

Draft Article

A Multi-Level Analysis of Household Food Security in Sub-Saharan Africa

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Abstract: Despite decades of research and intervention aimed at the alleviation of food security in Sub-Saharan Africa the problem remains. Attempts to understand and ensure food security have often focused on rural-communities throughout the region, but adhering to the status-quo is no longer possible as urban food security comes further into focus for policymakers throughout the region. As the urbanization of African cities continues, there will exist a greater need to understand the drivers of urban food security; especially the food security of low-income urbanites. The food security of low-income residents is the result of mixed policies and institutions that come together at varying levels of effectiveness in order to ensure consumption of safe and healthy food. In an effort to empirically study urban food security, we examine the interplay between market dynamics and socio-economic status on household food security. Our analysis brings forth a nuanced examination of the drivers of urban food security through the use of primary household, residential area, and market data in order to understand how household-market interactions affect the attainment of food security within disparate residential areas of an urban center.

Keywords: urban food security, urban food systems, multi-level analysis, Africa

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1.1 Introduction

Despite decades of research and intervention aimed at the alleviation of food insecurity in Sub-Saharan Africa the problem remains. The United Nation's Food and Agriculture Organization (FAO) defines food security as "...existing when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO 2006). Food security is the result of functional food systems capable of meeting the dietary demands of residents from all socioeconomic backgrounds, but the path to sustained food systems is less clear as recent debates have highlighted the importance of examining food systems as a sum of all parts (Erickson 2008). Previous attempts to understand food systems and ensure food security have often focused on rural-communities throughout the developing world, but adhering to the status-quo is no longer possible as urban food security will grow in importance as a result of the urbanization of Sub-Saharan Africa.

Sub-Saharan Africa's nations are rapidly urbanizing, and by 2030 nearly 770 million people will live in the continent's urban centers (FAO 2017). Urbanization will lead to greater consumption of food at the national and regional level as urban residents have greater purchasing power, as compared to their rural counterparts (Reardon et al. 2015). Increased food consumption means Sub-Saharan African urban food systems must keep pace with the growth in urban populations or face the negative prospectus of households unable to attain food security.

This is especially important for urban food systems as they are fed through domestic and international supply chains. As greater connections are created through rural to urban supply chains there exists greater vulnerability to shocks (Thomas Reardon and Zilberman 2018). Food systems rely on supply chains for ensuring affordable and available food, yet exposure to shocks can decrease their functionality. Shocks to urban food systems can create widespread food insecurity throughout individual nations and whole regions. The 2007/2008 food price crisis illustrated this through the unprecedented rise of food prices over a one year period (Moseley, Carney, and Becker 2010). The rise in prices caused far-reaching unrest throughout the developing world and led to widespread food insecurity (Frayne et al. 2010). At the time, the United Nations estimated 854 million people were food insecure globally, and the increase in food costs threatened the food security of an additional 100 million (UN High Level Taskforce on the Global Food Security Crisis 2008). During the period, the food security of Sub-Saharan Africa's urban populations worsened, while rural dwellers reported higher levels of food security (Verpoorten et al. 2013). Yet policymakers failed to sufficiently address urban population's food security needs during the crisis (Cohen and Garrett 2010), despite its visibility.

At their most basic level, urban food systems feature an important interplay between households, vendors, and residential areas. Past research has highlighted the importance of ensuring urban food security, yet little research exists on measuring the magnitude of urban food security at the household level through econometric approaches that consider the interplay between households, public markets, and residential areas. Research on the role of supermarkets and informal street vendors in the provision of food throughout cities and towns is extensive (Battersby 2017; Peyton, Moseley, and Battersby 2015; Crush and Frayne 2011; Hansen 2004), but less exists on the interplay between low-income residents, household characteristics, and spatial elements. Through the use of primary data collected during March and April 2017, we examine how these actors and institutions interact with one another in the attainment of food security. Specifically, we look to understand how employment opportunities, income, and demographic characteristics affect the attainment of household food security for low-income residents in primary cities across Sub-Saharan Africa.

