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Climate Change, Assets and Food Security in Southern African Cities

EARTHSCAN CLIMATE

Edited by Bruce Frayne, Caroline Moser
and Gina Ziervogel

There is overwhelming evidence that the climate is changing. It is the poorest countries and people who are the most vulnerable to this threat and who will suffer the most. This book shows how increasing urbanization and growing poverty levels mean that it is imperative to ask how climate change might impact on asset accumulation and food security for the urban poor. It demonstrates how these three, often separate foci, can be brought together to frame a holistic urban adaptation approach.

Furthermore, although much has been written about climate change, limited evidence exists in southern Africa of how climate change has been integrated in urban planning. The authors explore the urban climate change nexus linking asset adaptation, climate change science and food security through several case study cities. These include Cape Town, George and //Khara Hais (South Africa), Lusaka (Zambia), Maputo (Mozambique), Mombasa (Kenya) and Harare (Zimbabwe). The results shed light on how this nexus might be explored from different perspectives, both theoretical and practical, in order to plan for a more resilient future.

The book comprises ten chapters which focus on southern African cities, with each chapter written by highly experienced academics, research-focused practitioners and professional planners. Although the book concentrates on southern African cities, the insights that this book presents can be used to understand other urban centres in low and middle-income countries outside of this region and around the world.

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Government of Kenya, Attorney General (2009) *The Physical Planning Act*, chapter 286, Revised edition 2009 (1996). Nairobi: National Council of Law Reporting.
Government of Kenya, Ministry of Lands (2007) *The National Land Policy*. Nairobi: Ministry of Lands.
Government of Kenya, Ministry of Planning and National Development (2008) *Mombasa District Development Plan 2008–2012*. Nairobi: Ministry of Planning and National Development.
Government of Kenya, Ministry of State for Planning (2009) *2009 Census National Development and Vision 2030*. Nairobi: Government of Kenya.
Government of Kenya, National Bureau of Statistics (2007) *Kenya National Bureau of Statistics*. Nairobi: Government of Kenya.
Government of Kenya, National Bureau of Statistics (2009). Population and housing census highlights. *Kenya National Bureau of Statistics*. Nairobi: Government of Kenya.
Government of Kenya, National Environment Management Authority (2007) *Integrated Coastal Zone Management Policy*. Nairobi: National Environment Management Authority.
Hoyle, B. (2000) 'Port Development', in J. Hoorweg, D. Foeken and R. Obudho (eds), *Kenya Coast Handbook: Culture, Resources and Development in the East African Littoral*. Hamburg: LIT Verlag.
ILISHE Trust (2004) *Mapambano: A Documented Account of Land Struggles in Majaoni and Mwembelegeza*. Nairobi: Claripress.
Intergovernmental Panel on Climate Change (IPCC) (2007) *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Core Writing Team, Pachauri, R. K. and Reisinger, A. (eds)). Geneva, Switzerland: IPCC.
Lubaale, G. (2009) 'The impacts of and response to the food, fuel and financial crisis', (unpublished report), Sussex: IDS.
Meijerink, G., Roza, P. and Berkum, S. (2009) *East African Governments' Responses to High Cereal Prices*. The Hague: LEI Wageningen.
Moser, C. (2009) 'A conceptual and operational framework for pro-poor asset adaptation to urban climate change', paper presented at Fifth Urban Research Symposium 2009: Cities and Climate Change: Responding to an Urgent Agenda, June.
Mute, S. M. and Kibe, A. M. (2009) 'The Effects of East African Low Level Jet on Food Security in Horn of Africa: A Case Study of Coastal Region of Kenya'. *African Journal of Food, Nutrition and Agricultural Development*, 9, 8: November.
Olima, W. and Kreibich, V. (eds) (2002) 'Urban Land Management in Africa', *Spring Research Series*, 40.
Rakodi, C. I., Kreibich, V. and Olima, W. (2002) 'Interactions between Formal and Informal Urban Land Management: Theoretical Issues and Practical Options', *Urban Land Management in Africa: Spring Research Series*.
Rarieya, M. and Fortun, K. (2010) 'Food Security and Climate Information, Kenyan Challenges', *Sustainability Science*, 5: 99–114.

A SPATIAL PLANNING PERSPECTIVE ON CLIMATE CHANGE, ASSET ADAPTATION AND FOOD SECURITY

The case of two South African cities

Willemien Faling

Introduction

Most studies on climate change in Africa are driven by the atmospheric sciences community and are disconnected from development-related issues. Thus, they remain inadequate to address the interconnected challenges facing the continent (Scholes *et al.*, 2008). If climate change and its effects are left unchecked, the plight of millions of poor households in Africa will only worsen in future. Moreover, should climate change go unabated, it could undermine or even reverse attempts toward achieving sustainable development (IPCC, 2007; World Bank, 2006).

There are strong links between climate change, asset adaptation and food security and the focus of this chapter is on how spatial planning at a city-wide level can reduce the consequences of climate change and contribute to asset adaptation and food security. The chapter describes the vulnerability of South African cities to climatic changes due to a combination of rapid, unplanned urbanisation, and spatial inequalities and inefficiencies. This is followed by a description of climate change risks for livelihoods, poverty, asset adaptation and food security. The second section discusses case studies of two local municipalities in South Africa illustrating the need for development plans that integrate climate change strategies. These cities, similar to others in developing countries, have to confront the dual challenge of protecting the natural environment, whilst pursuing economic growth in a sustainable manner in the face of multiple social, economic, political and environmental stresses occurring at various levels (Government of South Africa, Department of Science and Technology, 2007). The last section explains

how spatial planning can intervene at a local level to address climate change, asset adaptation and food security, with the objective of building resilience.

Consequences of climate change for South African cities

Projected climatic changes over South Africa

The Intergovernmental Panel on Climate Change (IPCC) in its *Fourth Assessment Report* projects the following climate changes and variability for Africa: temperature increases, sea level rise, more frequent and severe weather events, flooding, droughts, tropical cyclones and heat waves – with consequences for human settlements, infrastructure, ecosystems, health, energy, housing, water and food security, migration, agriculture, tourism and biodiversity among others (Boko *et al.*, 2007).

In considering these issues, the IPCC expects the annual mean air temperature in Africa to increase between three and four degrees Celsius for the period 2088–2099 compared to 1980–1999 under the medium-high emissions scenario. Using regional climate models, Hewitson and Crane (2006) and Engelbrecht *et al.* (2009) project that South Africa will generally become drier, although summer rainfall will increase over the central interior, the Drakensberg Mountains and eastern parts of the country. A significant decrease in winter rainfall will be experienced in the south-western Cape, and significantly less summer rainfall in the Limpopo Province. The central interior of the country is the only region that is projected to become wetter in the climate scenarios (Engelbrecht *et al.*, 2009). The regional models furthermore suggest an increase in the frequency of heavy rainfall events in South Africa (Meadows, 2006).

Vulnerability of South African cities to climate changes

Not all cities and not all households are equally vulnerable to the impacts of climate change. Vulnerability refers to

> the degree to which a system (community) is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system (community) is exposed, its sensitivity, and its adaptive capacity.
>
> (UNFCCC, 2010)

Vulnerability thus consists of bundles of natural, physical, economic, social, political, spatial, technical, cultural, motivational, ecological and institutional stresses that are unevenly distributed within society (UNISDR, 2009; Anderson and Woodrow, 1998).

