Urban food security and climate change: A system of flows

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Introduction

Whilst the connections between food security and climate change have been examined extensively at the national and regional scales, the urban scale has been largely neglected in both fields as have the connections between the two. As will be discussed further in the chapter, urban food security has been neglected due to the perception that poverty and food security are still predominantly rural challenges in the global south. Climate change models tend to work at the global or regional scales, downscaling to the urban scale is challenging. As a result very few city scale climate models exist with most research depending on extrapolating from regional models, which leads to a high degree of uncertainty. The challenge of scale mismatches potentially the development of models that connect urban food security and climate change. The time scale on which climate change is unfolding is long and the time line has considerable uncertainty. The drivers of vulnerability to food insecurity also operate over long time periods, but the actual experience of food insecurity in urban areas is often triggered by single events, such as a food price increase or a loss of a household income. In order for meaningful connections to be drawn between climate change and urban food security it will be necessary find ways to make cross-scale linkages.

This chapter attempts to address food security and climate change at the spatial and temporal scales appropriate to the processes connecting the two. In doing so, it acknowledges that food security in the urban is affected by events that may be far from the urban area itself. Urban food security needs to be viewed as being impacted by climate change in multiple locations and at various scales, and not simply in situ. This chapter therefore proposes a model/approach to assess the connections between urban food security and climate change and suggests that this model/approach may be useful as a means to develop greater resilience of urban areas to the impacts of climate change. The model is based on viewing urban food security to be based on the connection of a series of resource flows each with their own sets of vulnerabilities and resiliences. Through this model, it may be possible to evade the scale-mismatch challenge and identify priority areas to protect urban food security from climate

change risks. The chapter draws on the findings of the 2008 AFSUN urban food security survey conducted in Cape Town to identify key elements of urban food security (Battersby in press).

The chapter begins by highlighting the need to consider urban food security as a different development challenge to rural food security with a different set of relationships to climate change. It then identifies key elements of urban food security through analysis of the strategies households employ to access food and of the dynamics of the urban food system in terms of food sources. From this empirical basis, it then proposes the model and draws conclusions based on the application of the model to key flows.

Placing urban food security on the development agenda

Urban food insecurity is increasingly recognised as a key developmental challenge in sub-Saharan Africa. However, because food insecurity has traditionally been conceptualised as a rural development problem, the existing conceptual tools used to understand the challenge and frame the responses are inadequate to address food security in urban areas. The focus remains largely on issues of availability and therefore finds solutions in increased food production, whereas the challenge of urban food insecurity is primarily one of access. Where issues of access have been considered, the supply chains have tended to be short and simple in comparison to the urban food system, which ultimately draws its food from a wide range of sources which have complex and diverse supply chains.

Maxwell (1999) suggests that urban food security has remained relatively invisible for three main reasons. Firstly, urban policy makers and practioners do not address food insecurity because limited budget and capacity mean that "more urgently visible problems" (Maxwell 1999, 1940), such as housing and sanitation take priority. Although historically the growth and form of cities was determined by their food system (Steele 2008), this is no longer the case. Food is rarely on the urban planning agenda. Secondly, he argues that urban food insecurity is rendered invisible by how it manifests. Food insecurity in rural areas is often linked to times of famine, in which enter communities experience food insecurity at the same time. Food insecurity in urban areas is not triggered by absolute food shortages, but by failures of households

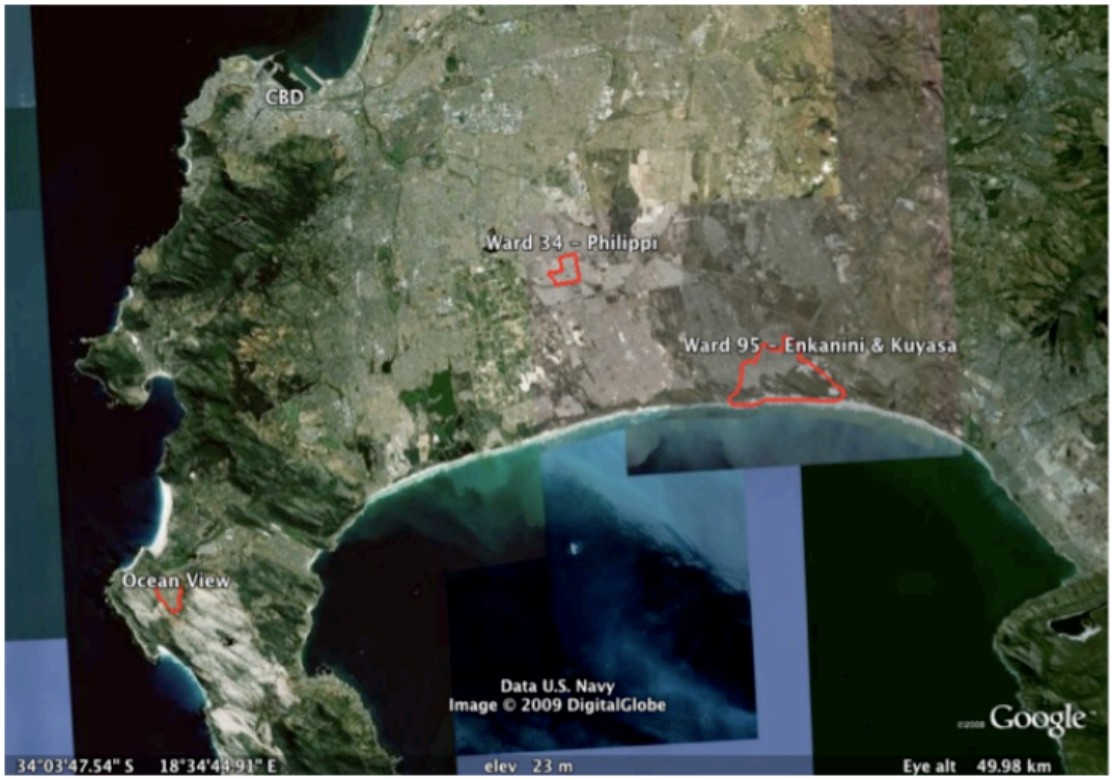
to be able to access food. Urban food security is therefore more an idiosyncratic than covariate shock than rural food security, though covariate shocks, such as food price increases are also significant. Food insecurity is therefore experienced primarily at the household scale and households employ a range of localised coping strategies, which render the struggle invisible. Finally, he argues that the long established perceptions of food security and poverty being rural problems make policy makers less likely to see urban food insecurity. Urban food security is thus politically invisible and has been largely neglected researchers. It is out of this paucity of research that the connections between urban food security and climate change have been left largely un-interrogated.

