CLIMATE CHANGE AND FOOD SECURITY IN SOUTHERN AFRICAN CITIES

Gina Ziervogel & Bruce Frayne

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Climate Change and Food Security in Southern African Cities

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Climate Change and Food Security in Southern African Cities

Gina Ziervogel & Bruce Frayne

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1. Introduction

The current urban transition in the Global South should be at the heart of discussions about the relationship between climate change and food security. By mid-century, an additional 3 billion people will inhabit the planet, and almost all of this increase will be absorbed by cities in the South. In Sub-Saharan Africa, where climate variability and change are expected to be the most acute, and where poverty and food insecurity are already intensifying, rates of urbanization are twice the global average.[1] In Southern Africa, an estimated 80% of the population will be living in towns and cities by mid-century, comparable to the projected 2050 figure of 82% for developed countries.[2] Meeting the rising demand for food within the context of exponential population growth, sustained urbanization, and climate change constitutes a defining challenge of this century.

In 2008, the Food and Agriculture Organization of the UN (FAO) stated that the phenomenon of urbanization "will be one of the strongest social forces in the coming years." Urbanization will bring severe challenges to household food security in the context of high rates of unemployment, increasing development of the informal sector, deteriorating infrastructure, overcrowding and environmental degradation.[3] One major challenge will be how to provide "adequate quantities of nutritious and affordable food for more urban inhabitants, with less water, land and labour."[4] A recent review of the impacts of climate change on food security in Sub-Saharan Africa agrees that all of the different dimensions of food security will be affected, including food availability, access, stability and utilization.[5] The same study also concludes that climate change will negatively accentuate existing levels of food insecurity and that these adverse impacts will fall disproportionately on the poor.[6]

This paper explores the links between climate change and food security within the context of the urban transition taking place in Southern Africa. Researchers, planners and policymakers in Southern African cities are already focusing on the impacts of increasingly severe changes in weather associated with climate change. Key issues include how climate science knowledge is used at the level of the city and how the impacts of climate change might affect city functioning at the metropolitan and household scales. What has not been addressed in any detail is the extent to which climate change will affect the food security of the city and its inhabitants, especially within the context of high levels of poverty and widespread food and nutrition insecurity.[7] It is therefore important to understand the linkages between climate change and food security in Southern African cities so that policies and practices can start to ameliorate the negative impacts

through pro-active – rather than reactive –planning and programming.

The paper is divided into four parts. The first part outlines the current state of knowledge on urban food security by providing some background to the emerging urban food security challenge and summarizing the levels of food insecurity in Southern African cities. The second section examines the latest trends in climate science and suggests that a down-scaling from the global and regional level of analysis to the city level is necessary to appreciate the implications of climate change and extreme weather events for urban areas. Thirdly, as a mechanism for exploring the climate change-food security nexus, the paper uses examples that illustrate linkages between the climate change and food security. Finally, it poses questions that may be useful for advancing planning and practice on issues related to urban food security in a changing climate as well as where future research might focus.

2. URBAN FOOD SECURITY

2.1 Defining Urban Food Security

The most common definition of food security is that used by the FAO which states that food security exists "when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."[8] Missing from this definition is any notion of sustainable food production. In its 2020 Vision, the International Food Policy Research Institute (IFPRI) accommodates the principle of sustainability in its definition of food security as "a world where every person has access to sufficient food to sustain a healthy and productive life, where malnutrition is absent, and where food originates from efficient, effective, and low-cost food systems that are compatible with sustainable use of natural resources."[9]

Although qualitatively different, the FAO and IFPRI definitions agree that the components of food security extend beyond food production to encompass broader socio-economic issues surrounding food availability and the ability to effectively translate hunger into an economic demand for food. The stability of food systems is important both on the supply side (in terms of production) and the demand side (in terms of people being able to access food). The complexity of the links between food systems and food security have been described as "dynamic interactions between and within the bio-geophysical and human environments

lead[ing] to the production, processing, preparation and consumption of food, resulting in food systems that underpin food security."[10] These food systems contribute to four food security outcomes, namely availability, accessibility, stability, and utilization of food:[11]

- *Food availability* depends on the production, distribution and exchange of food. It includes the production of adequate crop, livestock and fisheries as well as the collection of wild foods and resources for migratory and indigenous communities. While the components of food availability are contextual, the major elements of a secure food supply include domestic production, reliable import capacity, presence of food stocks and (when necessary) access to food aid.[12]
- *Food accessibility* refers to food affordability, allocation and preferences that enable people to effectively translate their hunger into demand. Poverty and vulnerability play a central role in food accessibility, as this component is centrally concerned with the purchasing power of households and individuals and the social dynamics governing access to food. The growth of urban areas has been accompanied by a greater emphasis on the incomes and social networks used in accessing food.[13] National economic security is also a factor in accessibility, as reflected in the presence of adequate food transportation venues and market infrastructure. Food distribution systems in cities also play a role in food accessibility.[14]
- *Food stability* involves continuity in the urban food supply and access to food. Factors affecting food stability include seasonal variations in food supply or income. These can be impacted by climate variability, price fluctuations, and political and economic factors.
- *Food utilization* refers to how a person is able to utilize food and nutrients (depending on age, health and disease) as well as the quality of food intake.[15] In countries plagued by poor health, sanitation and inadequate safety standards, chronic illness may compromise a person's digestion and undermine nutrient intake.

Although the first Millennium Development Goal (MDG) aims to eradicate extreme poverty and hunger by ensuring that the criteria for a food secure society are met, various factors threaten this goal. They include population growth, rising demand for food, the non-sustainable industrial agricultural system, the dominance of fossil fuels as the primary energy source, and the current climate change trajectory.