Spatial inequalities and inefficiencies

Spatial inequalities, fragmentation and urban sprawl are characteristic products of apartheid spatial planning. However, in more recent times the need to house the urban poor at a very low cost and within a short time frame has led to low-density housing projects on the urban periphery – entrenching these spatial patterns. The majority of poor households are located furthest from socio-economic opportunities, denying the most vulnerable of the population equal access to employment opportunities, wealth creation and social infrastructure (Government of South Africa, The Presidency, 2006; Boraine *et al.*, 2006; du Plessis *et al.*, 2003). This sprawl and de-densification of cities have created capacity problems for network infrastructure and increased the cost of new service connections. It also means that mass-transit systems are not viable, placing huge transaction costs on the poor by them having to commute increasingly longer distances to and from work using mini-bus taxis (Behrens and Wilkinson, 2003; du Plessis *et al.*, 2003). Thus, poor households that are spatially marginalised have less income and time to invest in assets that could protect them from climate change and food insecurity.

Rapid, unplanned urbanisation

Urbanisation continues unabated in South Africa. Urbanisation in itself is not negative, for there is a strong correlation between urbanisation and economic growth, but the inadequacies in the response by governments to urbanisation increase the vulnerabilities of the poor. Political choices, and not a lack of resources, result in not everyone sharing in the benefits that urban areas have to offer (Satterthwaite *et al.*, 2010).

Due to urbanisation and smaller household formation, the demand for housing and services in South Africa is much greater than the supply by local governments (Boraine *et al.*, 2006). Consequently, informal settlements appear, often overnight, in high-risk zones susceptible to flash floods, landslides and/or sinkhole formation, this either being the only vacant land available, or close to employment opportunities and transportation routes. Informal settlements (unless upgraded) have no infrastructure or emergency service provision, and are constructed from poor building materials. This combination of high population densities, substandard housing and infrastructure, and projected climatic changes deepens vulnerability and puts low-income households at risk of loss of livelihoods, ill health, social tension, deepening poverty and the destruction of productive assets (Laukkonen *et al.*, 2009; Roy, 2009; World Bank, 2008; Parnell *et al.*, 2007; Bulkeley and Betsill, 2005; Annan, 1999).

Climate change risks for South African cities

Urban risk is a consequence of countless feedback loops and thresholds and competing ideas. A relatively minor catalyst can breach the critical threshold and initiate a series of knock-on events with repercussions throughout the urban

system (Pelling, 2003). Climate change might be just such a catalyst. For some cities the impacts from climate change may be insignificant, while catastrophic for others, and outside their experience and ability to control. The poorest and most vulnerable communities are most likely to be the most affected (ALNAP and ProVention, 2009; Puppim de Oliveira, 2009).

Poverty, livelihoods and asset adaptation

Apartheid systematically and purposefully restricted the majority of South Africans from meaningfully participating in the economy. The assets of millions of people were directly and indirectly destroyed and access to skills and to self-employment was racially restricted. Partly as a result of this, pervasive poverty and unemployment are the foremost challenges facing the country (Government of South Africa, The Presidency, 2009). Poverty and vulnerability to climate change are closely linked with the most poor usually being amongst the most vulnerable. Parnell *et al.* (2007) describe a number of reasons why the poor are vulnerable: they lack skills and assets and therefore their livelihoods are at risk; cities in developing countries have limited safety nets such as welfare or health care systems; and many have informal or illegal residential status and cannot access welfare.

Households in South African cities have to contend with chronic or everyday risks as a function of their daily existence (Parnell *et al.*, 2007). Everyday risks lower people's threshold of resilience and pave the way for catastrophic events as they have very few resources to fall back upon. At the same time, everyday risks lower people's willingness to prepare for catastrophic events, as risk becomes an accepted part of life. This leads to the ratchet effect of vulnerability where each succeeding event reduces the resources of a household to resist and recover from the next shock (Wisner and Pelling, 2009; Pelling, 2003; Oelofse, 2002).

Many households depend heavily on the climate for their livelihoods, yet extreme weather conditions are common in South Africa, disrupting various socio-economic sectors. More frequent events caused by climate change are likely to deepen poverty and increase vulnerability, since injury, disability and loss of life directly affect the main asset of the poor: their labour (Scholes *et al.*, 2008). "Climate change will almost certainly make the process of eradicating poverty ... more difficult because of direct effects on poor people's livelihoods and the assets upon which they depend" (Laukkonen *et al.*, 2009).

Food insecurity

It is projected that climate change will result in overall reduced food production in South Africa (Benhin, 2006). South Africa is a semi-arid, water-stressed country. Climate change will exacerbate water scarcity due to a combination of increased demand, reduced groundwater recharge and deteriorating quality

(Meadows, 2006). Furthermore, changes in temperature and precipitation due to climate change, coupled with continued emissions of greenhouse gases, will bring changes in land suitability and crop yields. This will result in some cultivated areas becoming unsuitable for crops, and others requiring more irrigation. However, many farmers in South Africa cannot afford irrigation systems, thus when rainfall is late, early or low, it has wider consequences for national food security. Temperature increases will also enhance the ability of pest populations to survive the winter and attack crops in spring (Mannak, 2008; Schmidhuber and Francesco, 2007).

Urbanisation and population growth will further strain water sources and challenge food security as more land is needed for urban expansion, while the demand for food will increase. Food chains have complex linkages: the dependence on long international food supply chains, fuel and other goods makes populations vulnerable to rising food and fuel prices. Climate change-induced disasters also disrupt food demand and supplies, placing particularly low-income households at risk from food shortages or staple food price increases (Satterthwaite *et al.*, 2010). Low-income urban households already struggle to meet their nutritional needs due to an inability to earn a decent income and the high price of food. Whereas households access food mainly through markets, subsistence farming, urban–rural linkages and sharing with other households, studies have revealed an increased dependence on market purchases among low-income communities, resulting in households spending increasingly more of their income on food (Baiphethi and Jacobs, 2009; Hendriks, 2005).

The next section considers the need for spatial planning interventions in two municipalities in South Africa, given environmental degradation and climatic changes.

The case of two South African cities

The Northern and Western Cape provinces in South Africa have been identified as two regions at risk from future climate variation and change (Midgley *et al.*, 2005; Rutherford *et al.*, 1999). Two municipalities in these provinces – George and //Khara Hais – were selected for a study commissioned by the South African National Disaster Management Centre in 2009. This section investigates how the two municipalities, faced with diverse but challenging climates, fared in anticipating and planning for climate change, food security and asset adaptation.

//Khara Hais Local Municipality

//Khara Hais is situated in the Siyanda District Municipality (Figure 9.1) in the Northern Cape Province of South Africa, a unique semi-desert area with hot average daytime temperatures and low precipitation. The municipal area includes

the city of Upington, extensive stock farms and a narrow strip of intensive irrigation farming settlements about 15 to 20 kilometres apart on both sides of the Orange River. Agriculture (particularly dates, grapes and cattle), local commerce and tourism are the most significant economic sectors and depend heavily on the Orange River that runs through the municipality. The population is small, and only 25 per cent of the population is economically active, mostly in the agricultural sector. Other development constraints include poverty, poor skills, unemployment and HIV/AIDS (//Khara Hais Local Municipality, 2008, 2007; Siyanda District Municipality, 2008, 2007).