1.2 Food Security and Food Systems

Food systems affect all people, yet there exists a continuously shifting narrative surrounding what constitutes a food system, and which components of a food system are most important for ensuring functionality at the national and regional levels (S. Maxwell and Slater 2003). Much of the previous food

systems research, as well as efforts to evaluate and improve the systems, have been linked to rural communities through a focus on increased productivity (Crush and Frayne 2010). The rationale states, when rural farmers are able to increase productivity then they ensure their own food security. When productivity is increased beyond the threshold necessary to meet their household's needs then farmers will sell excess produce to the open market. Influx in supply will then reduce overall prices for food commodities. In turn, urban consumers are required to pay less to meet their own food needs. The encouragement and pursuit of pro-rural policies and interventions to improve rural production has pushed urban food security into a secondary position in favor of discussions centered on rural food security (Frayne et al. 2010; D. Maxwell 1999b). Not until price spikes occur or food shortages reach critical mass do policymakers look to intervene on the urban front (D. Maxwell 1999b). However, urban food security is not the sole result of increased production (Frayne et al. 2010), but rather the attainment of urban food security hinges on accessibility (D. Maxwell 1999a).

Sen's (1981) influential essay on entitlements and the importance of access to food created a discourse that illustrates hunger is not simply the result of poor production, but rather an effect of individuals unable to meet dietary needs through access to available food. The 1996 World Food Summit placed availability and accessibility on equal footing with regards to their influence on food security ("Food Security Policy Brief" 2006). Since the mid-1990s, the conversation has now evolved to engaging with and attempting to understand the complex human-environmental interactions that allow for the growing, processing, dissemination, and consumption of food by individuals (Ericksen 2008); otherwise known as food systems. To this day, researchers, policymakers, and other stakeholders struggle to understand how to best identify and frame issues surrounding food security and food systems.

As compared to rural food systems, urban food systems are more integrated into economies at the regional and global scale, which benefits and burdens urban populations at the same time (CITE). The interplay between urbanization and globalization and their shared effect on urban food systems is essential to understanding urban food security. Having the ability to examine growth of cities and towns, understanding the connectivity between disparate urban centers, and how this enables or hinders urban food security is a considerable challenge. Unfortunately, little research exists regarding the heterogeneity of urban food security across disparate urban centers (Frayne et al. 2010). In order to recognize the effects of urban food systems, a greater understanding of the livelihoods and experience of low-income urbanites is necessary (D. Maxwell 1999b).

Past research has begun to unravel this issue through empirical work attempting to parse out the effects of accessibility. The dissemination and consumption of food by individuals and households alike is imperative in the capture of urban food security. For low-income urbanites, the cost of food expenditure is especially steep, and achieving food security is more difficult as food costs can serve to exclude this demographic group (Caesar and Crush 2016). The poorest African urban households may spend nearly 70% of their income on food (Mason et al. 2011).

Understanding the interplay between urban market dynamics and individual households is growing in importance as a result of increases in urban populations. Formal outlets like supermarkets exist for the purchase of food, however the cost associated with these retailers often excludes the low-income households. Instead, low-income urban households often rely on public markets and street vendors for the purchase of food. In Lusaka, Zambia, supermarkets made up just 1.2% of the total market share of the poorest 20% of the city's residents, while public markets and street vendors both represented about 21% each (Mason and Jayne 2009). Throughout Africa's urban centers, low-income residents rely heavily on the the informal sector to meet their dietary demands, and without this group of retailers, there would exist a void within the food system necessary to meet low-income demand.

The informal sector has played an important role in the provision of food throughout low-income areas of African cities for decades (Hansen 2004); however, the extent to which they are allowed to operate changes based on policies that govern and validate the legitimacy of their activities. As a result of urban food systems having been omitted from previous empirical policy studies (Crush and Frayne 2010), there exists mixed governance arrangements in place for urban food systems in Southern African urban areas (Blekkings et al. In Review). Heterogenous governance arrangements allow for the food needs of

residents of all socio-economic classes to be fulfilled through a multitude of vendors. Urban food systems throughout Southern Africa feature a number of governance arrangements: formal top-down, formal bottom-up, informal top-down, and informal bottom-up (Blekking et al. In Review). However, it is unknown whether mixed governance of food systems may insulate a large-scale urban food system from outside shocks and stresses, like the shock urban markets experienced during the 2007/2008 global food crisis. Food systems unable to maintain functionality in light of shocks will fail the needs of low-income residents, as this group is the most susceptible to system stresses (Crush and Frayne 2010).