2.2 The Urban Food Security Challenge

In 2007, the global proportion of people living in urban areas passed 50%, marking the first time in human history that more people lived in urban

than in rural areas.[16] As the global population continues to grow toward a mid-century estimate of 9-10 billion, the majority of this demographic increase will be in cities of the developing world.[17] Future urban growth will be most intense in Asia and Africa. These two regions will have the largest urban populations on the planet by 2030: 2.66 billion and 748 million respectively.[18] At twice the global average, the pace of urbanization is already highest in Sub-Saharan Africa (SSA). The average rate of urban growth for SSA is close to 4% and this is expected to persist for decades to come.[19]

Turning to Southern Africa, the regional population is approximately 210 million, of whom at least 100 million already live in urban and peri-urban areas. By 2020, this figure is expected to rise to 150 million and to exceed 200 million by 2030. However, rapid urbanization is not associated with increased incomes and better standards of living in Southern Africa as it is in some other developing regions.[20] Moreover, poor urban households are facing significant pressures as a direct result of the current global economic crisis and the high price of food staples. Consequently, urban food security is an emerging development and policy concern fundamentally different to questions of food security within the rural and agricultural sectors.[21]

A food security lens is useful in conceptualising the urban poverty dynamic that is unfolding in cities of the Global South and in Southern African in particular. In 1996, the World Food Summit made a commitment to halve the number of undernourished people in the world by 2015. By 2006, little progress had been made. In SSA the number of undernourished people grew by 37 million between 1990 and 2002. In 2009, the FAO estimated that the number of undernourished people passed one billion for the first time.[22] Each year, 10 million children under the age of five die, the majority in developing countries. Malnutrition is often viewed as a 'silent emergency', and is the outcome of chronic food insecurity and hunger. In urban areas, food availability is seldom the major constraint, but rather lack of access to food for the urban poor, especially children, is critical. In a recent report highlighting the urgency of the situation, the World Bank argues that despite decades of interventions, malnutrition still affects at least one third of the developing world's population.[23] Micronutrient deficiencies and stunting associated with poor levels of food security are considered an "extremely serious development issue" by the Bank, with the highest prevalence concentrated in South Asia and Sub-Saharan Africa.

UNICEF reports that the urban-rural malnutrition gap is closing.[24] This is the consequence of rising urban poverty associated with urbanization

in developing countries. Malnutrition rates are generally reported at the city level rather than the neighbourhood level. However, malnutrition levels are disproportionately higher in low income and slum areas, and possibly greatly exceed levels in rural areas.[25] Urban areas will inevitably become the focus of hunger and malnutrition in the coming decades.[26] Food security, and urban food security in particular, is therefore both an ecological and a poverty challenge.

Recent research undertaken by the African Food Security Urban Network (AFSUN) in 11 Southern African cities demonstrates the strong links between urban poverty and high levels of food insecurity at the household level, with the majority of poor urban households surveyed reporting conditions of food insecurity.[27] The study revealed the following about urban food insecurity in the region:

- Four out of five poor urban households are food insecure;
- Dietary diversity is poor;
- Poverty and food insecurity are directly correlated;
- Food price increases have negatively impacted four out of five poor households;
- There is a seasonal dimension to urban food insecurity;
- Food security has a gender dimension to it, with female-centred households the most food insecure;
- Health and food insecurity are related, with food insecure households having higher levels of morbidity and mortality (including HIV/AIDS and TB);
- Urban-urban and rural-urban inter-household food transfers are important, especially for food insecure urban households; and
- Urban agriculture is not a major source of food amongst poor households

While urban food security is often characterised as 'invisible' to policy-makers, the AFSUN findings demonstrate that chronic food insecurity is pervasive in urban centres throughout Southern Africa.[28] Dealing with urban food poverty will therefore be a major policy and development challenge to city and national governments across the SADC region over the coming decades. Persistent urbanization and poverty mean that governments, urban managers and civil society have a significant challenge ahead in relation to improving food security for the poor while also addressing the currently unsustainable functioning and growth trajectory of the region's resource-hungry cities. While this is a daunting challenge, it is also a major opportunity. Tackling ecological sustainability from the food security vantage point provides a direct and tangible approach to

creating wealthier, healthier and less environmentally consumptive cities.

Although food supply is generally adequate at the city level in Southern Africa, there is compelling evidence that the majority of the urban poor do not have equal or universal access to sufficient food, and that the food which is consumed is often highly processed and of poor nutritional value. This demands a new focus on urban food security at the city scale. From an urban management perspective, supporting local food production is important in promoting livelihoods and health within the city, reducing costly food imports, using local waste productively and contributing to sustainable urban development. An increase in local food production necessitates the development and support of local level, neighbourhood-accessible marketing systems to distribute produce throughout the city, to wealthy and poor alike. Links to higher order production systems and retail value chains are also required. In order to realize the goal of creating healthy, vibrant and prosperous cities around the basic need of food, an enabling and supportive environment is required. Food (in all is complexity) must be fully integrated into the planning and management systems of the city, and be further enabled and supported by provincial and national line ministries.