Climate change and environment degradation

//Khara Hais is periodically threatened by prolonged droughts. When it does rain, it results in flooding, erosion, instability in the vegetation and a decrease in biodiversity (Oosthuizen and John, 2005). It became evident from interviews with farmers, businesses and officials that the weather has become more erratic and the seasons have changed in nature. For example, summers have become even hotter and drier with high intensity rainfall. In addition, the water quality has systematically degraded over time because of growing agricultural and industrial

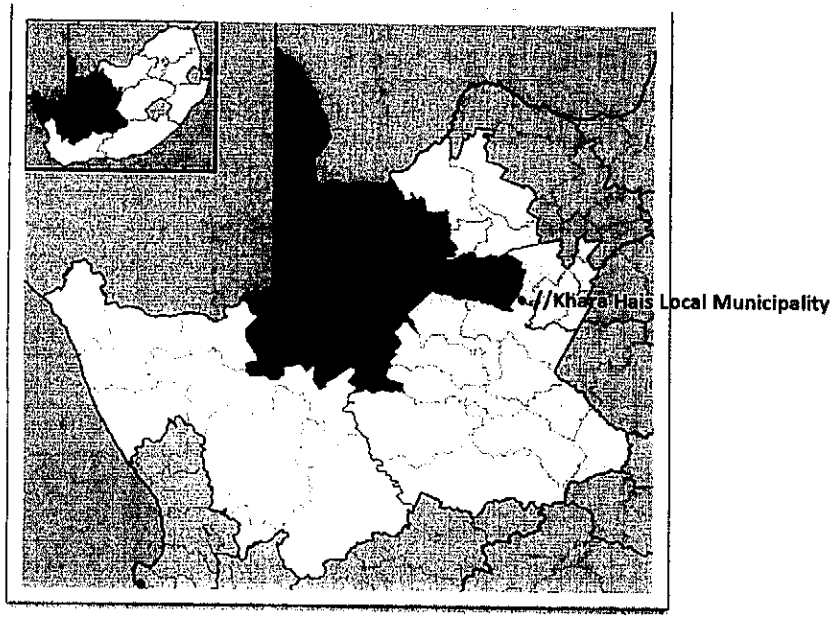

Figure 9.1 Siyanda District Municipality in the Northern Cape Province

activities upstream from //Khara Hais. Injudicious farming on floodplains, overexploitation of groundwater and overgrazing causes brackish land, erosion, deterioration of the water quality, an increase in alien species, pests and weeds, and a decrease in biodiversity (van Niekerk *et al.*, 2009; Meyer, 2001). These changes in the climate and the environmental degradation have implications for food security (Figures 9.2–9.4).

Tourist activities furthermore cause land and water pollution, fires, destruction of the unique fauna and flora, damage to ecosystems, deterioration of gravel roads and erosion (//Khara Hais Local Municipality, 2008; Siyanda District Municipality, 2008).

Severe weather has a damaging impact on household assets. The residents of informal settlements and former black townships are the most vulnerable to flash floods, owing to gravel roads, substandard building material, poor construction methods and inadequate storm water provision (Figure 9.5). It is also feared that many people will flee farms and rural towns in the vicinity and migrate to Upington if water or employment opportunities become scarce. Climate migrants may seek employment, security of tenure, and access to basic municipal services, schools and clinics thus adding pressure to the already existing backlog on service provision (van Niekerk *et al.*, 2009).

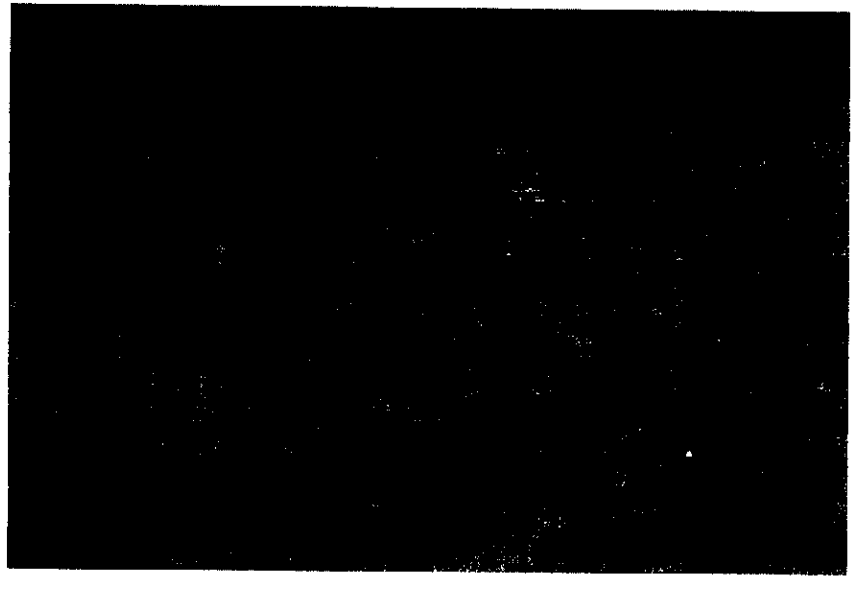

Figure 9.2 Orange River at Augrabies, Northern Cape Province

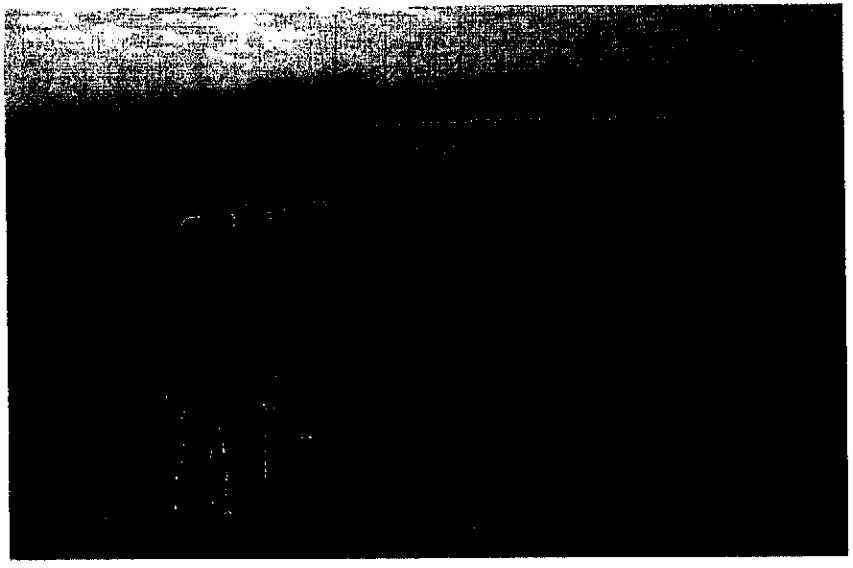

Figure 9.3 Mr Dawid du Plessis stands in a dustbowl at a water valve almost covered in Kalahari sand, where his family had worked irrigated lands until the early 1970s

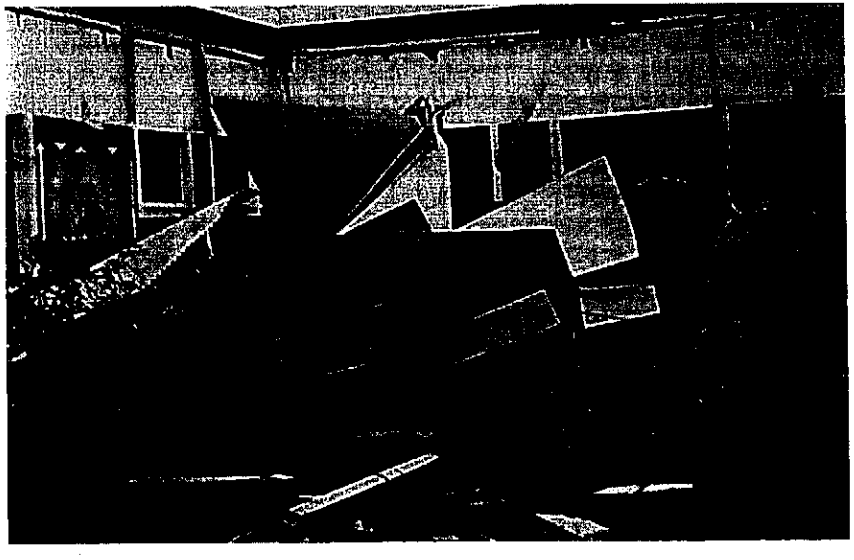

Figure 9.4 Damage caused by what locals describe as a "twister cyclone" that hit the farm Klipkolk in the Northern Cape

