902,596.00	12,919,726.59	7,451,298.00	6,459,863.30
Cederberg	42,553,100.00	35,723,576.87	21,276,550.00	17,861,788.44
Saldanha Bay	1,460,000.00	1,266,842.00	1,460,000.00	633,421.00
Matzikama	8,594,000.00	7,156,601.00	4,297,000.00	3,578,300.50
Swartland	4,894,368.62	4,122,970.44	2,447,184.31	2,061,485.22
West Coast Total	72,404,064.62	61,189,716.90		
Cape Winelands				
Breede River/ Winelands	16,595,547.42	13,814,864.74	4,148,886.86	3,453,716.19
Breede Valley LM	6,274,300.00	4,984,931.35	6,274,300.00	1,246,232.84
Stellenbosch	211,838.00	183,811.83	0.00	45,952.96
Cape Winelands	1,454,460.00	1,467,448.47	727,230.00	366,862.12
Cape Winelands Total	24,536,145.42	20,451,056.39		
Overberg				
Swellendam	53,449,120.00	44,417,478.74	13,362,280.00	11,104,369.69
Overstrand	755,000.00	599,847.50	755,000.00	599,847.50
Theewaterskloof	13,898,440.00	11,832,756.39	6,949,220.00	5,916,378.20
Cape Agulhas	12,007,215.00	10,661,190.00	6,003,607.50	5,330,595.00
Overberg DM	3,030,000.00	3,194,832.00	3,030,000.00	3,194,832.00
Overberg Total	83,139,775.00	70,706,104.63		
Eden District Municipality				
Bitou	35,677,172.00	31,019,361.36	17,838,586.00	15,509,680.68
Eden District	55,300,008.00	49,919,806.57	13,825,002.00	12,479,951.64
George	66,210,189.61	58,974,712.88	16,552,547.40	14,743,678.22
Hessequa	62,812,000.00	57,556,011.20	12,562,400.00	11,511,202.24
Kananaland	10,507,500.00	9,246,212.00	3,502,500.00	3,082,070.67
Knysna	105,448,066.00	94,270,397.01	26,362,016.50	23,567,599.25
Mossel Bay	56,934,324.70	50,499,454.60	28,467,162.35	25,249,727.30
Oudtshoorn	9,118,500.00	8,407,276.45	4,559,250.00	4,203,638.23
Eden Total	402,007,760.31	359,893,232.07		

Central Karoo				
Prince Albert	382,000.00	358,583.40	382,000.00	358,583.40
Central Karoo Total	382,000.00	358,583.40		
Municipality Total	582,469,745.35	512,598,693.39		
Parastatals				
Eskom	5,400,000.00	5,091,820.00	2,700,000.00	2,545,910.00
Spoornet	82,246,640.00	74,719,920.97	41,123,320.00	37,359,960.49
Telkom	808,983.65	749,529.42	404,491.83	374,764.71
Parastatal Total	88,455,623.65	80,561,270.39		
Private Sector				
South African Insurance Agency	21,019,753.16	20,316,976.64	10,509,876.58	10,158,488.32
Bellair Dam	14,000,000.00	15,702,400.00	14,000,000.00	15,702,400.00
Irrigation Boards	163,000.00	182,820.80	163,000.00	182,820.80
Private Sectors Total	35,182,753.16	36,202,197.44		
Total for 8 cut-off lows	2,940,730,455.29	2,574,603,424.86		

Appendix 2: Tables for riots and protests data

Reported protests and riots (1993-2012) (Figure 10)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Eastern Cape	1	2	1	1		3	2		8	1	4	3	2	1	7	157	193
Gauteng	10	4	12	9	19	41	19	13	40	19	40	35	68	16	22	162	
KwaZulu-Natal	5	2	3	3	4	3	3	1	5	6	9	10	12	5	9	109	189
Limpopo	3					2			3	1	1	2		1		53	

Mpumalanga	3		1			7	5	2	5	3	1	2	11	2	6	37	85
North West	1	4		2	4	1	1	1	6		10		1	6	2	121	
Northern Cape			1		3	1	1		2					1	2	24	35
Free State	1		1	2	4	1	1	8	8	1		3	1		3	33	
Western Cape	4	4	7	10	11	12	15	3	16	12	14	5	15	8	9	299	444

Proportion of population receiving basic services (2011) (Figure 11)