An important characteristic of the food sector in developing country cities is its dualistic nature. Although there are strong formal components, there are many important informal components as well. The informal food economy is characterized by an absence of specialization and diversification in the products sold. There is a close inter-linkage between production and consumption as products and services are both produced and consumed, often by the same individuals. Capital investment is extremely low and innovation is more social than technical. Social networks provide low cost or free labour in the form of apprentice help or family members who are fed but receive little or no pay. Many informal food economy operators keep no accounts and avoid paying taxes. Because of the links maintained with rural areas, the informal food economy can often provide raw materials at lower cost. At the same time, to assume that the urban food economy is entirely dualistic with little inter-connection would be false. Although the informal economy overwhelmingly addresses the needs of households and micro-enterprises with limited purchasing power, it would be a mistake to imagine that the formal and informal food sectors are distinct and separate. There is growing competition between the two sectors in poor areas of cities and the informal economy also sources an increasing amount of produce from the formal sector.[29]

The processes that impact on food security are scale-dependent (Table 1).[30] The range of processes included in the table is certainly not

exhaustive, but it does illustrate that their impact on food security can be disaggregated by scale. The ability of groups to secure food, resources, and livelihoods at the local scale is at least partially determined by national processes. In policy terms, it is necessary to tackle food insecurity at both the local, provincial and national scales.

TABLE 1: Processes that Impact Food Security at Different Scales	
Local scale (e.g. household)	National/Provincial scale
Loss of customary rights and change to modern 'tenure' systems	Urbanization
Loss of access to communal resources	Changing legislation and tenure systems
Increasing need for cash	Population growth
Monetisation of resources and services/ increasing health and education costs	Increasing penetration of global markets/ reorientation of production away from local circulation and reciprocity
Privatization of land and resources	Increasing HIV/AIDS prevalence
Deagrarianisation (diversification out of agricultural-based livelihoods)	Declining biodiversity and forests and expansion of agriculture
Source: Adapted from Adger et al., "New Indicators of Vulnerability and Adaptive Capacity"	

3. Climate Science and the City

There is overwhelming evidence that the global climate is changing, observed directly through increasing average air and ocean temperatures, changes in the frequency and severity of storms, alterations in precipitation patterns, and extreme weather events.[31] There has been an increase in the frequency of storms, with heavy precipitation over most land areas. Long-term trends (between 1900 and 2005) show significantly increased precipitation in the eastern parts of North and South America, northern Europe, and northern and central Asia. Parts of the African Sahel, the Mediterranean, Southern Africa, and Southern Asia have become drier. Since the 1970s, droughts have become longer and more intense, affecting larger areas, especially in the tropics and subtropics.[32] In Southern Africa there has been a warming trend consistent with global temperature increases. This has been accompanied by a greater frequency in below-normal rainfall years, with a high number of drought events being reported in the last few decades.[33] Significant food shortages are associated with these droughts. In the drought of 2002-3, for example, there was a regional food deficit of 3.3 million tonnes and 14.4 million people needed emergency assistance.[34]

Climate change impacts many different aspects of the socio-ecological system including disease coverage, biodiversity, land degradation and changes in water availability.These changes have significant implications for social systems, although the way in which change is actually experienced depends on location,exposure, sensitivity and the ability of a society to respond. The implications of climate change and extreme weather events for urban areas, in particular, are not well understood, as much of the existing research focuses on rural areas.[35] The characteristics of urban settlements determine the nature of the climate impacts and, in some instances, the nature of climate events.[36] The concentration of population, economic activity and built environments in urban areas can change exposure to floods, heat waves, and other climate and weather events. For example, heavy precipitation might fall equally over neighbouring urban and rural areas. However, hard surfaces within the urban landscape could lead to increased run-off and flooding not experienced in the rural areas. Similarly, the impact of a general increase in temperature can differ between neighbouring urban and rural areas. The heat generated by the city (known as the urban heat island effect) further increases air temperatures. Climate change is expected to aggravate such phenomena, although the severity of the impact will depend on the adequacy of planning and governance.[37] Some climate projections are therefore appropriate to both urban and rural areas in a region, while others need to consider the feedback impacts of the urban landscape.

Much of the existing research on the implications of climate change for urban areas focuses on broader processes such as changes in precipitation, temperature, extreme events and sea level rise.[38] There is also scientific research emerging that looks more closely at urban climate change dynamics including how aerosols can change the nature of urban precipitation and how temperature inversions might shift with changing synoptic states.[39] Such detailed climate science has not been well integrated into work on urban social impacts and human adaptation and information is limited on how climate change impacts are likely to be experienced at the urban scale.[40] The London Climate Change Partnership was one of the earliest groups to recognise this gap and conducted a study detailing the key climate change impacts on different urban issues such as water resources, health, biodiversity, transport and business and finance.[41]

The limited consideration of local climate change dynamics can in part be attributed to the fact that, until recently, broad climate change scenarios had not been sufficiently disaggregated. The disaggregation process involves taking the output from global circulation models (GCMs) and interpreting them (via statistical techniques or more complex methods like those available in neural networks) in relation to local climate dynamics.[42]

At the urban scale, GCM data would be too coarse to be of use and so downscaled information is necessary for projecting future changes in climate. Empirical disaggregation makes use of quantitative relationships between the larger scale climatic environment and local variations sourced from historical data. However, disaggregated data seldom explicitly focuses on urban climate dynamics, resulting in limited information about urban climate change.