Figure 9.5 An informal settlement in Upington just before a summer storm erupts

Planning for climate change, food security and asset adaptation

An assessment of the strategic planning documentation of the local and district municipalities have revealed that, though cognisance is taken of environmental degradation and the concept of climate change, there is no climate change strategy for the district, nor any analysis of expected impacts of climate change on, for example, food security. Implicit in all development strategies is to provide poor communities with equitable access to assets such as housing and services, and enabling them to acquire assets such as education. Furthermore, in much of the strategic planning documentation such as the //Khara Hais *Integrated Development Plan* (//Khara Hais Local Municipality, 2007), *Spatial Development Framework* (//Khara Hais Local Municipality, 2008) and the Siyanda *Growth and Development Strategy* (Siyanda District Municipality, 2008) sustainability is encouraged for all future developments in the district, but only the //Khara Hais *Spatial Development Framework* attempts to propose specific interventions to promote sustainable development. One of these proposals is to allow for urban agriculture as a way to improve household food security. In the Siyanda *Growth and Development Strategy* feedback is given on existing community feeding programmes, but no strategies are proposed to deal with food security in an integrated way. Thus no connection is made in any of the documents between food security, asset adaptation and the impacts from climate change. Urban resilience, as a holistic, integrated, multidimensional concept, is not embedded in any of the strategies, while sustainable development mostly remains sophisticated rhetoric.

George Local Municipality

The George Local Municipality is situated in the Eden District in the Western Cape Province (Figure 9.6). It lies between the Outeniqua Mountains and the Indian Ocean on the famous Garden Route. The municipal area includes the City of George (including Pacaltsdorp and Thembalethu), the coastal towns of Wilderness, Harold's Bay, Victoria Bay and Kleinkrantz, productive land for agriculture and forestry, national parks, indigenous vegetation, and unspoilt coastline. The George economy is diversified and rooted in agriculture, manufacturing, tourism, trade and business, though all are strongly related to the natural resource endowment of the municipal area. The lowest-income groups in George reside furthest from job opportunities. Unemployment and poverty are also major socio-economic challenges (George Local Municipality, 2007a, 2007b, 2008a; Eden District Municipality, 2006).

Climate change and environment degradation

Agriculture is a major land use in the municipal area, covering a large percentage of land. Commercial forests have been established by clearing the land of natural vegetation that had, in effect, protected the steep slopes of river gorges – one of the richest floras in the world (George Local Municipality, 2007b, 2008b). From interviews with residents, businesses, farmers and officials, their concern over the climate became clear. Longer periods of drought during winter (the rainy season) combined with bursts of torrential rainfall have been observed to cause "green droughts" (on the surface it looks green, but there is a general lack of water). Heavy downpours trigger flash floods and the run-off is channelled by the

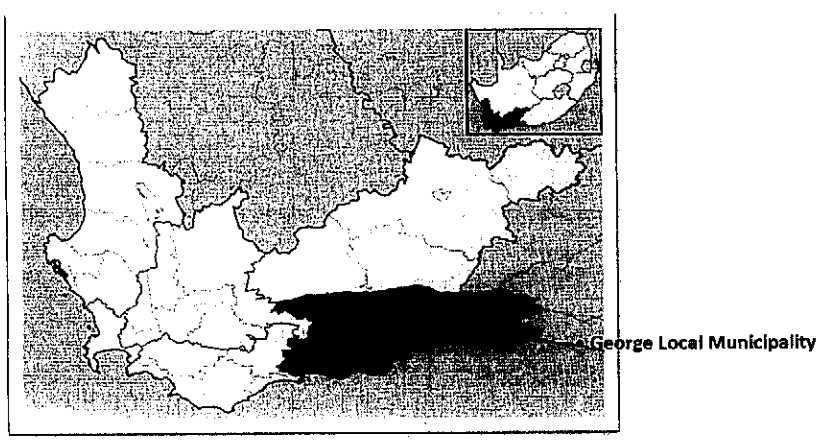

Figure 9.6 Eden District Municipality in the Western Cape Province

many ravines often causing landslides, eroding riverbanks, and damaging irrigation infrastructure (van Niekerk *et al.*, 2009). In addition, the natural vegetation, forestry and agriculture are threatened by urban expansion, an increase in the demand for water, the provision of land for small farmers and the development of big golf estates (Eden District Municipality, 2008b; George Local Municipality, 2007b, 2008b).

Tourism has augmented the recreational activities on the estuaries and the coastline, putting even more pressure on resources in the coastal zone. The many residential developments along the coast, as well as the economic, industrial and commercial activities have a destabilising impact on the environment; the coastal towns and villages in the municipality are vulnerable to flash floods and sea level rise. For example, in 2006, severe weather combined with spring tides caused several roads and major bridges to collapse, dysfunctional municipal services, rockslides in the Outeniqua Pass, houses in the coastal towns to be flooded and sand dunes to be eroded from under beach houses (Figure 9.7). However, the most affected people in George are poor people who settle in informal settlements on floodplains or hillsides where they are vulnerable to flash floods and landslides (Figure 9.8). Here their lives, livelihoods and assets are at risk (van Niekerk *et al.*, 2009).