While the challenge of urban food security has historically been considered as secondary to rural food security, demographic and economic realities in the developing world are forcing a re-appraisal. In 2008, the world became predominantly urban, with the sub-Saharan Africa being the most rapidly urbanization region (UN Habitat 2009, 25). While poverty and food insecurity have been viewed as predominantly rural, this reality is shifting as not only do urban areas become more significant in terms of absolute population, but also in terms of proportion of the population living in poverty. Ravallion notes that the poor urbanise faster than the non-poor (Ravallion 2002, 442). In addition, conditions in many urban areas in terms of access to shelter, security of tenure, lack of basic services and increasing inequality are driving many urban residents into poverty (Mehta 2000). The face of poverty is increasingly poor and the urban can be considered the new development frontier.

It is not enough however, simply to note that poverty and food security are increasingly urban and hope to employ the same means of analysis and attempt the same solutions that are applied to rural areas. The ways in which poverty and food security manifest in urban areas and their drivers need to be examined independently of prior rural assumptions. In this section I therefore use the findings of the African Food Security Urban Network's Cape Town household food baseline survey to highlight some key issues pertaining to food security in urban areas.

The food security baseline survey was conducted between August and October 2008 in three locations in Cape Town: Ocean View, Ward 34 (Brown's Farm, Philippi),

Ward 95 (Enkanini & Kuyasa, Khayelitsha) (Map 1). Within this survey 1060 households were sampled and the survey was part of a wider 11 city survey across southern Africa sampling over 6500 households.



Map 1: Field sites in Cape Town

Across the region as a whole, 77 percent of households were either severely or moderately food insecure (Frayne & Pendleton, in press).[1] In Cape Town this proportion was marginally greater at 80 percent. Therefore, whilst food insecurity has been considered to be a predominantly rural problem, the data from the AFSUN survey indicates very high levels of urban food insecurity, comparable to those in rural areas.

A recent study in rural Eastern Cape using the same food security measurement tool found 100 percent of participant households to be severely or moderately food insecure. However, while food insecurity appears to be more extensive in rural areas than urban areas, our survey found that the severity of food insecurity in poor areas of Cape Town was greater than that in the rural area sampled (see Figure 1). This is

[1] Levels of food insecurity were calculated using FANTA's Household Food Insecurity Access Scale measurement tool (Coates et al 2007)

largely due to the dependence on the cash economy in urban areas, and as will be demonstrated within this chapter, a limited range of livelihood strategies and therefore greater vulnerability to shocks, including climate change and increased climate variability.

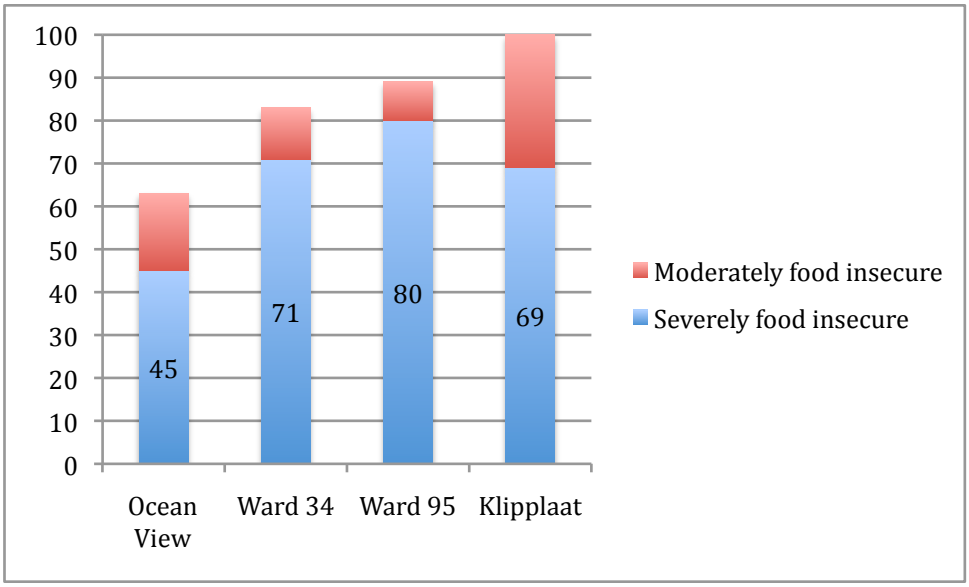


Figure 1: Comparison of food security in Cape Town and Klipplaat. (source: AFSUN survey and Ballantine et al 2008, 6)

Urban food insecurity manifests differently to rural food security in a number of important ways, most notably its temporality. Figure 2 illustrates the months in which households in Cape Town experienced food shortages. Unlike rural areas, these months do not correlate to particular periods in the agricultural cycle, but are determined by annual periods of low casual labour availability, high expenditures (e.g. heating in winter) and other non-food related factors.