Historically, urbanization has been coupled with industrialization and has produced sustained economic growth (Hove et al. 2013; Fox 2012). Yet many Sub-Saharan African countries urbanized without concurrent economic development: from 1975 - 1995, the urban population increased by around 5% annually, while economic growth remained stagnant (Hove et al. 2013; Fox 2012; Fay and Opal 2000). This period of “urbanization without growth” is unique to Sub-Saharan African countries ([Fay and Opal 2000](#)), and although per capita GDP in the region rebounded through the 2000s, economic growth for many countries has decreased in recent years (World Bank 2017). Nonetheless, rapid urbanization has continued, producing substantial levels of urban poverty. As such, the United Nation’s Human Settlement Programme estimates that over 55% of urban dwellers in Sub-Saharan Africa live in slums, or dwellings that lack one or more of improved water, improved sanitation, sufficient living area, durable housing, secure land tenure (UN-HABITAT 2015, 2003).

As more residents transition from rural communities to urban centers, low-income residential areas are likely to expand, as their relative lower cost of living will appeal to new inhabitants. The influx of more individuals into these areas may stress urban food systems. The level to which urbanization and poverty are interconnected in Sub-Saharan Africa is not well understood (Frayne et al. 2010; D. Maxwell et al. 2000).

Urban food systems have the power to positively or negatively impact the quality of life in an urban setting (Pothukuchi and Kaufman 1999), based on their ability to ensure access to food at stable prices. When urban population expansion occurs in areas with little food systems planning, greater levels of hunger and poverty follow suit (Morgan and Sonnino 2010). While few case studies have examined the relationship between household-level food security and poverty, a nascent body of evidence suggests low-income urban dwellers are food insecure in Sub-Saharan Africa. Research from the African Food Security Network that measured household food security in 11 cities across Southern Africa found a significant relationship ($p < 0.001$) between food security and poverty (Frayne et al. 2010). A study estimating the effects of the 2007/2008 global price shocks on urban food security in Ouagadougou, Burkina Faso, found that the dietary diversity of the lowest income households was not affected by the price shock because their dietary diversity was low previous to the price increases. Middle-income urban households, however, reported a decrease in dietary diversity in during the same period (Martin-Prevel et al. 2012). In Nairobi, 85% of households in slums report being food insecure, though these results cannot be compared to areas outside of slums (Kimani-Murage et al. 2014).

2.1 Study site and sampling design

Aside from South Africa, countries throughout southern Africa tend to be single-city dominated (Hove et al 2013). Such primary cities are often the capital city and house at least double the population of the next largest city. Lusaka, Zambia, is one such city. We use Lusaka as a means of contextualizing urban food security for low-income residents in primary cities throughout Sub-Saharan Africa.

Lusaka is home to 1.8 million people, about one-third of Zambia’s total urban population (UN DESA 2014). The city’s 60+ residential areas are a mixture of formally-recognized and informally-established settlements (Figure 1). Like other primary cities, Lusaka’s food system consists of an assortment of supermarket chains, public markets, private grocers, and street vendors. Residents often visit multiple vendors in a week for food purchases, and a clear delineation in consumption patterns occurs with regard to the relationship between supermarkets and consumers from varying socio-economic classes. Previous work notes Lusaka’s low-income residents purchase less often from supermarkets due

to affordability constraints, as compared to grocers, public markets, and street vendors (Mulenga 2013; Mason and Jayne 2009).