Although our understanding of potential links between future climate change and the urban landscape is limited, there is a better understanding of how past climate events have impacted on urban areas, particularly within the literature on urban disasters.[43] This has enabled the Intergovernmental Panel on Climate Change (IPCC) to produce a typology of how changes in climate are likely to impact on urban areas (Table 2).[44] Despite such efforts to unravel the probable impacts of future climate variability and extremes on urban areas, there has been little consideration of the implications for urban policy and practice. This is likely to rapidly change as local government and civil society start to engage with the realities of urban climate change. However, climate scientists need to tailor information to the urban scale and potential users need to learn to ask for appropriate information and find ways to integrate this information into daily planning, policy and adaptation responses at the city and neighbourhood scales.[45]

TABLE 2: Projected Impacts on Urban Areas of Changes in Extreme Weather and Climate Events

Climate phenomena and their likelihood	Major projected impacts
Warmer and fewer cold days and nights Warmer and more frequent hot days and nights over most land areas Virtually certain	Reduced energy demand for heating Increased demand for cooling Declining air quality in cities Reduced disruption to transport due to snow, ice Effects on winter tourism
Warm spells/heat waves: Frequency increases over most land areas Very likely	Reduction in quality of life for people in warm areas without air conditioning Impacts on elderly, very young and poor
Heavy precipitation events: Frequency increases over most areas Very likely	Disruption of settlements, commerce, transport and societies due to flooding Pressures on infrastructure, potentials for use of rain in hydropower generation Loss of property

Areas affected by drought increases Likely	Water shortages for households, industries and services Reduced hydropower generation potentials Potential for population migration
Intense tropical cyclone activity increases Likely	Disruption by flood and high winds Disruption of public water supply Withdrawal of risk coverage in vulnerable areas by private insurer (at least in high income countries) Potential for population migration
Increased incidence of extreme high sea level (excludes tsunamis) Likely	Costs of coastal protection versus costs of land-use relocation Decreased freshwater availability due to salt-water intrusion Potential for movement of population and infrastructure
Source: Wilbanks, et al., "Industry, Settlement and Society"	

Although engagement with climate science is important in order to understand what changes might occur, it is as important to explore the linkages between current climate variability and food security. In many cases, current variability is not well managed. Focusing on current challenges helps to ensure that climate change is not seen as a distraction that is only valuable for those with time to plan. Rather, reducing vulnerability to current variability helps to address many current development challenges.[46] For example, understanding how to reduce the current impacts of flood risk on food security is an important starting point if flood risk is expected to increase in future.

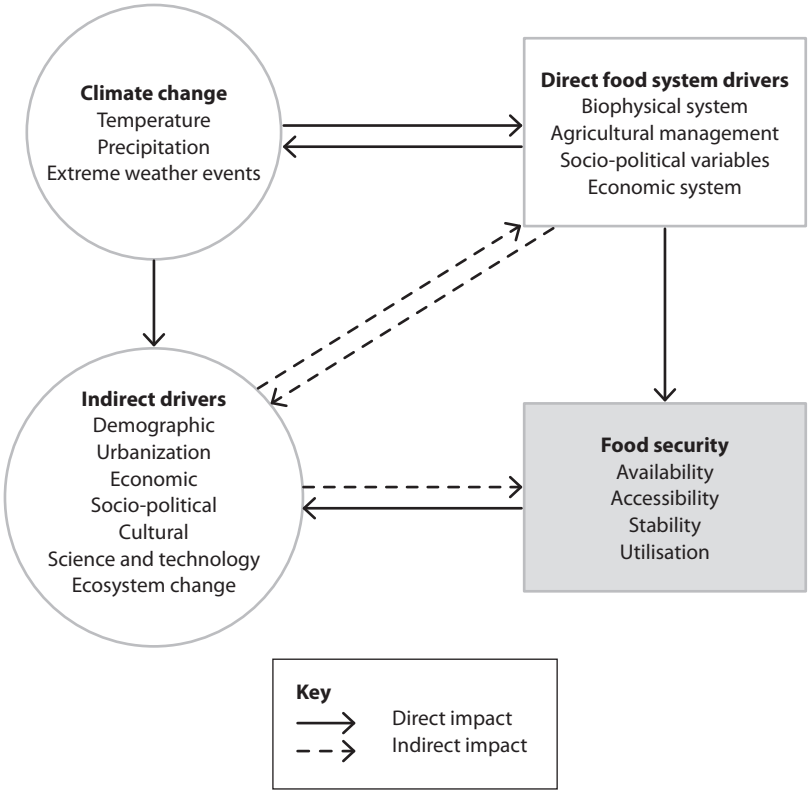
4. Linking Urban Food Security and Climate Change

The links between food security and climate change are complex, because food security involves more than just food production. To date, much of the research has focused on exploring the linkages between climate change and food production, while limited attention has been paid to the direct and indirect impacts on the other critical dimensions of food security.[47] This is likely to result in an underestimation of the impact of climate change on food security. By not exploring all of the direct and indirect linkages, adaptation and mitigation options might overlook important opportunities for changes in food systems. In order to better understand how climate variability and climate change relate to all of the different

dimensions of food security, the links between various bio-geophysical and socio-economic systems need to be explored.[48]

To better understand the possible impact of climate change on urban food security, it is first necessary to examine the general linkages between climate change, food security and the drivers of food systems (Figure 1). Climate change impacts on both the direct and indirect drivers. The indirect drivers include global economics, demography and environmental trends, whereas the direct drivers centre around the biophysical system and its management as well as key socio-political and economic variables.

FIGURE 1: Linkages between Climate Change and Food Security



The majority of the food consumed in cities is transported from rural areas or imported. Food security in urban areas will certainly be impacted if climate change affects rural production and productivity, locally and regionally. In some places urban agriculture provides some produce, although this too could be impacted by climate change through stress on urban water resources. Access to food in urban areas is also likely to be impacted by climate change because most food is purchased in urban areas. Food prices are a direct determinant of affordability and hence

access. If climate variability or extremes impact on job opportunities this will affect the ability to buy food. Some members of the urban poor use their homes as businesses, and when climate-related disasters damage or destroy houses, the infrastructure required to earn a livelihood is removed. In addition, a change in climate or weather extremes may affect the availability of certain food products and their price. High prices may make certain foods unaffordable which in turn will affect individual nutrition and health. Changes in seasonality attributed to climate change can lead to certain food products being scarce at certain times of the year. These seasonal variations in food supply can make livelihoods more vulnerable.