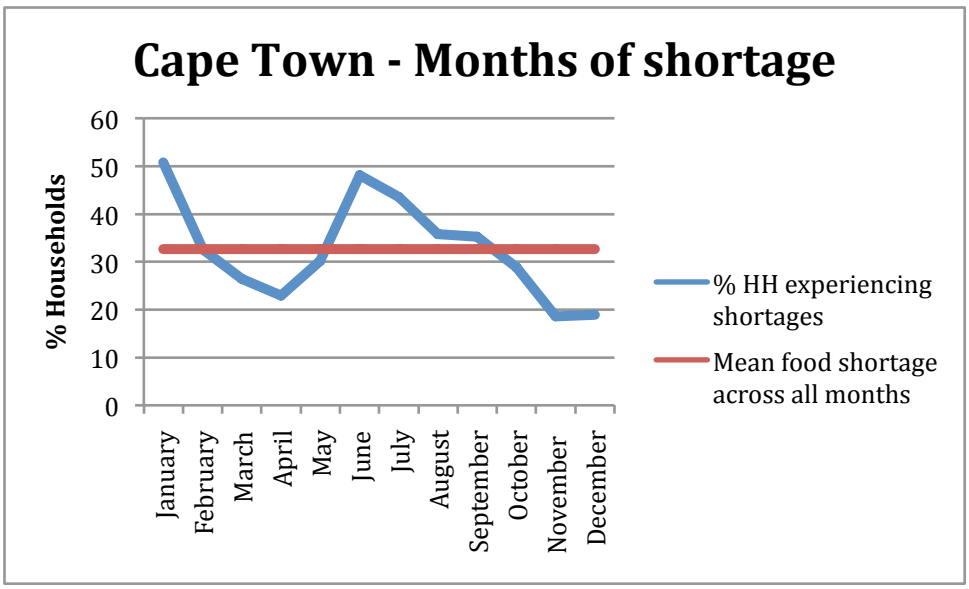


Figure 2: Months of adequate household provisioning

The drivers of food insecurity in urban areas are more complex and less directly related to food availability than those in rural areas. In urban areas the need to consider food accessibility, stability and utilization is ultimately as great as the need to consider food availability. In addition, the food system in urban areas tends to be complex and diverse. As the following sections will demonstrate, households access food through a number of formal and informal sources and have multiple means by which they secure and employ assets to secure this food. Each of these sources and strategies have the potential to be impacted by climate change, both directly and indirectly. It is therefore vital to understand the dynamics of the urban food system in order to consider the connections between urban food security and climate change.

Household strategies for accessing food

Given the high levels of food insecurity within the Cape Town sample population it may be expected that households would have diversified livelihood strategies in order to maximize potential food security and increase resilience. However, livelihoods in Cape Town were relatively un-diverse. Half of the sampled population indicated that they had no alternative livelihood strategies, and were entirely dependent on their main source of income, and 31% had just one other strategy. This makes households extremely vulnerable, should their existing source of income be lost, a very real threat in the context of the current economic circumstances.

At the time of the survey 45.6% of respondents classified themselves as not working, but looking. Just 585 of the 4177 individuals included in the survey were in formal waged work, with an additional 292 employed in casual labour. Just less than half of the households (42.5%) were in receipt of some form of state grant (pension, child support and disability). Those employed in the formal wage sector earned a median income of R2000 per month. The median income of a casually employed worker was just half that amount, and the median amount received by a grant-receiving household was R620.

Households that had members employed in the formal wage sector were the least likely to have alternative strategies. There is a sense of security that comes with formal employment, however these households are extremely vulnerable to food insecurity should the source of income fail, or food prices rise rapidly, as they did in 2008.

The alternative strategies that were being employed were dominated by casual labour (in addition to that listed by the main source of income of the household). This was an alternative strategy of 16.2% of households, a further 8.2% were self-employed at home. Other significant livelihood strategies were marketing (4.8%) and renting space to lodgers (4.5%). The oft-advocated strategy of urban agriculture was listed by only 10 out of 1060 households. The urban population of Cape Town, as in many developing world cities, are highly dependent on the cash economy to secure food, rather than growing their own food source, which makes them vulnerable to the impacts of climate change across a far broader geographical range than is assumed in rural food security and climate change research.

As will be discussed further in the following section, urban households wee also highly dependent on informal safety nets, when their ability to source food through purchase fails. Almost half of the sampled households (44.5%) had acquired food through sharing with neighbours in the last year, through eating food provided by others (34.1%) and through borrowing food (29.2%).

Households also ensured some form of food security through manipulation of their diet and volumes of food consumed. It was common practice for households to reduce

the variety of foods they were eating due to lack of resources (49.0% reported they did this sometimes or often) or even to eat food that they would prefer not to have to eat due a lack of resources to obtain other types of food (48.0%). In addition households were reducing meal sizes (46.4%), eating fewer meals per day (43.4%) and even finding no food of any kind in the household because of lack of resources (36.3%). These reductions in dietary diversity and overall food intake will have long term health and development impacts on the households. Within our survey we found a median dietary diversity of 6 out of 12 food types, but as Fig 3 shows, this seemingly high figure masks the fact that three of the most common food types consumed are largely non-nutritive ("other" was usually tea and coffee). Limited dietary diversity is a part of the struggle for food access linked to food prices and the food geography of the city. Prices are ultimately linked to fluctuations in availability and management of the wider food system. These fluctuations in availability are often attributed to climate variability, thus connecting household dietary choices and climate change.

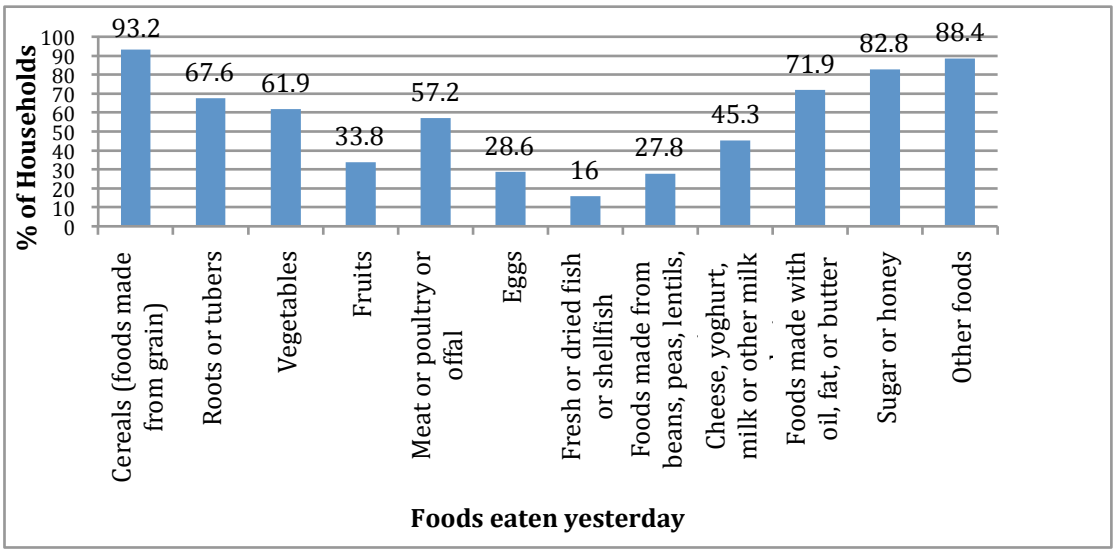


Figure 3: Dietary diversity of sampled households

A final household survival strategy related to food is that households may defer consumption of food to meet other immediate pressing needs (de Waal 1990). This may be evidenced by Fig 2's illustration of months of adequate nutrition. The supply of food to the city was constant throughout the year, so the challenge was not one of availability, but of a failure of access. This may be due to a reduction in income, as happens in January in the city when many sources of formal and casual labour close