Lusaka, like large cities in Southern Africa, contends with social and environmental stress due to climate change. How policymakers can effectively respond to such stressors is poorly understood (UN-HABITAT 2015). Informal urban settlements in Lusaka are vulnerable both to drought and extreme rainfall, with some areas of the city battling water scarcity and others flooding. Poor infrastructure exacerbates the problem throughout the city (Heath, Parker, and Weatherhead 2012), as the lack of adequate water and sanitation, especially within informal settlements, aggravates the city's struggles (UN-HABITAT 2015).

The city's public markets are made up of two market types: cooperative and council. The two market types are delineated based on their governance structure (Blekking et al. In Review). Cooperative markets are governed through an informal bottom-up governance approach. Cooperative members set the guidelines for market operation. Just over half of all markets in Lusaka are cooperative markets. Alternatively, council regulated markets are formally governed through formal top-down governance arrangements, with the Lusaka City Council establishing market guidelines.



Figure 1: Households and markets surveyed during March and April 2017 data collection in Lusaka, Zambia.

2.2 Data and Methods

We use data collected from 526 households (870 individuals) in this analysis. Sampled households were selected using a stratified area sampling approach within the 18 residential areas, with 35 households per residential area set as a target. Low-income residential areas were identified for sampling through consultation with experts at the Zambia Agriculture Research Institute. Low-income

residential areas were focused on as a result of past research that shows households within these areas are more likely to struggle with food security as a result of low purchasing power (Crush and Frayne 2010). Each sampled household belongs to one of the 18 residential areas. During our survey, one individual from each household was used as a respondent. That respondent was asked a series of questions regarding economic, demographic, and food consumption trends. The respondent was also asked to provide information on the top five wage earners within the family, namely the type and frequency of employment and income earned. Data was collected in March and April 2017.

We use a multilevel mixed-effects linear model to empirically study the interplay between individuals, household variables, and spatial characteristics in the attainment of urban food security. We include residential areas as a random effect in the model. Using a mixed-effects model allows for the presence of between-residential area differences in food security. We use the household's food consumption score (FCS) as the model's dependent variable. The FCS was created by the United Nation's World Food Programme in 1996, in order to evaluate rural household food consumption rates. The FCS is a composite score based on the frequency of consumption of a diverse group of foods (World Food Programme 2008). The metric measures how many times a particular food group is consumed over the course of seven days, providing a score of 0 to 7. Each food group is weighted based on caloric density. All scores are added together to formulate a final FCS for each household. Composite scores below a threshold of 21 is identified as poor, between 21.5 and 35 is borderline, and in excess of 35 is acceptable (World Food Programme 2008).

Table 1: Descriptive Statistics of Model Variables

Variable Name	Mean	Stand. Dev.	Min.	Max	Variable Type
Age of Person	37.40 years	11.89	14.00	79.00	Continuous
Person's Typical Monthly Income	K1,000 to 1,499	2.49	1.00	9.00	Ordinal
Person's Employment Type	Self-Employed	0.93	1.00	3.00	Nominal
Person's Gender (1=male)	0.57	0.50	0.00	1.00	Dichotomous
Person's Educational Attainment	Some Secondary	1.53	1.00	8.00	Ordinal
Household Asset Index	2.96	0.83	1.00	3.00	Ordinal
Number of People in Household	5.97 individuals	2.69	1.00	26.00	Continuous
Household Cost of Food per Week	K150 to 199	1.88	1.00	8.00	Ordinal
Household Has a Garden (1=yes)	0.18	0.39	0.00	1.00	Dichotomous
Travel Time to Purchase Vegetables	12.5 minutes	20.50	0.00	180.00	Continuous
Residential Area's Legal Status	Informal then Formal	0.56	1.00	3.00	Nominal
N = 870 individuals from 526 households					

We include a mixture of categorical and continuous variables in our model (Table 1). Households were, on average, composed of 5.97 individuals, and were headed by male's 57% of the time. Households spent between K 150 - 199 on food per week. During data collection, the exchange rate between the Zambian Kwacha and United States Dollar was K 9.3 to 1 USD. On average, households had an asset index of 2.96. Vegetable gardens were found at 18% of all households. The average person in our sample was self-employed and had attained some secondary education, but had not finished their

secondary education. The average individual earned between K 1,000 to 1,499 per month. The average family resided in a residential area that first began as an informal settlement, but was later formalized through a permitting process by the Lusaka City Council. While the other residential area options were formal from the start and currently an informal settlement. Average walking time from the household to the nearest location that vegetables are purchased from was about 13 minutes.