Food utilization refers to the use of food and how a person is able to secure the nutrients and quality of food needed.[49] As climate changes, the types and variety of seed cultivars that can be grown also change so that they are more appropriately suited to the climate. This has implications for what people eat. For example, in Southern Africa maize is a staple crop. However, sorghum fairs better if there is less rainfall. Yet, many people prefer to eat maize rather than sorghum and continue to plant maize despite poor yields that may become even more threatened with future climate change. If other produce that is easier to grow in a different climate becomes cheaper, people may change their food basket. Alternatively, it could result in people spending a greater percentage of their income on food if prices increase.

In addition, people with HIV and AIDS require improved nutrients to help fight the disease.[50] Changing food security linked to climate change can therefore impact on the nutrition security of ill household members.[51] The ability of a household to maximize their utilization of food is also related to housing and to physical infrastructure, including electricity for refrigeration and cooking. Severe weather events can damage infrastructure – particularly in poorly serviced areas which are more prone to disasters – with negative consequences for food and nutrition security and food safety in poor urban households and communities. A change in climate or climate extremes may impact on the availability of certain food products which will impact on their price. High prices may make certain foods unaffordable and can in turn influence individual nutrition and health. Changes in food seasonality attributed to climate change, can lead to certain food products being more scarce at certain times of the year. Although most of the production is in rural areas, the impacts of scarcity are felt acutely by the increase in price that filters through to urban consumers.

One of the main challenges in linking climate change and urban food security is that the former is a long term process while the latter – particularly

for poor households – is an immediate and daily concern. However, the dynamics of both climate change and urbanization are converging spatially and temporally. On the one hand, the pace of research on potential impacts of climate change on society is increasing rapidly, underscoring the need for urgent action. On the other hand, the unavoidable demographic growth and urbanization of humanity – concentrated in the cities of the developing world – means that the face of poverty will increasingly be urban. These two dynamic global forces are converging to create an ecologically unsustainable pathway, and at an exponential rate. Already cities occupy only some 2% of the planet's land area, yet they consume 75% of the world's resources.[52]

Looking at the sustainability challenge of climate change and urbanization through a food security lens is a useful way to highlight the linkages between cities and climate change. For example, agriculture is resource intensive and generates about 30% of greenhouse gas emissions. This excludes the additional and serious ecological impacts of current systems of processing, marketing, consumption, as well as the costly waste of food.[53] Ericksen writes that "in addition to food security, food system activities contribute to environmental outcomes, and food security itself is determined in part by environmental factors independent of the food system activities."[54] Food security, climate change and sustainable development are intimately connected in a web of feedback processes and outcomes – the extent to which these are positive or negative depends on how these relationships are conceptualized and managed. Given that the urban poor constitute the increasing majority of those vulnerable to food insecurity and unsustainable urban growth and development, programmes to address the problem must include this constituency in their design.

The United Nations' five sustainable development priority areas are water and sanitation, energy, health, agriculture and biodiversity. These areas encompass physical and social systems which recognise the complex relationships between each major priority area. Once again, in applying a food and nutrition security lens to these five development areas, the cross-scale and inter-sectoral linkages that impinge on the climate change-food security-society nexus are highlighted. Figure 2 makes some of the more obvious links from a food security perspective. These links may be useful in the further development and testing of the climate science, asset adaptation and food security framework that this paper proposes in relation to Southern African cities.

FIGURE 2: Links Between Food Security and the UN's Five Sustainable Priority Areas

Food Security				
water and saintation	**energy**	**health**	**agriculture**	**biodiversity**
rainfall drought irrigation water quality conservation urbanisation	fossil fuels land change transport processing consumption wildlife	chemicals pollution food quality safety diet and disease access	industrial farming; local and alternative models; organics markets	mono crops fisheries biotech genetics ecology extinction

5. Adapting to Climate Change

Food security is currently being influenced by climate variability and will continue to be affected by climate change, perhaps at an increasing rate in the future. It is therefore necessary to understand how the food system can best adapt to climate change as well as how to reduce emissions from the food system that contribute to climate change. Food production is both the target and the cause of anthropogenic climate change. Disruption of the biophysical resources on which agriculture and forestry depend will impact the availability of food in the cities. At the same time, land use changes to accommodate agriculture and forestry, the use of nitrogen-based fertilizers, methane releases from animal waste, and the transport of food and fibre have all been implicated in the accelerated release of greenhouse gases responsible for climate change.

Whilst a range of development initiatives have the potential to deliver benefits for climate change adaptation, the international climate change adaptation regime looks for 'additionality' (i.e. adaptation strategies need to represent something more than 'business as usual.') The challenge is to make climate change adaptation good development – and not vice versa. It is not sufficient to attach climate change adaptation as an add-on motivation for existing development programmes. A number of specific strategies can support effective adaptation. Some strategies might aim to reduce impacts to a specific hazard, such as drought, while other strategies might try to increase the resilience of a sector by adopting new technologies that improve the ability to cope with high climate variability, such as new seed varieties. Within each strategy, there are various actions that

might contribute to pursing the strategy. For example, if the strategy is to decrease the impact of climate variability on small-scale farming, actions might include increased mulching, planting wind breaks and improving irrigation efficiency.

In addition to specific strategies and actions, it is important to develop platforms on which different stakeholders with different aims can build an integrated vision and response aimed at ensuring food security in the face of climate change. Effective platforms enable communication between climate scientists, adaptation experts and those impacted by climate change.[55] The importance of multi-stakeholder platforms lies in going beyond a focus on activities that need to change, towards social and institutional processes that reduce vulnerability. This requires more than technical projects that are 'delivered' at the local scale, and which tend to be based on a 'predict and provide' approach to adaptation, to processes that support institutional change and learning and reduce vulnerability to a wide range of climate change impacts that are difficult to predict.