for the holidays, but it is also likely to be due to demands for increased expenditure for other goods. During the winter months there are higher fuel costs as well as other expenses. Households may defer income that would have been spent on food at these periods pushing them into food insecurity as a livelihood strategy.

The strategies that households are able to employ are both endogenous, but also shaped by wider spatial and economic circumstances of the city. This was evident when the spatial variation in livelihood strategies was considered across the three study sites. For example, casual labour, the most common alternative strategy, was far most frequently utilized in Ocean View due to its proximity to wealthy white areas of the city and therefore sites of potential employment. The extremely peripheral Khayelitsha site had the lowest proportion of casual labour. The urban form and relations between places play a significant role in determining possible livelihood strategies, and also the ability to access food. In considering strategies to address food insecurity it is vital to engage with the spatial nature of the urban food system and access to food in urban areas. The following section on sources of food will highlight these issues.

The sources of food in Cape Town

Within the Cape Town survey, households accessed food from a wide range of sources. This chapter proposes that this diversity of sources requires a more systematic assessment of the impacts of climate change on urban food security. Each source of food and each food type will have its own path from source to site of consumption and is dependent on a different set on economic, social and political relations, and therefore each will be differently impacted by climate change.

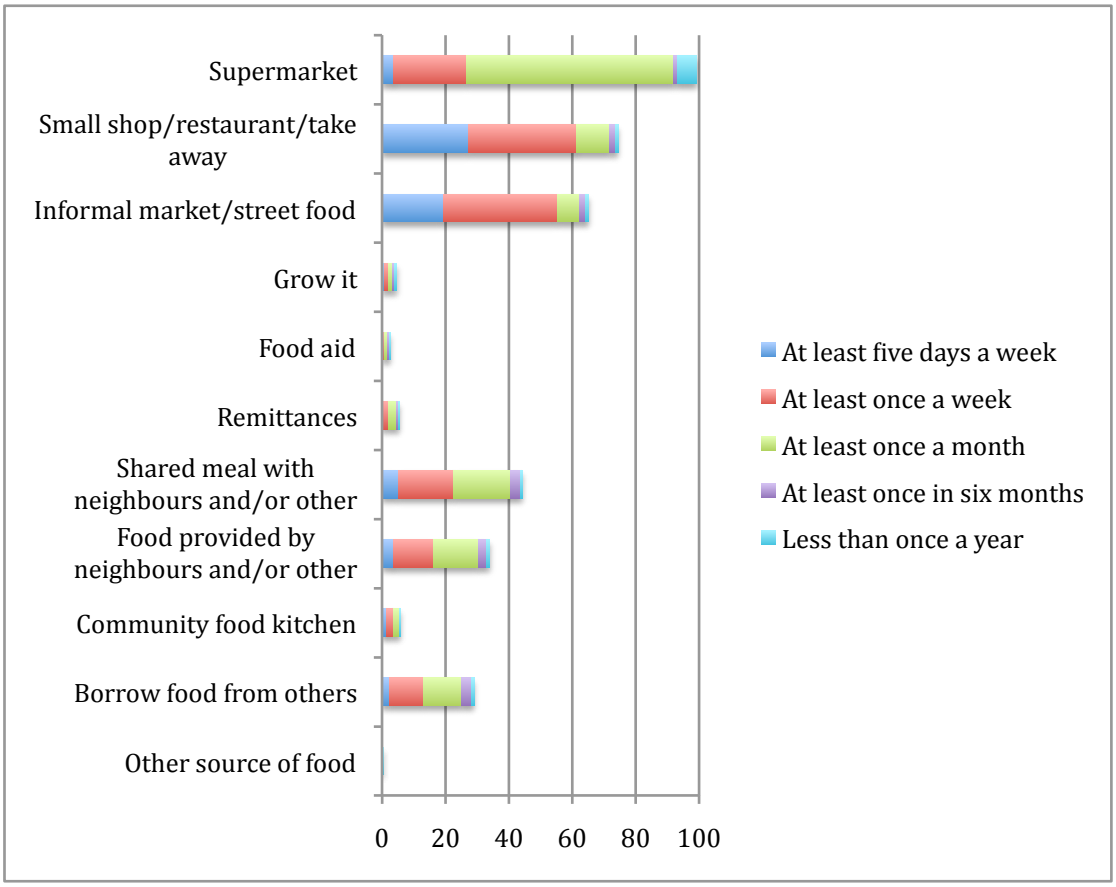


Figure 4: Sources of food of sampled households

As is evident from Figure 4 the vast majority of survey respondents accessed food most frequently through purchase, either in the formal or the informal sector. Virtually every household sampled (99.3%) had purchased food at a supermarket at some point in the previous year. However, just 26.8% went to supermarkets once a week or more. Households were far more likely to purchase their daily or weekly supplies of food from small shops/restaurants/take aways (mainly spaza shops) or from informal markets/street foods (61.% and 55.1% respectively). Supermarkets are generally cheaper per unit purchased than small independent formal shops and spazas. For example, in 1995 the mark up on brown bread in a national supermarket was less than 13%, whereas it was 20% in an independent supermarket and 20-26% in urban cafés and spazas (Benyon 1995 in Wilkinson & Makgelta 2002, 6). While South African supermarkets are currently being taken to court over price fixing (Harrison 2009), prices in spaza shops are consistently higher. Not only are prices higher, but local politics in Cape Town is ensuring that prices remain high. In June 2009 spaza shop owners in Gugulethu made local Somali traders raise their prices so that the

South African-owned spaza shops could remain competitive on price, thus removing access to cheaper food from the urban poor (Underhill 2009).