Our model includes a categorical variable for an individual's typical income, with each additional category coming after an addition of K500. The model also includes a household asset index measure. There is low positive correlation between the two variables. Both are used in the model as typical monthly income belongs to the vector of individual-level variables, while the asset index is used as a household-level measure.

The asset index was constructed based on a procedure designed by the World Bank and Demographic and Health Surveys (DHS) Program (Rutstein, Johnson, and Measure 2004). The index is based on assets commonly found within urban Zambia. Assets not owned by between 5% and 95% of our sampled population were dropped. We use principal components analysis (PCA) to aid in the calculation of the index (Filmer and Pritchett 2001). The remaining household items are the first principal components of the PCA. PCA assigns each household asset a factor score, and these factor scores produce a continuous measurement for ownership by individual households. The index is then divided into quintiles to understand the effect asset ownership has on predicting a household's food consumption score. All analysis was conducted using Stata 14.2.

3.1 Results

Model results indicate income-related variables are strong determinants of a household's food security (Table 2). An increase in an individual's income classification by one category, or the addition of K500 per month, statistically increases FCS by 1.63 points ($p < 0.01$), holding all else equal. However, the category of employment engaged in by an individual was not significant in the model at the 0.05 level or below, when compared to individuals in self-employed positions. Holding all other variables equal, educational attainment increased household FCS by 1.52 points ($p < 0.01$).

Table 2: Mixed Linear Model Regression Results

Variable Name	Coefficient	Stand. Err.	z	P-value
Age of Person	-0.21***	0.06	-3.29	0.001
Person's Typical Monthly Income	1.59***	0.37	4.31	<0.001
Person's Employment Type				
Informally Employed vs Self-Employed	-2.29	2.34	-0.98	0.327
Regularly Employed vs Self-Employed	1.34	1.59	0.84	0.401
Person's Gender (1=male)	-2.26	1.52	-1.49	0.137
Person's Educational Attainment	1.48***	0.56	2.65	0.008
Household Asset Index	3.05***	0.66	4.6	<0.001
Number of People in Household	-0.44	0.29	-1.49	0.135
Household Cost of Food per Week	2.31***	0.49	4.69	<0.001
Household Has a Garden (1=yes)	-0.59	1.92	-0.31	0.760
Travel Time to Purchase Vegetables	0.07**	0.03	1.98	0.047
Residential Area's Legal Status				
Informal then formal vs. Always Formal	4.40	3.67	1.2	0.230
Not Yet Declared Formal vs. Always Formal	4.06	3.92	1.04	0.300
Constant	47.14***	5.32	8.86	<0.001
Residential Area	6.96	5.79		
Prob. > chi2	<0.001			
Note: ***P < 0.01, **P < 0.05, *P < 0.10.				

Increased asset ownership at the household-level significantly increased household FCS by three points ($p < 0.01$), *ceteris paribus*. Cost of food per week was a statistically significant determinant of a household's food consumption ($p < 0.01$), holding other factors constant. The number of individuals residing within the household and time travel time (walking) to purchase vegetables from the location most often used for vegetable purchases were significant at the 0.1 and 0.05 levels ($p < 0.1$ and $p < 0.05$, respectively), holding all else equal.

The age of the person was the only variable of statistical significance that decreased the FCS ($p < 0.001$), holding all else equal. However, multiple other variables decreased FCS and may have substantive impacts, albeit not statistically significant effects.

4.1 Discussion

Urban food security as measured through food consumption is the result of multiple factors, each having mixed effects on the intended outcome. An individual's income and a household's asset index

both have statistically significant impacts on household FCS. Because food for consumption must be purchased within an urban setting, it stands to reason income will play a significant determining role in how much may be consumed. An individual's type of employment is not a statistical determinant of higher FCS at the household level; however, this does not mean that all employment types are homogeneous in their effects on ensuring food security. Household members that engage in informal employment may not have gainful employment throughout an week, month, or year. During times of no employment, it stands to reason FCS and other measurements of food security will be reduced due to a lack of income. Our study captures FCS for one moment in time. More powerful analysis would be determined through data collection of the same residents with a finer temporal scale.