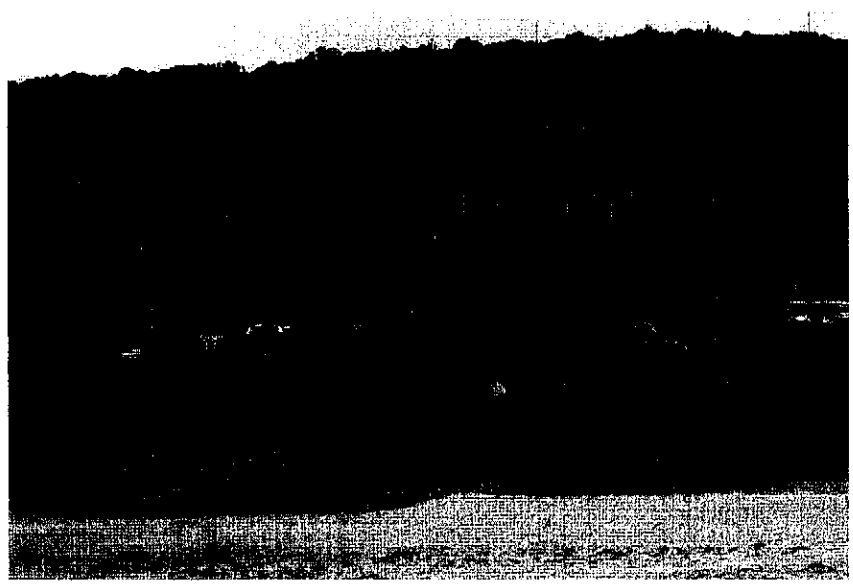

Figure 9.7 Dunes being eroded from under a beach house in Wilderness, George

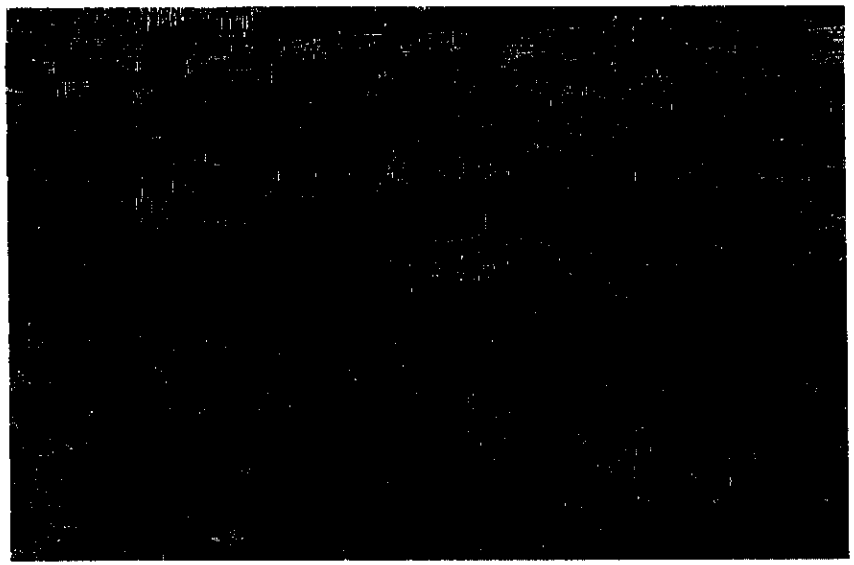

Figure 9.8 A township built on a hillside in George

Planning for climate change, food security and asset adaptation

The Western Cape Province developed a comprehensive climate change strategy and action plan in 2008. This strategy still needs to be translated into local interventions. Climate change has been identified as a major threat in a few development planning strategies, and some mitigation and adaptation measures have been put forward in the Eden Disaster Management Plan (Eden District Municipality, 2008a) and *State of the Environment* (Eden District Municipality, 2008b). The latter report also acknowledges that food security and asset adaptation will be impacted by climatic changes, but no countermeasures have been proposed to deal with these challenges. The Eden *Growth and Development Strategy* (Eden District Municipality, 2007) identified a number of actions as part of a livelihood strategy to extend households' access to a portfolio of assets so as to reduce the poverty of communities. Startlingly, the George *Local Economic Development Strategy* (George Local Municipality, 2005) does not even acknowledge food security or asset adaptation. Sustainable development is, however, advocated and promoted in many documents such as the Eden *Growth and Development Strategy* (Eden District Municipality, 2007), *Integrated Development Plan* (Eden District Municipality, 2008a) and *Spatial Development Framework* (Eden District Municipality, 2003), as well as the George *Spatial Development Framework* (George Local Municipality, 2007b, 2008a, 2008b). Yet, it is not linked to climate change, food security or asset adaptation specifically. Though it is clear that

climate change is a much bigger reality for George, a similar conclusion can be drawn as in the case of //Khara Hais. Asset adaptation and food security are barely addressed, and holistic, integrated, multidimensional measures to build resilient cities are not yet embedded in development strategies.

In light of the above case studies, the last section explores spatial planning interventions that could address climate change, food security and asset adaptation with the objective of building resilient cities.

Planning resilient cities

Spatial planning as a vehicle to plan resilient cities

At any given time, space embraces people's social, political, economic, environmental and cultural activities and the countless links between them. Spatial development frameworks have therefore become an important long-term, proactive planning instrument across the world (Claassen, 2009).

Spatial planning is the systematic preparation of spatial policies, of which the outcome is a spatial plan (Faludi, 2002). Spatial plans reintroduce the significance of space to public policy. It asks the "where?" of sector plans (Steenwegen, 2006). Spatial plans generally are long-term visions (usually 20 years) that shape future spatial development and infrastructure investment. They:

- are holistic
- provide spatial knowledge to decision makers
- proactively coordinate public- and private-sector investment
- engage communities
- protect resources, or allocate investment to achieve more balanced distribution of economic development
- contain uncontrolled, short-sighted market-driven development.

Most importantly spatial plans coordinate and integrate different socio-economic and environmental sectoral policies on vertical (same territory) and horizontal (between departments) levels ranging from economic development, transportation and environmental protection, to health, culture and language (Biesbroek *et al.*, 2009; Albrechts, 2006; Adams *et al.*, 2006; Alden, 2006; Kunzmann, 2006; Faludi, 2002).

For these reasons a spatial plan is a compelling vehicle to integrate climate change mitigation and adaptation, food security and asset adaptation measures with development strategies (Biesbroek *et al.*, 2009).

Climate change mitigation and adaptation

A resilient city indicates the capacity to successfully adapt to the impact of climate change and is the overarching goal achieved through mitigation and adaptation

(Hamin and Gurran, 2009). Mitigation refers to the reduction of greenhouse gas (GHG) emissions to counter global warming (UNISDR, 2009). Adaptation to climate change "entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes" (UNFCCC, 2010).

Cities are one of the most important climate change battlefields: the manner in which developments are designed and planned will have a significant impact on future GHG emissions, as well as on settlements' ability to adapt to potential climate change (Roy, 2009; Bulkeley and Betsill, 2005). Likewise, mitigation and adaptation responses have a strong spatial dimension, synergies and trade-offs, hence spatial planning is called the "switchboard" for implementing mitigation and adaptation measures at local and regional levels (Biesbroek *et al.*, 2009). According to Blanco *et al.* (2009: 158) "adapting to climate change is at its core a call for planning" and adaptation is the "type of planning that fits naturally the agenda of urban and regional planning".

Asset adaptation

"Insecure land tenure in the city is arguably the most important single constraint shaping the willingness of individuals to invest scarce personal or communal resources in safety" (Wisner and Pelling, 2009). In the light of projected climatic changes, access to well-located land for the urban poor is crucial for sustainable economic growth, environmental protection, poverty reduction, social cohesion and political stability (Brown-Luthango, 2010). Proximity to social services, infrastructure and employment opportunities will greatly enhance households' resilience to climate change.

The urban land market will not necessarily provide for the poor to access land, therefore intervention in the market is required. In this regard an overall urban land reform strategy for South Africa is proposed by Brown-Luthango (2010), a strategy that identifies vacant/unused plots of land in the city that could be put to productive use. Municipalities will gain access to additional revenue from property tax, and the poor will gain secure rights to land and property as a means to access credit and to generate economic activity. Such a strategy has the potential to facilitate infill development, urban renewal and a more compact city (Brown-Luthango, 2010).

Food security

Spatial planning is seen as an instrument to ensure sustainable development by weighing short-term developmental challenges against long-term sustainability and making trade-offs that minimise conflict between these goals (Roy, 2009). Spatial plans can accommodate growing urban populations whilst also securing water and food by preventing the pollution of fresh water sources and the encroachment of cities on agricultural land. Thus, a land use decision is also

a water use decision, and to plan for future food security requires integrated land use and water resource management (Gowing, 2003).

Urban agriculture is often practised by low-income households for subsistence or to augment their income. Increased natural production for consumption has the potential to improve food security in both rural and urban areas by increasing food supply and by reducing dependence on purchasing food (Baiphethi and Jacobs, 2009; Hendriks, 2005). Spatial development plans therefore ought to better protect productive agricultural land, as well as make provision for urban agriculture in appropriate parts of the city (Brown and Crawford, 2009; Boko *et al.*, 2007).

Spatial planning interventions

The nature and location of spatial planning interventions are often a cause for great debate. Questions that arise from this include: What types of interventions are effective in ensuring sustained livelihoods? What kinds of areas afford the vulnerable greater protection against the effects of climate change and meet their needs for food security and asset adaptation? Is it possible in all circumstances to adapt areas to climate change, or is resettlement the only alternative?

The *National Spatial Development Perspective* of South Africa offers some useful principles to guide regional spatial planning interventions. It proposes (1) interventions that promote inclusive and sustained economic growth as a precondition for other interventions; (2) basic service provision to all citizens, irrespective of where they reside; (3) fixed capital investment that focuses on localities of economic growth and/or economic potential; (4) in localities with low demonstrated economic potential, government spending should concentrate on human capital development rather than fixed infrastructure; and (5) that future settlements and economic developments should be channelled into activity corridors and nodes adjacent to or linked with main growth centres (Government of South Africa, The Presidency, 2006). On a local level it is generally recommended that compaction be increased, open spaces be managed better, energy sufficiency be improved, and the need to travel be reduced by creating more public transport infrastructure and integrating land use and transport planning (Bulkeley *et al.*, 2005). This section concentrates on city-wide interventions.