Population groups, regions and sectors that are vulnerable to current climate exposure need to be identified, and dangerous thresholds quantified where possible, beyond which current activities will not be able to cope with climate change. This process enables adaptation planning to respond to specific climate change related threats rather than broad development needs – although the overlap between these two needs is typically significant. In order to achieve this, there needs to be a good understanding of the current vulnerability baseline in order to identify pathways of adapting to future climate variables. In addition, current risk management strategies should be examined in terms of their robustness in relation to current climate variability, specifically for different climate hazards and variables. Future scenarios overlaid with existing thresholds can then be used to identify adaptation priorities.

Although climate change is going to be widespread, it is the rural and urban poor who will feel the impacts of climate change the most. In Southern Africa, many poor households depend directly on natural resources and agriculture and will not have the ability to move or otherwise buy their way out of problems as temperatures rise and flood and drought intensity and frequencies impact agricultural production, water supplies, diseases and infrastructure. Many of these impacts might be less significant to those who have insurance or the ability to change activities.

Urban disaster risk management programmes can be an entry point for adapting to climate change while considering food security issues. Research in the Philippines suggests that it is adjusting everyday lifestyles,

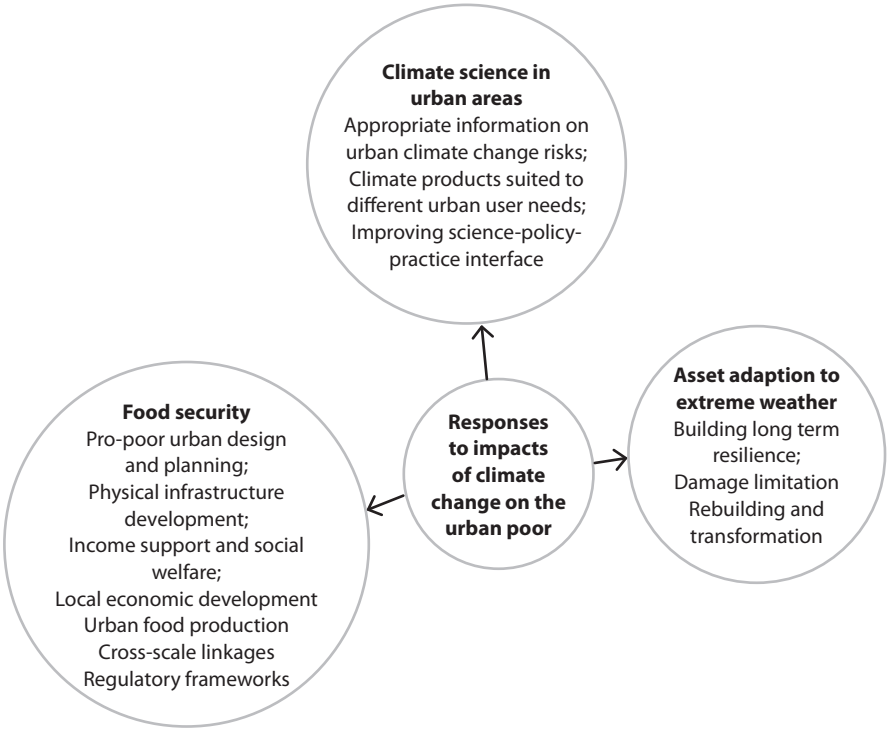
rather than adopting extreme responses, that best helps households cope with increasing hazard risk.[56] De Haen argues that development policy and disaster management need to become more mutually supportive in order to reduce disaster impacts on poor population groups.[57] He suggests that improving disaster resilience in disaster-prone locations should be an integral part of food security policies and strategies. This could include investments in productivity enhancement, social safety nets for the most needy, risk information and analysis, improved land use planning, upgrading physical infrastructures and risk transfer mechanisms.

Adaptation can be supported at both the household level and the macro level. Often macro level policies will support local change. For example, water stress is likely to be amplified by climate change in South Africa.[58] The increased use of rainwater harvesting could make a small impact on the livelihoods of those living in areas without good access to piped water by impacting on people's health and increasing the ability to grow vegetables and to have water available for household activities including cooking and cleaning. Policies subsidising rainwater tanks would encourage households directly and could reduce demand on water sources by multiple users, thereby supporting adaptation.

Health impacts are likely to be felt by those with few resources who are often unable to afford medicine or transport to health clinics, requiring health-care infrastructures to adapt to changing needs. Malaria is expected to change its range and the prevalence of diseases such as malnutrition, diarrhoea and HIV/AIDS, might become harder to manage. Increased temperatures are expected to have health impacts linked to heat stress.[59] Adjustments can be made to building standards, particularly for low-income housing, that can help to reduce the effect of increasing temperatures. The growing prevalence of malaria is being addressed through other global programmes, and these responses can be seen as adaptation to climate change, if it is established that climate change is driving a change in the distribution of malaria.

Although the details of how to adapt to climate change within the urban food system are not outlined in detail here, one way of looking at climate change adaptation is through a framework that links climate science, food security and asset adaptation (Figure 3).

FIGURE 3: Climate Science-Food Security-Asset Adaptation Framework



This framework suggests that by exploring the intersection of food security, urban climate science and asset adaptation, more appropriate long-term responses and solutions to the impacts of climate change on poor households in cities could be developed. The intersection of the different fields highlights the need for actors, including practitioners and policy makers, from different disciplines to think 'outside the box' and get beyond their individual priorities and concerns.