Supermarkets are generally cheaper per unit that spazas and have higher quality food and far greater diversity of goods. Given the apparent benefits of supermarkets over spazas, why do the urban poor continue to shop at the spaza shops? The first reason is one of geography. Supermarkets are a recent addition to townships and their penetration is only partial. Many areas, like Ocean View, are not serviced by a supermarket at all and other areas have only one servicing a large spatial extent. Residents tend to be dependent on public transport. Lack of proximity coupled with limited mobility of residents makes spaza shops the only viable daily source of food. In addition, supermarkets may be cheaper per unit, but they tend to sell in larger packages than spazas, who bulk break. Poor urban residents cannot afford to buy in bulk and therefore buy in smaller amounts at spazas which are more expensive per unit. And finally, many spazas extend credit to customers, a service that supermarkets cannot offer.

Supermarkets are increasingly penetrating township markets though. South African supermarkets are increasingly entering the southern African market too, and changing the food retailing sector. Supermarkets now account for 60% of all food sales in South Africa, but account for less than 2% of all food retail outlets, and a far smaller minority of all food retailer outlets in township areas (Weatherspoon & Reardon 2003, 337). The recent surge in supermarket entry into township areas can be attributed both to growing disposable income among African consumers, which has effectively opened new markets to the supermarkets and their subsidiaries (such as Boxer owned by Pick N Pay and Sentra owned by Shoprite) (van Wyk 2004). In addition, the improved infrastructure in many townships has made the presence of large retail businesses feasible (Tustin & Strydom 2006, 56). This movement of the larger formal retailers into township areas will clearly impact the informal food markets, which has been valued at between R20bn and R30bn per year (Apps 2004). The African Co-operative for Hawkers & Informal Businesses (Achib) has stated that about 150 informal retail stores (spazas) in Soweto alone have been forced out of business in part due to the entry of large retail chains into the township (Bissiker 2006).

This shifting dynamic within the food retail sector in South African cities in general and townships in particular raises some interesting questions around urban food security with reference to climate change. Supermarkets and spazas differ in both the diversity of foods on offer and the source of foods on offer. While spazas sell many highly processed foods that are also available in supermarkets (bread, potato chips, carbonated drinks, sweets), many spazas and street traders also sell locally sourced and locally produced foods. For example, it is estimated that some 30% of produce grow in the Philippi Horticultural Area (a commercial agricultural area within the city of Cape Town) finds it way into the local informal food sector. Research currently being undertaken by a Masters student at the University of Cape Town suggests that this figure may be higher. The fresh produce sold in supermarkets is far less likely to be locally sourced, coming from elsewhere within South Africa or from beyond national borders. Climate change and climate variability will affect supplies of fresh fruit and vegetables differently according to the region of origin. The supply chains in place within the formal and informal sectors are also different and are therefore not affected by economic and political processes in the same ways.

It therefore appears that a blend of formal and informal food systems within the city may bring resilience to food access for the urban populations. However, this blend itself may not be sustainable, as evidenced by the data on spazas going out of business because of the presence of supermarkets. Cities need to consider the value of the informal sector for urban residents in future development planning. Informality may be viewed as an indicator of poverty, but it is also an important source of insurance for the poor against hunger. In addition, it provides an opportunity for the enhancement of a localised food system which acts in parallel with the more commercially viable linear food system operated by the supermarkets.

While this section has thus far focused on the market, formal and informal, Figure 4 clearly indicates that the market does not work adequately for the urban poor. Not only are people often buying lower quality foods for higher prices, but many people are also dependent on alternative sources of food. A large proportion of the sample population acquired food from neighbours and other households through sharing meals (44.5% in the last year), eating food provided by others (34.1%) and borrowing

food (29.2%). A smaller amount received food as remittances (5.5% in the last year). As Figure 4 illustrates, those households receiving food in this manner tend to receive it from these sources at least once a month. Furthermore, the more food insecure a household is, the more likely it is to be dependent on these informal sources of food. The importance of these social networks to ensure food security will be returned to in the following section.

A final point to be addressed with regard to sources of food is the relative absence of urban agriculture (UA) in the Cape Town data. Less than 5% of sampled households stated that they sourced food by growing it. The City of Cape Town is the only city in Africa to have an urban agriculture policy and has dedicated much attention to the encouragement of UA (City of Cape Town 2007). The benefits of UA in providing an alternative means of accessing food for households has been acknowledged by many authors (e.g. May and Rogerson 1995, Mougeot 2006), and yet it is not significant in poor areas of Cape Town. Barriers to the take up of UA include access to land, skills and local attitudes to farming. Given resistance to UA by residents and local climate change projections coupled with increasing pressure on land and water supplied, I am hesitant to advocate for significant extension of UA in Cape Town. However, it is potentially an important source of food in other cities and provides a source of food from local areas (as opposed to the more distant sourcing of food from supermarkets etc.). If simply as a means of providing an alternative path for food to flow into the urban food system, it should be considered as a means of increasing the resilience of food supply.

This section has already begun to consider multiple means of supplying food as a means to bring resilience into the urban food system. This introduces the theme of flows which will be discussed more extensively in the following section.

Understanding the impacts of climate change on urban food security

One of the challenges associated with connection urban food security has been a concern about scale mismatches, both temporally and spatially. Many of the problems, with particular reference to the spatial scale mismatch, can be associated with the attempt to look at climate change and food security in situ. As the material presented above indicates, much of household and wider city food security is

determined by processes and relationships only indirectly connected to the urban area itself. In addition, because the urban food system and the factors shaping access to food are so diverse and operating at so many different scales, attempting to draw a single local model is inappropriate.