Urban transportation

Urban transportation is one of the biggest contributors to GHG emissions. The functional separation of land uses has increased journey distances and traffic volumes. This decentralisation and dispersion of land uses require an elaborate road network – which has become a bottomless pit of investment, and prevents clusters of high densities that can support public transportation from developing (Belzer and Autler, 2002; Newman and Kenworthy, 1996). The poor bear the brunt of the economic and social costs. Spatial planning can therefore have great mitigating impact in the long term by integrating land use and transport planning. The

objectives should be to reduce the demand for private transportation, transport volumes and travel distances. This is done by optimising – often through densification – the spatial distribution and connectivity of urban activities to minimise the distances between land uses. Greater diversity of and accessibility to land uses in neighbourhoods designed for walking and cycling will result in lower automobile traffic volumes. Planning for adequate city-wide public transportation, while simultaneously slowing down or taxing automobiles and increasing the vehicle occupancy rates, will also reduce traffic volumes (Hamin and Gurran, 2009; Grazi and van den Bergh, 2008; Ruth and Rong, 2006). These options require new transport modes and infrastructure, which is an opportunity for adapting critical infrastructure to climatic changes such as severe weather and sea level rise (ALNAP and ProVention, 2009; Bart, 2009). The planning and implementation of appropriate infrastructure should be done thoroughly as transport infrastructure is particularly costly to install and complex to alter once in position (Kithiia and Dowling 2010; Coaffee, 2008).

Cities that have spatially integrated land use and transportation for the sake of climate change, and give priority to pedestrians and cyclists, will greatly benefit the livelihoods and asset adaptation of poorer households. A range of income levels will have more equal access to various land uses and opportunities (Rabinovitch, 1996). Injuries sustained in accidents and health effects from pollution will be reduced (Pelling and Wisner, 2009), and healthier lifestyles are encouraged through active travelling (Barton, 2009). Low-income households will spend less time travelling and less of their disposable income on transport; consequently they will have more time and capital available to invest in assets (Behrens and Wilkinson, 2003).

Urban containment, compaction and densification

Built-up areas worldwide will triple by 2030 if average densities continue at the current trend. Some of this growth is a result of urban population growth, but inefficient spatial planning policies are to be blamed for urban sprawl (World Bank, 2008). Urban sprawl increases journey distances and traffic volumes (Newman and Kenworthy, 1996). It thus disadvantages poor households as explained above and contributes to GHG emissions (Government of South Africa, Department of Housing, 2004). It takes more resources to adapt sprawled settlements to the impacts from climate change than compact cities. Urban sprawl furthermore encroaches on productive agricultural land, thereby threatening livelihoods and food security (Bart, 2009).

Limiting urban sprawl through strategies such as compaction, densification appropriate to a particular culture, urban growth edging, transit orientated development (TOD) and infill development may result in higher densities and a mix of land uses (Lau *et al.*, 2005). These strategies provide benefits for climate change mitigation and adaptation, food security and asset adaptation. This is because they promote greater interconnectivity between land

uses; restructure a fragmented, inequitable and inefficient urban form; achieve social and economic diversity and vitality; protect natural and agricultural landscapes; promote optimal and efficient use of resources and infrastructure; reduce the cost of service delivery; allow for poor households to live closer to economic opportunities; intensify land uses; and reduce GHG emissions (Swilling *et al.*, 2008; Ruth and Rong, 2006; Jenks and Dempsey, 2005a; Banister, 2005; Watson *et al.*, 2004; Government of South Africa, Department of Housing, 2004).

Moderate densities on the other hand allow for ventilation between single units as well as for significant green spaces, and may be more effective under certain conditions (Hamin and Gurran, 2009).

Nodes and corridors

A polycentric spatial model clusters city features – particularly those that provide a service to the community – in strategic nodes and corridors. Public transit along these corridors connects the nodes to form a highly accessible, interconnected city. Dense, mixed land use nodes afford choice of lifestyle and location, encourage shared facilities and infrastructure, and prioritise the needs of pedestrians and cyclists (Jenks and Dempsey, 2005b). Thus, low-income households living in close proximity to nodes and public transportation networks have better access to economic opportunities, employment, wealth creation and social services than those households living on the periphery, and have more opportunities and resources available to invest in assets. They are also better able to withstand the effects of climate change, for by being close to nodes, they rely on already existing critical infrastructure such as storm water, sewage, energy, roads and emergency services. Adapting key urban activities to the impacts from climate change such as increased temperatures, different precipitation patterns and rising water levels is also more efficient when clustered than when dispersed (Swilling *et al.*, 2008; Ruth and Rong, 2006; Banister, 2005; Watson *et al.*, 2004).

Green space and urban agriculture

If not well planned, then high densities may result in a loss of permeable surfaces and tree cover that help reduce the need for air conditioning, threaten the carrying capacity of ecological systems, and increase the risk of urban flooding and heat island formation (Hamin and Gurran 2009; Laukkonen *et al.*, 2009). Urban parks, forests and greenery, connected via corridors to allow for animal species to migrate, should be maintained to cool cities and to sequester carbon. The green spaces and corridors should have multiple uses such as urban agriculture, recreation and leisure that can adapt to the impacts from climate change, for example serving as flood retention areas in the case of severe weather (Hamin and Gurran, 2009).

If implemented, the spatial interventions described above would not only have a significant impact on the environment when compared to developments in the 19th and 20th centuries in terms of reduced GHG emissions, but would also contribute to climate change adaptation and benefit low-income households significantly.

Conclusions

Poor urban households in South Africa are particularly vulnerable to the impacts of climate change and food scarcity due to the combination of structural poverty, substandard infrastructure and housing, and historical spatial planning entrenched by current spatial development trends. Increasingly, poor households are forced to live in spatially marginalised areas, aggravating their ability to adapt to the adverse effects of climate change. Spatial planning endeavours to dismantle these spatial distortions and implement interventions that are conducive to meeting the social, economic and environmental objectives of sustainable development. Spatial development frameworks do this by promoting integrated transport and land use planning; growth management strategies such as compaction, densification, urban growth edges, nodes and corridors and infill development; and appropriate higher densities, mixed land uses, and a network of green open spaces. These interventions have many social, economic and environmental benefits, such as allowing low-income households to live closer to economic opportunities, thereby saving time and resources to invest in assets, as well as protecting natural and agricultural landscapes.

The two case studies from George and //Khara Hais are probably representative of many cities in the developing world that do not specifically analyse and monitor hazard and vulnerability factors related to climate change, livelihoods or food security. These are some of the most underestimated issues in spatial planning and habitually left to the "environmental" or "social" people. Local municipalities are so overwhelmed with attempting to provide the basic needs of people and creating decent living environments for the poor, that it should not come as a surprise that climate change has remained a low priority on municipalities' agendas (Robberts, 2008). Given the significance of climate change and its consequences for food security and asset adaptation, sustainable development measures that specifically integrate climate change mitigation and adaptation measures are crucial to spatial planning. Furthermore, action plans must identify localities, allocate budgets and identify responsible people if these measures are to be successfully implemented.

References

Adams, N., Alden, J. and Harris, N. (2006) 'Introduction', in Adams, N., Alden, J. and Harris, N. (eds) *Regional Development and Spatial Planning in an Enlarged European Union*, Aldershot: Ashgate Publishing Ltd.