Local Municipality	Population 2011	Household 2011	Flush toilet %	Weekly refuse %	Piped water %	Electricity %
Eastern Cape						
Buffalo City	755 200	223 568	68.8	70.4	52.6	80.9
Cacadu	450 584	125 632	40.4	78.7	51.0	87.3
Amathole	892 637	237 776	14.8	15.9	12.1	69.8
Chris Hani	795 461	210 852	31.2	28.3	23.4	76.3
Joe Gqabi	349 768	97 775	23.8	28.0	17.6	69.0
O.R.Tambo	1 364 943	298 229	10.6	10.7	8.9	70.2
Alfred Nzo	801 344	169 261	5.1	6.3	5.8	46.2
Nelson Mandela Bay	1 152 115	324 292	87.4	82.9	74.1	90.5
Eastern Cape	6 562 052	1 687 385				
Free State						
Xhariep	146 259	45 368	77.5	66.0	42.7	92.2
Lejweleputswa	627 626	183 163	75.5	79.8	47.6	90.9
Thabo Mofutsanyane	736 238	217 884	48.9	49.2	33.6	87.2
Fezile Dabi	488 036	144 980	78.2	81.7	56.7	89.8
Mangaung	747 431	231 921	60.7	78.9	46.1	91.4
Free State						
Gauteng						
Sedibeng	916 484	279 768	84.5	88.2	67.5	90.6
West Rand	820 995	267 397	76.1	76.8	53.6	81.7
Ekurhuleni	3 178 470	1 015 465	85.0	88.4	57.2	82.2
City of Johannesburg	4 434 827	1 434 856	87.1	95.3	64.7	90.8
City of Tshwane	2 921 488	911 536	76.6	80.7	64.2	88.6
Gauteng						
KwaZulu-Natal						
Ugu	722 484	179 440	18.2	24.6	24.6	71.9
Umgungundlovu	1 017 763	272 666	42.0	44.3	42.7	86.1
Uthukela	668 848	147 286	31.9	33.1	28.7	74.5
Umzinyathi	510 838	113 469	18.9	20.2	17.5	48.9
Amajuba	499 839	110 963	46.1	57.4	43.1	83.8
Zululand	803 575	157 748	19.1	22.4	22.3	69.8
Umkhanyakude	625 846	128 195	9.9	9.0	13.4	38.4
Uthungulu	907 519	202 976	27.2	29.6	30.5	75.8
iLembe	606 809	157 692	22.5	34.4	23.7	71.4
Sisonke	461 419	112 282	17.6	20.7	14.7	62.4
eThekweni	3 442 361	956 713	63.4	86.1	60.2	89.9
KwaZulu-Natal						
Limpopo						
Mopani	1 092 507	296 320	15.8	16.9	16.8	88.7
Vhembe	1 294 722	335 276	13.9	13.7	15.4	87.2
Capricorn	1 261 463	342 838	26.6	29.7	23.3	87.4
Waterberg	679 336	179 866	43.6	44.2	30.7	86.7

Sekhukhune	1 079 840	263 802	6.3	8.2	9.3	85.9
Limpopo						
Mpumalanga						
Gert Sibande	4 039 939	1 075 488	64.0	63.6	44.3	83.4
Nkangala	1 308 129	356 911	48.7	48.3	40.6	85.7
Ehlanzeni	1 688 615	445 087	21.5	24.7	26.4	88.9
Mpumalanga						
North West						
Bojanala	1 507 505	501 696	33.4	49.2	26.0	84.2
Ngaka Modiri Molema	842 699	227 001	28.0	35.4	25.2	80.4
Dr Ruth Segomotsi Mompati	463 815	125 270	32.2	26.9	18.6	82.2
Dr Kenneth Kaunda	695 933	208 047	84.2	75.3	47.9	88.6
North West						
Northern Cape						
John Taolo Gaetsewe	224 799	61 331	26.2	26.0	22.6	87.0
Namakwa	115 842	33 856	57.9	80.1	63.3	86.5
Pixley ka Seme	186 351	49 193	65.7	72.6	47.0	85.1
Siyanda	236 783	61 097	63.9	70.3	48.5	86.6
Frances Baard	382 086	95 929	77.2	74.3	52.0	83.3
Northern Cape						
Western Cape						
City of Cape Town	3 740 026	1 068 573	88.2	94.3	75.0	94.0
West Coast	391 766	106 781	77.7	76.5	78.7	94.4
Cape Winelands	787 490	198 265	86.7	79.9	75.9	92.8
Overberg	258 176	77 196	74.2	83.2	76.1	91.2
Eden	574 265	164 110	78.3	86.4	71.8	91.1
Central Karoo	71 011	19 076	77.6	78.7	77.2	89.4
Western Cape						