This chapter therefore proposes a model for understanding the connections between urban food security and climate change, and perhaps for developing strategies to enhance food security, which views food security as a series of flows. Food security at a household level is dependent on availability of food, the ability to access available food and the ability to utilize available food. Food availability, access and utilization are each affected by processes occurring in different locations relative to the site of consumption, with utilization challenges generally being most locally generated and impacted by the more immediate events and availability challenges often determined by processes occurring distant from the source of consumption and impacted by longer term trends. Many of the challenges of access are shaped by availability issues, particularly the role that availability fluctuations have on prices. The flows model proposed here focuses mainly on issues of availability and access. Utilization issues will be addressed separately.

As the data from the Cape Town case study presented above indicate, urban food security is not simply dependent on availability. Food is acquired from a wide range of sources and households use many strategies to ensure food security. Urban food security can be viewed as a series of flows that contribute to a households ability to access food. Key flows identified by the Cape Town survey and results of the other 10 cities in the AFSUN network were Food, Cash, People and Social Networks. The ability of households to ensure their food security is dependent on their ability to navigate and manipulate these flows. Households may depend on each of these flows in different ways at different times. Each of these flows is potentially impacted by climate change. Should this occur, the model hypothesises that households will use their adaptive capacity to modify how they engage with the flows in question and use alternative paths to attempt to meet their food security needs.

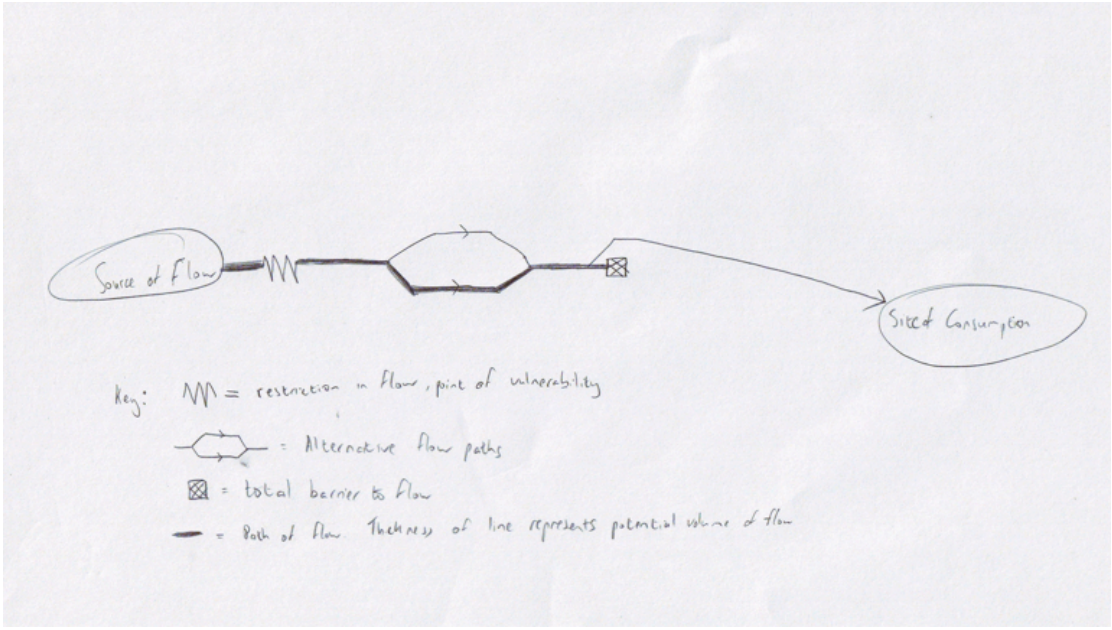


Figure 5: Factors shaping the flow of resource from source to site of consumption

It is important to look at each of these flow types in some details to consider how they operate and the likely impact of climate change upon their operation. In this model all flows have common features (see Fig 5). In each there is a site of consumption and a source of flow. The path which that good or service takes is subject to points of friction which make the flow less efficient and reduce the volume of the flow. These may be points that are particularly vulnerable to climate change. Each path may also have points of divergence where the good or service takes alternative paths, only to reconnect to reform a single flow. An example of this may be the sale of food to different types of distributors, which allows different paths to the site of consumption. There may also be absolute barriers to the flow, such as a tariff barrier or a pricing mechanism which makes it impossible for the good or service to reach the site of consumption. Another form may be the loss of an important source of household income. In cases where this occurs, it is anticipated that alternative pathways may emerge, but these will be much more limited than the original path. Different points along the flow will be impacted by climate change in different ways.

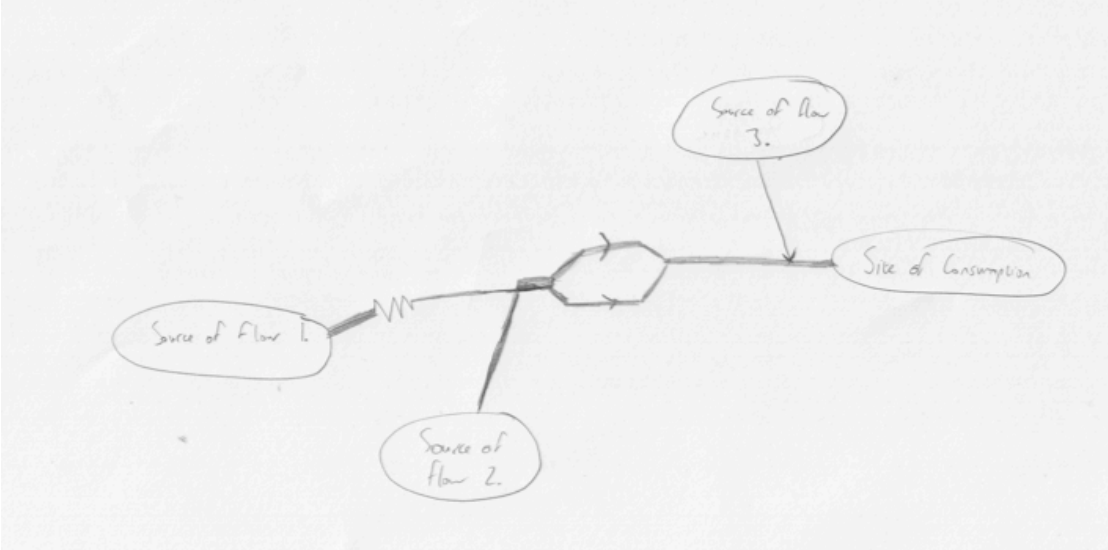


Figure 6: The connections between different sources of the same flow type to the site of consumption