Albrechts, L. (2006) 'Shifts in strategic spatial planning? Some evidence from Europe and Australia', *Environment and Planning A*, 38: 1149–1170.

Alden, J. (2006) 'Regional development and spatial planning', in Adams, N., Alden, J. and Harris, N. (eds) *Regional Development and Spatial Planning in an Enlarged European Union*, Aldershot: Ashgate Publishing Ltd.

ALNAP and ProVention (2009) *Responding to Urban Disasters: Learning from Previous Relief and Recovery Operations*, London: Active Learning Network for Accountability and Performance.

Anderson, M., and Woodrow, P. (1998) *Rising from the Ashes: Development Strategies in Times of Disaster*, Boulder, CO: Lynne Rienner Publishers.

Annan, K. (1999) *Preventing War and Disaster: A Growing Global Challenge*, New York: United Nations.

Baiphethi, M. and Jacobs, P. (2009) 'The contribution of subsistence farming to food security in South Africa', *Agrekon*, 48, 4: 459–482.

Banister, D. (2005) *Unsustainable Transport: City Transport in the New Century*, New York: Taylor.

Bart, I. (2009) 'Urban sprawl and climate change: A statistical exploration of cause and effect', *Land Use Policy*, 27, 2: 283–292.

Barton, H. (2009) 'Land use planning and health and well-being', *Land Use Policy*, 26S: S115–S123.

Behrens, R. and Wilkinson, P. (2003) 'Housing and urban transport policy and planning in South African cities: A problematic relationship?', in Harrison, P., Huchzermeyer, M. and Mayekiso, M. (eds) *Confronting Fragmentation: Housing and Urban Development in a Democratising Society*, Cape Town: University of Cape Town Press.

Belzer, D. and Autler, G. (2002) 'Transit oriented development: Moving from rhetoric to reality', *Discussion Paper*, Brookings Institution Center on Urban and Metropolitan Policy and the Great American Station Foundation.

Benhin, J. (2006) 'Climate change and South African agriculture: impacts and adaptation options', *CEEPA Discussion Paper*, 21. Pretoria: Centre for Environmental Economics and Policy in Africa, University of Pretoria.

Biesbroek, G., Swart, R. and van der Knaap, W. (2009) 'The mitigation–adaptation dichotomy and the role of spatial planning', *Habitat International*, 33: 230–237.

Blanco, H., Alberti, M., Forsyth, A., Krizek, K., Rodríguez, D., Talen, E. and Ellis, C. (2009) 'Hot, congested, crowded and diverse: Emerging reseach agenda in planning', *Progress in Planning*, 71: 153–205.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R. and Yanda, P. (2007) 'Africa', in Parry, O.C.M.L. (ed.) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC*, Cambridge: Cambridge University Press.

Boraine, A., Crankshaw, O., Engelbrecht, C., Gotz, G., Mbanga, S., Narsoo, M. and Parnell, S. (2006) 'The state of South African cities a decade after democracy', *Urban Studies*, 43, 2: 259–284.

Brown, O. and Crawford, A. (2009) 'Climate Change and Security in Africa', A Study for the Nordic–African Foreign Ministers Meeting. Winnipeg: International Institute for Sustainable Development.

Brown-Luthango, M. (2010) 'Access to land for the urban poor – policy proposals for South African cities', *Urban Forum*, 21: 123–138.

Bulkeley, H. and Betsill, M. (2005) *Cities and Climate Change: Urban Sustainability and Global Environmental Governance*, Oxford: Routledge.

Claassen, P. (2009) 'Spatial planning, with the Western Cape Province as a case study', in Strydom, H. and King, N. (eds) *Environmental Management in South Africa* (2nd edn), Cape Town: Juta.

Coaffee, J. (2008) 'Risk, resilience, and environmentally sustainable cities', *Energy Policy*, 36: 4633–4638.

du Plessis, C., Irurah, D.K. and Scholes, R. J. (2003) 'The built environment and climate change in South Africa', *Building Research and Information*, 31, 3–4: 240–256.

Eden District Municipality (2003) *Spatial Development Framework*, George: Eden District Municipality.

Eden District Municipality (2006) 'Local Economic Development', *Fact Sheet*, No. 1. George: Eden District Municipality.

Eden District Municipality (2007) *Growth and Development Strategy: Eden Local Economic Development Strategy*, George: Eden District Municipality.

Eden District Municipality (2008a) *Revised Integrated Development Plan: 2008/2009*, George: Eden District Municipality.

Eden District Municipality (2008b) *State of the Environment Report*, George: Eden District Municipality.

Engelbrecht, F. A., McGregor, J. and Engelbrecht, C. (2009) 'Dynamics of the Conformal-Cubic Atmospheric Model projected climate-change signal over southern Africa', *International Journal of Climatology*, 29: 1013–1033.

Faludi, A. (2002) *The European Spatial Development Perspective (ESDP)*, Cambridge: Lincoln Institute of Land Policy.

George Local Municipality (2005) *Placing the Economic Development of George in Context: Background document for the consultation process related to the LED-strategy development of George*, George: George Local Municipality.

George Local Municipality (2007a) *Integrated Development Plan: 2007–2011*, George: George Local Municipality.

George Local Municipality (2007b) *Spatial Development Framework Vol III: Urban Structure Framework*, George: George Local Municipality.

George Local Municipality (2008a) *Spatial Development Framework Vol I: Main Report*, George: George Local Municipality.

George Local Municipality (2008b) *Spatial Development Framework Vol II: Strategic Environmental Assessment*, George: George Local Municipality.

Government of South Africa, Department of Housing (2004) *Breaking New Ground: A Comprehensive Plan for the Development of Sustainable Human Settlements*, Republic of South Africa: Department of Housing.

Government of South Africa, Department of Science and Technology (2007) *South Africa's Climate Change Technology Needs Assessment: Synthesis Report*, Government of South Africa: Department of Science and Technology.

Government of South Africa, The Presidency (2006) *National Spatial Development Perspective. Republic of South Africa*, Pretoria: Government Printer.

Government of South Africa, The Presidency (2009) *Medium Term Strategic Framework: 2009–2014. Republic of South Africa*, Pretoria: Government Printer.

Gowing, J. (2003) 'Food security for sub-Saharan Africa: Does water scarcity limit the options?', *Land Use and Water Resources Research*, 3: 2.1–2.7.

Grazi, F. and van den Bergh, J. (2008) 'Spatial organization, transport, and climate change: Comparing instruments of spatial planning and policy', *Ecological Economics*, 67, 4: 630–639.

Hamin, E. and Gurran, N. (2009) 'Urban form and climate change: Balancing adaptation and mitigation in the U.S. and Australia', *Habitat International*, 33: 238–245.

Hendriks, S. (2005) 'The challenges facing empirical estimation of household food (in) security in South Africa', *Development Southern Africa*, 22, 1: 103–121.

Hewitson, B. and Crane, R. (2006) 'Consensus between GCM climate change projections with empirical downscaling: precipitation downscaling over South Africa', *International Journal of Climatology*, 26: 1315–1337.

IPCC (Intergovernmental Panel on Climate Change) (2007) *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Core Writing Team, Pachauri, R.K and Reisinger, A. (eds)), Geneva: Intergovernmental Panel for Climate Change.

Jenks, M. and Dempsey, N. (2005a) 'The language and meaning of density', in Jenks, M. and Dempsey, N. (eds) *Future Forms and Design for Sustainable Cities*, Oxford: Architectural Press.

Jenks, M. and Dempsey, N. (2005b) 'Conclusion: Future forms for city living?', in Jenks, M. and Dempsey, N. (eds) *Future Forms and Design for Sustainable Cities*, Oxford: Architectural Press.