One of the emerging impacts of climate change in highly urbanized areas such as the Western Cape region is on local agricultural production. Although it is clear that urban food security is not primarily about production, it is useful to explore the impacts climate change might have on agriculture in the province as well as how it might impact on the other components of food security.Two likely scenarios for climate change for the Western Cape are (a) a temperature increase of at least 1°C by 2050 and (b) increased flooding. These changes would have considerable impacts on the food system (the production, processing, distribution and consumption of food.) In turn, there would be considerable negative impacts on food security including food availability, accessibility and utilization (Table 3). However, these food system and food security impacts do not distinguish between urban and rural areas. We therefore need to

ask about the specific implications of climate change for the capital assets of the urban poor under the two scenarios (Table 3).[60]

TABLE 3: Potential Impacts of Climate Change on Food Systems and Food Security

Likely scenarios	Food system impacts	Food security impacts	Specific urban impacts
Temperature increase of at least 1°C by 2050	*Producing food*: • Shift in agro-ecological zones • Change in crops grown per area *Processing food:* • Increased need for cooling of perishable products • Change in post-harvest losses *Distributing food:* • Perishable products have shorter shelf life • Food storage impacted by changing pests • Improved refrigeration needed *Consuming food:* • Food stuff perishes quicker	*Food availability:* • Overall decrease in stability of food supply • Decreased yield if irrigation potential reduced • Shorter shelf life for perishable products *Food accessibility:* • Reduced availability might lead to increase in food prices which would make food less affordable, particularly for urban populations *Food utilization:* • Need to eat food sooner with shorter shelf life • Less cooked food required • Might require more fluid intake	*Human capital:* • Changes in patterns of consumption • Increase in diseases related to shorter shelf life of food products • Increased on-site food production • Increase household spending on food *Financial capital:* • Street vendors & home based enterprises change perishable products to buy & sell • New investments to protect perishable goods being sold & shelved • Increased price of perishable food *Physical capital:* • Increased demand for water systems in human settlements

TABLE 3 cont.

Likely scenarios	Food system impacts	Food security impacts	Specific urban impacts
Increased flooding	*Producing food:* • Change in growing conditions (damaged crops and lower yields; increased soil erosion) • Impact on livestock health (increase livestock disease; animals stranded) *Processing food:* • Damaged storage facilities • Damage to food processing plants *Distributing food:* • Change in cooling and storage facilities during transport • Damage to storage facilities and infrastructure used for distribution *Consuming food:* • Food basket composition changed • Increased water body size for water-borne diseases increases human health risks and cleanliness of food	*Food availability:* • Overall decrease in stability of food supply • Decrease in surplus production • Increased need for food aid • Increase in food imports *Food accessibility:* • Increase in food prices might make food less affordable • Food supply chains can be affected, resulting in allocation problems *Food utilization:* • Food safety problems due to emergency rations being used • Preferred foods not available • Frequent flooding might result in people changing food types	*Human capital:* • Rural urban migrations • International migrations • Increased risk of riots and violence associated with access to affordable food in cities *Financial capital:* • Street vendors & home based enterprises change perishable products they buy & sell • Increased price of perishable food *Physical capital:* • Increase demands in affordable and adequate land • Increased squatting in vulnerable and risk areas • Increase demand for physical collective assets (basic services & infrastructure)

Conclusion

The challenge of urban food insecurity has not yet been systematically addressed in Southern Africa.[61] The connections between urban food security, urban poverty and climate change have received even less attention. This paper has laid out the challenges in each of the fields and some of the connections, particularly in the context of the urban transition taking place in Southern Africa. Given that climate change is a long term development challenge and is closely linked to the growing challenge of urban food security, it makes sense to explore this interaction in more detail.

How, then, might we think about the compelling issues that link climate change, food security and cities together and, in particular, how might these emerging dynamics affect the most vulnerable and least resilient - the urban poor? Climate change adaptation and mitigation policies need to become an integrated part of the development agenda for fighting poverty and hunger. This will require new cooperation and institutional capacity to analyze and monitor all climate change impacts. Food security and climate change present important challenges to a wide range of stakeholders, particularly policy makers. Amongst the key questions are how policy makers can make sense of the complex war on hunger when climate change emerges as a new front. Policy makers face a challenge in integrating future climate predictions into policy-making, particularly when they are already faced with imminent and certain threats to food security in the present. Meeting the climate/food security challenge simultaneously requires progress in poverty eradication, reduced global inequality, assured resource rights, the promotion of stable livelihoods, and gender equity. The problems of global disparity and achieving food security in a highly variable climatic context are connected and cannot be solved separately.[62]

In this paper, food security has been presented as a useful lens to conceptualise the urban poverty dynamic that is unfolding in cities of the Global South. Although availability of food and food production has been a focus of past research, access to food is the critical factor for the urban poor. Access is often determined by affordability, which can depend on scarcity. This leads to an increase in price that filters through to urban supply. If changes in production because of climate variability and change affect scarcity, the urban poor are likely to feel it the most.

The historical emphasis on food production suggests that the impact of climate change on food security has been underestimated and more research is needed on the impacts of climate on access and utilization. In order to address this, both the ecological and poverty dimensions need to be addressed and both of these are likely to be impacted by future climate change. In terms of urban climate change, climate impacts are going to depend on the characteristics of urban settlements. In order to address this, downscaled climate change scenarios are needed to develop scenarios for specific locations. At present there is little focus on this in Southern African cities, partly because of limited capacity and partly because it has only recently started to emerge as an important issue. Although climate science has not been well integrated into work on urban social impacts and human adaptation, a change in climate is likely to impact on required heating and cooling, air quality, transport, infrastructure, coastal and riparian land use and on availability, access and utilization of food.