In addition, each kind of flow will have a number of different sources leading to the same site of consumption as illustrated in Fig 6. These add redundancies into the system as discussed in the previous section on food sources. Given the differences in the sources, and perhaps also the substance of the good or service (e.g. maize, not wheat), the flows will be resilient or vulnerable to different conditions of change. Through understanding the dynamics of the flows in operation and potential additional sources, it is possible to use this model to think of ways to enhance urban food security and reduce vulnerability to change, as in the previous section's discussion on the benefits of maintaining the blend of formal and informal food systems. This becomes increasingly important when the multiple means by which households access food are considered. Households access food through drawing on multiple types of flows, not simply food, but also cash, people and social networks. Attempts to address food insecurity therefore need to recognise the diversity of means by which households access food and their capacities to negotiate the strengths and weaknesses of the various systems of flows (See Fig 7).

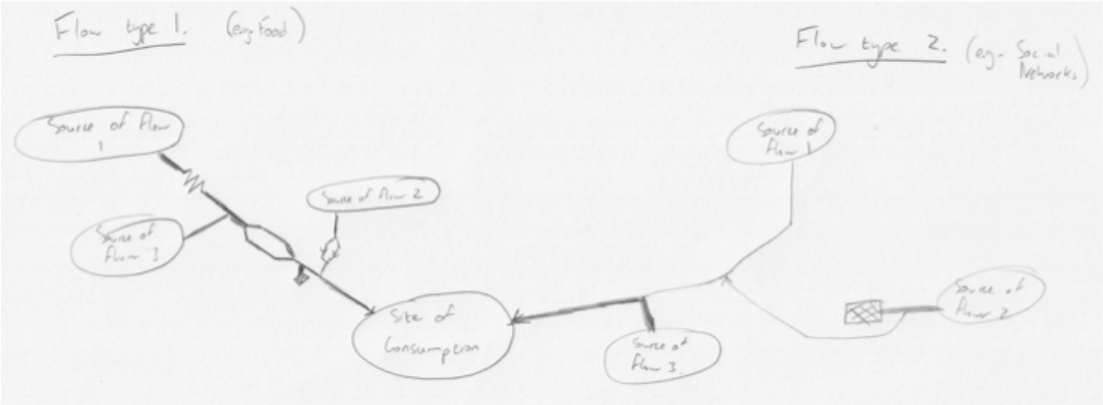


Figure 7: The connection between different flow types and the site of consumption

Flows and climate change

This chapter has identified four key sets of flows which households draw on to ensure food security. These are all potentially impacted by climate change. The following section highlights some critical points in each form of flow.

Food

The diet of the urban poor is based largely on cereals, with 93.2% of sampled households eating products made from grains within the past 24 hours. In Cape Town there is a high dependency on bread and maize products as the staple of the diet. It is therefore most important to examine the potential impacts of climate change on this aspect of the food flow system.

There are four key sources of that feed into how the urban poor in Cape Town access grain and associated grain based products. They are either bought in the formal sector, bought in the informal sector, through social networks or sourced directly from relatives and friends. This last option was not very important in the Cape Town context with very few households obtaining food in this manner, but it is included in this chapter because it was an important source of food in a number of the other cities within the AFSUN survey, particularly Windhoek. Remittances of food have been recognised as an increasingly important feature of urban life, particularly in times of economic hardship. This will be examined further in the cash, people and social networks sub-sections.

As noted, the formal sector tends to source food from beyond the local food context. In the case of wheat and maize products, the informal is also largely dependent on big national companies. The important spatial scales to be considered are therefore the national and regional projections for climate change. These projections suggest both a decline or collapse of the wheat sector in the Western Cape and a reduction in maize production (Gbetibouo & Hassan 2005, Akpalu et al 2008) . There are suggestions in the literature that farmers could shift to other crop types more adapted to projected climate regimes.

Climate change is not the only factor likely to shape the ongoing trends of availability of grain production. In a presentation in February 2010, Theo de Jager of Agri-SA stated that climate change was just one threat amongst many that were issuing a challenge to national food sovereignty. He highlighted uncertainty in the agricultural sector with regard to land reform as already impacting productivity and spoke extensively about pricing structures. The prices that farmers are currently receiving from the local market for wheat are making local agriculture commercially unviable. It makes better economic sense to purchase from Latin America (de Jager 2010). The position that Agri-SA have taken is that ensuring national food sovereignty is vitally important, should a circumstance like the food price increases of 2008 occur again. In 2008, exporting countries like Argentina blocked the export of grain to ensure national food supply, therefore forcing up global prices. Given that South Africa became a net importer of food in 2008, this makes the country more vulnerable to international pricing trends, which may be driven by climate impacts amongst other things (Agri-SA 2009).

The major climate related impacts upon the flows of food are likely to be those at the regional and national scales, but local, city-scale climate change and variability may also impact the food flow, particularly within the informal sector. The projected increase in temperature in Cape Town will reduce the shelf life of many food stuffs. Given the limited cooling and temperature regulation capacity of most informal traders, this will impact the availability and therefore the prices of food. In addition, extreme weather events, which are projected to increase in frequency, may lead to the widespread loss of stock, which will lead to short term shortages and extended periods of recovery through increased prices.

It is vital to recognise that similar foods, even food emanating from the same source but taking different paths to the site of consumption, may be impacted by climate change in different ways. Supermarket wholesalers may raise prices in anticipation of shortages using seasonal forecasts, but traders buying directly from farmers and selling to smaller traders may not shift their pricing structures through lack of information. Thus the same food from the same source may enter the market at different prices.

The question is therefore how to make the flows of food more resilient to ensure urban food security. Some authors suggest that farmers will diversify or even completely shift their crop type in light of projected climate change (Gbetibouo & Hassan 2005). This wholesale shift is unlikely given that farmers (both commercial and small-scale) are notoriously risk averse. However, there may be some shifts in production. It has been suggested that urban populations are more open to including new foods in their diets than traditional rural communities, so these shifts may be accepted by urban populations. Increased diversity of food stuffs and food sources would incorporate various redundancies into the food flow which would help to ensure urban food security.