//Khara Hais Local Municipality (2007) *Five Year Integrated Development Plan (IDP): 2007–2012*, //Khara Hais Local Municipality.

//Khara Hais Local Municipality (2008) *Spatial Development Framework. Vol I–III*, //Khara Hais Local Municipality.

Kithiia, J. and Dowling, R. (2010) 'An integrated city-level planning process to address the impacts of climate change in Kenya: The case of Mombasa', *Cities*, 27, 6: 1–10.

Kunzmann, K. (2006) 'The Europeanization of spatial planning', in Adams, N., Alden, J. and Harris, N. (eds) *Regional Development and Spatial Planning in an Enlarged European Union*, Aldershot: Ashgate Publishing Ltd.

Lau, S., Wang, J., Giridharan, R. and Ganesan, S. (2005) 'High-density, high-rise and multiple and intensive land use in Hong Kong: A future city form for the new millennium', in Jenks, M. and Dempsey, N. (eds) *Future Forms and Design for Sustainable Cities*, Oxford: Architectural Press.

Laukkonen, J., Blanco, P., Lenhart, J., Keiner, M., Cavric, B. and Kinuthia-Njenga, C. (2009) 'Combining climate change adaptation and mitigation measures at the local level', *Habitat International*, 33: 287–292.

Mannak, C. (2008) 'How climate change threatens Africa's food security', *Mail and Guardian*, 25 July.

Meadows, M. E. (2006) 'Global change and Southern Africa', *Geographical Research*, 44, 2: 135–145.

Meyer, S. (2001) ''n Omgewingsentrum as omgewingsbestuursinisiatief vir die Noord-Kaap Provinsie', unpublished thesis, Randse Afrikaanse Universiteit, Johannesburg.

Midgley, G. C., Kgope, B., Morant, P., Theron, A., Scholes, R. and Forsyth, G. (2005) 'Status quo, vulnerability and adaptation assessment of the physical and socio-economic effects of climate change in the Western Cape', *CSIR Report no. ENV/-S-C 2005-073*, Stellenbosch: CSIR Environmentek.

Newman, P. and Kenworthy, J. (1996) 'The land use-transport connection: An overview', *Land Use Policy*, 13, 1: 1–22.

Oelofse, C. (2002) 'Dimensions of urban environmental risk', in Nomdo, C. and Coetzee, E. (eds) *Urban Vulnerability: Perspectives from Southern Africa*, Cape Town: Periperi Publications.

Oosthuizen, R. and John, J. (2005) *Northern Cape: State of the Environment Report – Atmosphere and Climatic Specialist Report*, Pretoria: CSIR.

Parnell, S., Simon, D. and Vogel, C. (2007) 'Global environmental change: Conceptualising the growing challenge for cities in poor countries', *Area*, 39, 2: 357–369.

Pelling, M. (2003) *The Vulnerability of Cities: Natural Disasters and Social Resilience*, London: Earthscan.

Pelling, M. and Wisner, B. (2009) 'Reducing urban disaster risk in Africa', in Pelling, M. and Wisner, B. (eds) *Disaster Risk Reduction: Cases from Urban Africa*, London: Earthscan.

Puppim de Oliveira, J. (2009) 'The implementation of climate change related policies at the sub-national level: An analysis of three countries', *Habitat International*, 33: 253–259.

Rabinovitch, J. (1996) 'Innovative land use and public transport policy: The case of Curitiba, Brazil', *Land Use Policy*, 13, 1: 51–67.

Robberts, D. (2008) 'Thinking globally, acting locally – institutionalizing climate change at the local government level in Durban, South Africa', *Environment and Urbanization*, 20, 2: 521–537.

Roy, M. (2009) 'Planning for sustainable urbanisation in fast growing cities: Mitigation and adaptation issues addressed in Dhaka, Bangladesh', *Habitat International*, 33: 276–286.

Ruth, M. and Rong, F. (2006) 'Research themes and challenges', in Ruth, M. (ed.) *Smart Growth and Climate Change: Regional Development, Infrastructure and Adaptation*, Cheltenham: Edward Elgar Publishing Ltd.

Rutherford, M., Midgley, G., Bond, W., Powrie, L., Roberts, R. and Allsopp, J. (1999) *South African Country Study on Climate Change: Plant Biodiversity, Vulnerability and Adaptation Assessment*, Cape Town: National Botanical Institute.

Satterthwaite, D., McGranahan, G. and Tacoli, C. (2010) 'Urbanization and its implications for food and farming', *Philosophical Transactions of the Royal Society B*, 365: 2809–2820.

Schmidhuber, J. and Francesco, N. (2007) 'Global food security under climate change', *Proceedings of the National Academy of Sciences*, 104, 50: 19703–19708.

Scholes, B., Ajavon, A.-L., Nyong, T., Tabo, R., Vogel, C. and Ansorge, I. (2008) *Global Environmental Change (including Climate Change and Adaptation) in Sub-Saharan Africa*, ICSU Regional Office for Africa.

Siyanda District Municipality (2007) *Five Year Integrated Development Plan (IDP): 2007/8–2011/12*, Siyanda District Municipality.

Siyanda District Municipality (2008) *Growth and Development Strategy*, Siyanda District Municipality.

Steenwegen, L. (2006) 'Sustainable development: Reality or myth?', in Adams, N., Alden, J. and Harris, N. (eds) *Regional Development and Spatial Planning in an Enlarged European Union*, Aldershot: Ashgate Publishing Ltd.

Swilling, M., de Wit, M. and Thompson-Smeddle, L. (2008) 'You the urban planner', in Zipplies, R. (ed.) *Bending the Curve: Your Guide to Tackling Climate Change in South Africa*. Cape Town: Africa Geographic.

UNFCCC (United Nations Framework Convention on Climate Change) (2010) 'Glossary of Climate Change Acronyms', http://unfccc.int/essential_background/glossary/items/3666.php (accessed 19 August 2010).

UNISDR (United Nations International Strategy for Disaster Reduction) (2009) 'Terminology on Disaster Risk Reduction', http://www.unisdr.org/eng/terminology/terminology-2009-eng.html (accessed 19 August 2010).

van Niekerk, D., Tempelhoff, J., Faling, C., Thomson, L., Jordaan, D., Coetsee, C. and Maartens, Y. (2009) 'The effects of climate change in two flood laden and drought stricken areas in South Africa: Responses to climate change – past, present and future', Report to the National Disaster Management Centre, Department of Cooperative Governance, Republic of South Africa.

Watson, D., Plattus, A. and Shibley, R. (2004) *Time-saver Standards for Urban Design*, Digitial Engineering Library, McGraw-Hill, http://accessengineeringlibrary.com (accessed 5 May 2008).

Western Cape Province (2008) *A Climate Change Strategy and Action Plan for the Western Cape*, Cape Town: Department of Environmental Affairs and Development Planning.

Wikipedia (2010a) Eden District Municipality, http://en.wikipedia.org/wiki/Eden_District_Municipality (accessed 28 April 2010).

Wikipedia (2010b) Siyanda District Municipality, http://en.wikipedia.org/wiki/Siyanda_District_Municipality (accessed 28 April 2010).

Wisner, B. and Pelling, M. (2009) 'Urbanization and disaster risk reduction in Africa', in Pelling, M. and Wisner, B. (eds) *Disaster Risk Reduction: Cases from Urban Africa*, London: Earthscan.

World Bank (2006) 'Natural disaster hotspots: Case studies', *Disaster Risk Management Series*, 6, Washington DC: The World Bank Hazard Management Unit.

World Bank (2008) *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Climate Change Impacts and Strengthening Disaster Risk Management in East Asian Cities*, Washington DC: World Bank.