The FCS is determined based on household food consumption. As such, it was not possible to calculate individual scores based on our sampling strategy. The use of equitable FCSs provides a broad overview of the city's food security for low-income households; however, our analysis falls short of making generalizable individual evaluations beyond the household level.

Household composition as measured through the number of people residing within a home is not statistically significant, but further analysis of a household's composition based on the number of employed individuals or familial structure may have substantive insights on the attainment of household food security. A large household with a wide distribution of ages may have substantively different food security outcomes, as compared to a smaller, nuclear household. At the individual level, the addition of one year to an individual's age significantly decreases FCS. This may indicate degraded accessibility to food vendors as a result of transportation issues or decreased employment opportunities as an individual moves onto an advanced age. In our analysis, gender has no effect. This finding may be result of improved accessibility to employment opportunities for women. In rural communities, there exist stronger gender roles and fewer economic opportunities. Both limit a woman's ability to obtain income and ensure household food security.

Food security within an urban setting is largely based on accessibility, and our results substantiate past research pointing to this claim. The time it takes a member from the household to walk to the market where vegetables are most often purchased is statistically significant. Food vendor proximity (public markets, street vendors, and grocers) can have substantive impacts on household food security. With this being said, household gardens, the most immediate form of food, is not a statistically significant determining factor of a household's overall food consumption. Like an individual's employment, this does not mean household gardens do not have substantial effects on FCS. A household garden's effect may be a the function of the size and extent of the household's garden. Larger household gardens are likely to have greater impacts as compared to smaller kitchen gardens.

Our model does not indicate the legality of a residential area has any effects on household food security, but the extent to which there are so many varied levels of legal statuses does indicate the rapid growth of the city. As cities expand there is an increased need for local governments to plan for greater populations and ensure municipal institutions capable of providing public services. When local government is slow to formally recognize new areas of urban expansion there is often little in the way of infrastructure or support from the city council or other governmental entities. Across the region this scenario is playing out in both large-sized cities and medium-sized cities of less than one million as the rural to urban transition continues (United Nations 2014). The disconnect between formal, planned expansions of cities and the rapid, unbridled growth of the same is likely to hinder the effectiveness of service provision to low-income urban residents. Effective policies and governance arrangements (both formal and informal) aimed at mitigating the effect of more residents are important. The seriousness of connecting urban planning to food security policies is likely to strengthen with increases in urbanization.

Governance can play a substantial role in ensuring supportive food systems in Sub-Saharan Africa. Previous research from South Africa highlights the role of local governments in the promotion of malls throughout Cape Town (Peyton, Moseley, and Battersby 2015). By focusing on the development of large shopping centers without explicitly considering food systems or food security, local governments are hindering the attainment of food security throughout Sub-Saharan Africa (Battersby 2017). Cities throughout the region have seen a rapid growth of shopping centers, and within shopping centers comes

international supermarket chains and international fast food corporations. Past research connects the proliferation of fast food restaurants with the rapid shift in dietary preferences taking shape in Sub-Saharan Africa (Battersby 2017).

Our use of the food consumption score brings to light an important point for this study. The FCS is not an indicator of urban food security without fault. Barrett (2010) points out the wide range of food security measurement metrics currently available to researchers each falls short in one way or another. Each method of measurement features substantial pros and cons. The FCS was created for rural areas where availability of food is often a limiting factor in the attainment of food security. However, in urban areas, the greatest limiting factor is the cost of food. The distribution of FCS from our sample shows relatively few respondents falling below the threshold (21) for poor food consumption, and most respondents exceeded the threshold for acceptable food consumption (35) (Figure 2).