One of the main challenges in linking climate change and urban food security is that the former is a long term process while the latter – particularly for poor households – is an immediate and daily concern. However, the dynamics of both climate change and urbanization are converging. On the one hand, the pace of research on potential impacts of climate change on society is increasing rapidly, underscoring the need for urgent action. On the other hand, the unavoidable demographic growth and urbanization of humanity – concentrated in the cities of the developing world – means that the face of poverty will increasingly be urban. These two dynamic global forces are converging to create an ecologically unsustainable pathway, and at an exponential rate. Looking at the sustainability challenge of climate change and urbanization through a food security lens is thus a useful way to highlight the linkages between cities and climate change.

In laying out the connections between urban food security, urban poverty and climate change, the gaps that exist have been highlighted making it evident that improved understanding of the linkages between climate change and food security in Southern African cities is needed. This improved understanding is needed to inform policies and practices that can start to ameliorate the potential negative impacts through pro-active – rather than reactive – planning and programming. Five areas of focus are suggested as a priority for Southern African cities:

- *Integration of food security and climate change in urban policy:* Food security and climate change are both issues that have historically not been part of urban planning yet it is evident that they need to be integrated at the urban management level. This could happen via standalone departments or as part of existing department functions;
- *Committed resources:* Resources are needed to address these challenges explicitly in order for policy to be developed and implemented. Both financial and human resources are required to achieve this. One of the challenges with financial resources is that they tend to operate on a short term budget cycle of around 3 years, when the type of implementation required is often long-term, which will entail operational hurdles to be overcome;
- *Planning:* Urban planning is central to managing the climate change and food security link. All too often the poor have limited access to even basic physical and social infrastructure in Southern African cities, which makes them especially vulnerable to extreme weather events. In addition, it is the poor who tend to occupy marginal land which may be prone to flooding and other natural disasters. Planning must therefore stress urban infrastructure as key to the protection of assets amongst poor and food insecure communities in the region's cities,

and this needs to occur within properly resourced municipal/city and regional/national governments. This is no different to other contexts where infrastructure is considered a foundation of development. For example, the C40 Clinton Climate Initiative focuses on infrastructure, with communities 'embedded' in this approach.[63] Here the strategy deals with infrastructure from a climate change perspective on a sector by sector basis, and includes buildings, energy, lighting, ports, renewables, transport, waste and water.

In addition to physical infrastructure, we also argue that in the context of urban poverty and the limited resources that characterize the cities and towns of Southern Africa, social infrastructure must also be proactively developed. While addressing physical infrastructure is a critical mitigation strategy that may have positive spin-offs for the urban poor, building and protecting valuable social assets amongst low-income communities must be centre-stage of any climate change action plan in the context of developing countries. Cities in Southern Africa will not achieve mitigation targets nor will they effectively build human resilience unless the poor themselves are the focus of such strategies. Climate action plans must be comprehensive and provide a vital opportunity to marry the macro efforts at slowing climate change and the micro efforts of so many urban communities and households to earn a decent living under difficult conditions;

- *Research:* Although there is a growing body of research on climate change impacts and adaptation, the extent to which climate change will affect the food security of the city and its inhabitants, especially within the context of high levels of poverty and widespread food and nutrition insecurity, has not been widely researched.[64] Information is needed on the potential impacts of climate change to help mould future food security interventions. Access to food is likely to be strengthened through a number of strategies such as job creation, poverty alleviation, improved land-use planning and social protection. These responses may also help poor urban households to cope with the impacts of climate change on the food system, although further research is needed to understand the dynamics in more detail. On top of this, new strategies that explicitly deal with climate change and urban food security issues are needed. The research process might focus on identifying priority adaptation strategies in conjunction with planners, climate scientists and related government stakeholders;
- *Strengthening the science-policy-practice interface:* Policy makers need to make sense of the complex war on hunger while climate change emerges as a new front. They face a challenge in integrating future climate predictions into policy-making, particularly when they are already faced with imminent and certain threats to food security in the

present. Meeting the climate/food security challenge simultaneously requires progress in poverty eradication, reduced global inequality, assured resource rights, the promotion of stable livelihoods, and gender equity. The problems of global disparity and achieving food security in a highly variable climatic context are connected and cannot be solved separately.[65]

GLOSSARY

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.[66]

Climate change: a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

Climate variability: Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events.[67]

Extreme events (weather or climate): An extreme (weather or climate) event is generally defined as the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends ("tails") of the range of observed values of the variable.[68]

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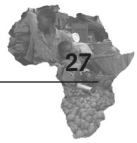

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Climate Change and Food Security in Southern African Cities

The current urban transition in the Global South is at the heart of discussions about the relationship between climate change and food security. This paper explores the links between climate change and food security within the context of the urban transition taking place in Southern Africa. Climate change is expected to negatively accentuate existing levels of urban food insecurity and these adverse impacts are likely to fall disproportionately on the poor. Researchers, planners and policymakers in Southern African cities are starting to explore how changes in weather associated with climate change are likely to affect urban lifestyles and systems. In order to do this, it is important to understand how climate science knowledge is used at the level of the city and how the impacts of climate change might affect city functioning at the metropolitan and household scales. One of the critical areas that has not been addressed in any detail is the extent to which climate change will affect the food security of the city and its inhabitants, especially within the context of high levels of poverty and widespread food and nutrition insecurity. This paper argues that it is important to understand the linkages between climate change and food security in Southern African cities to begin to design and implement pro-poor planning and programming.

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