Cash

While the flow of food is vital to ensuring food security, it is also essential to recognise that access to cash to purchase food is an integral part of ensuring food security. Cash flows into households through formal waged work, casual labour, through social grants and through remittances. As with flows of food, there are different points of vulnerability within these flows, impacted by events in a range of locations. As discussed earlier, the relatively diverse livelihoods of households in the Cape Town survey makes them vulnerable to external shocks, as they are dependant on one source of flow to provide their site of consumption.

It is difficult to make generalisations about the potential impacts of climate change on the flow of cash to ensure food security, given the diversity of sources of employment and therefore sources of income. However, it is useful to note that while the direct causes of employment loss may be locally generated (firm closures, work ceasing due

to seasonal fluctuations), the indirect causes may be generated from processes occurring at a regional or international scale. The flows model calls for these direct and indirect factors to be considered in understanding the points of restriction of flow and vulnerability and barriers to flows. While it is difficult to identify potential impacts of climate change on the flow of cash, what the flow model does highlight is the possibility of food security being ensured through the navigation and manipulation of multiple sources of flow within a particular flow type. The cash from casual labour flow may be impacted by short term climate variability (storms, floods, seasonality), the formal wage sector is likely to be more resilient to this. Likewise, the alternative livelihood strategies in the informal wage sector may be more resilient to economic shocks, such as recessions, than the formal wage sector. Flows of cash through remittances from rural areas can be drawn upon in times of climate related or other crises in the urban area. It is clear that being able to draw upon multiple sources of flow of cash, vulnerable and resilient in different circumstances and points in the flow, is an important means of ensuring food security and insuring against climate related risk.

People

The flow of people is a slightly different kind of flow. Migrancy itself can be a food security strategy. A household may relocate members in order to increase potential earnings, or to reduce expenditure. This may be a relatively short-term strategy or a long-term strategy, in which households maintain a rural and an urban base to spread risk. These 'stretched' households, like all things elastic, have a snapping point when too much pressure is exerted on the flow. Given the increased marginality of small holder farming in rural South and southern Africa under conditions of increased climate variability and climate change, there will be less benefit to having these stretched households and there is likely to be increased rural to urban migration. In addition, with the pressures from climate change and other factors discussed in the food flow section, the commercial agriculture section is likely to displace more farm workers from residence on the commercial farms and job security will be lost (Agri-SA 2009). This will place strain on the remittances that feed into the cash flow, and ultimately lead to a reduction in stretched households and increased urbanization. However, while the in-country rural-urban stretched household may be in decline. Some cities, most notably Harare in Zimbabwe, are seeing evidence that cross-border

stretched households are becoming increasingly important (Tawodzera 2010). This new source of flow of people introduces a more resilient form as it enables households to source finance and resources from places with different political and economic circumstances, and, particularly in the case of Zimbabwe, to navigate differences in currency to the households benefit.

Social Networks

The final type of flow is the flow of social relations. This refers to the ways in which households are about to negotiate access to food through drawing on existing relationships in their community. This is not dependent on the flow of food, the flow of cash or the flow of people. It is the flow that operates when the other flows are weak. As was evident in Fig 4, many households, particularly the more food insecure households, depend on frequently borrowing food and sharing food with neighbours. This practice is widely accepted as culturally appropriate, but it does place responsibility for forming a social safety net in the event of market failure on residents in poor areas of cities. This can ultimately lead to reduced resilience of these households. In the event of the other flows being negatively impacted by climate change (increased prices, limited employment, limited rural to urban flows) these supporting households may find that they are no longer able to provide food to food insecure households, thus greatly weakening or even blocking this flow. In Cape Town there was very limited presence of NGOs working to ensure food security in the sampled communities. The need for social safety nets will increase as a result of climate change, at the same time as the ability of communities to provide these informal safety nets declines. There is therefore a need to reconfigure the functioning of this flow to introduce new forms of safety nets that can respond to needs of households when access to food through other flows fails.

Non-access related climate change impacts

Moving beyond the focus on flows, it is also important to consider the possible impact of climate change on households' ability to utilize the food they are able to access, which in turn may shape the foods households access. As in the case of the flows these are both direct and indirectly impacted by climate change and extreme weather events. Many poor households have limited capacity to store goods, particularly foods that require refrigeration. This clearly shapes the quantities and types of foods

purchased. As noted earlier, in buying in smaller quantities households incur higher costs per unit. In addition, with limited storage and cooking capacity, many households may be dependant on purchasing processed foods for home preparation or depend on street foods, both of which are more expensive than unprocessed and are often nutritionally deficient. Should the long term projections of increased temperatures in the city occur, the shelf life of foods will be reduced, increasing the chance of spoilage for households with limited refrigeration capacity. This is likely to reinforce the practices of buying relatively highly processed foods in small unit sizes, with attendant knock on effects for food and nutrition security.

It is also likely that Cape Town will experience more extreme weather events. As was seen in the data on months of adequate household provisioning, households may chose to experience food insecurity in an attempt to meet urgent households needs. Damage to housing through storms and flooding means that resources that would have been spent on food and food preparation will be deferred to repair and to attempts to mitigate against future events

Conclusions

This chapter has attempted to develop a new model for understanding the dynamics of food security in urban areas through using a flow-based model. The model highlights that urban food security is based on the integration of a range of flow types (and individual sources of flows within these broad flow types) in household survival strategies. Given that these flows emanate in different locations and take a range of paths, they are subject to a range of potential climate related impacts. The chapter argues that by encouraging dependence on a wider range of flow types and specific flows within each flow types (i.e. increasing the number of reduncancies), household food security can enhanced. In order to achieve this, government (local and national) need to facilitate the survival of flows that have been neglected thus far, including the informal food system and rural-urban connections. In addition, further research needs to be done assessing the vulnerability of individual flows to projected climate change. It is hoped that this model provides a means for integrated cross-scale systems thinking to develop connection climate change and urban food security.

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