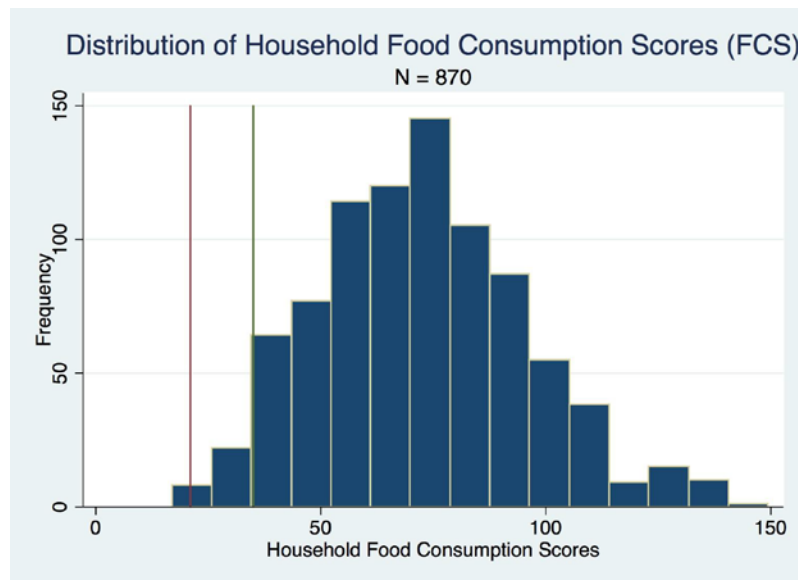


Figure 2: Distribution of Household FCS with thresholds at 21 and 35

When individuals and households are unable to access available food due to price they will be excluded from meeting their dietary demands. As more empirical studies of urban food security emerge in the future, a nuanced approach to the measurement of food security in towns and cities must be developed. One difficulty of measuring life in urban areas stems from the use of indicators, like FCS, that were created for use in rural areas but are then applied in urban settings (Satterthwaite 2014). The FCS indicates a household's level of food consumption, but may not provide an entirely accurate portrayal of food security as the score does not feature a means to consider accessibility. Future measurements of urban food security must take more urban-appropriate measures into consideration. An indicator in the future must consider not only the immediate availability of food, but also the price, location, and preference of foods being consumed. The development of a more robust indicator for use in the measurement of urban food security will be integral to future studies of individual and household food security.

A natural extension of this work and its focus on low-income residents would be the inclusion of processed foods in future analyses. Africa's urban centers and associated food systems are undergoing an intensive dietary transformation (Battersby 2017; T. Reardon et al. 2015). This rapid transformation is not limited to middle- or high-income residents either. Research from multiple countries finds low-income residents are able to diversify their diets, even though their incomes are more meager (T. Reardon et al. 2015). As increased production, lower transportation costs, and greater connectivity to distribution channels grows, the low-income urban residents will have greater opportunity to consume processed foods in addition to staple foods. The diversification of urban diets to include processed foods means

there is a greater need to include processed food consumption in evaluations of urban food systems beyond measures that simply focus on staple and traditional foods.

4.1 Conclusion

The urbanization of Africa's towns and cities brings to light the importance of empirically studying and understanding urban food security. The topic has been overlooked in the past in favor of rural food security research, but as nations throughout Southern Africa continue their urbanization trends, the need for urban food systems capable of ensuring household food security will increase. Through econometric approaches that consider the interplay between households, public markets, and residential areas we find income-related variables at the individual and household level have the greatest significance in ensuring the attainment of food security for urban residents.

Policymakers must be aware of the ebb and flows of accessibility within Sub-Saharan Africa's urban centers; especially the changes in employment opportunities faced by low-income residents, as this group already faces greater challenges in ensuring their dietary needs are met. In our analysis we use the World Food Programme's Food Consumption Scores as a metric through which urban food security may be measured. The metric provides valuable insights regarding urban food security, yet the remains room for improvement in the evaluation of urban food security through the use of such metrics.

As the urbanization of African cities and towns continues, the need for policymakers to directly address urban food security with robust policies capable of mitigating food system shocks and stresses will increase. Not doing so is likely to create scenarios like those witnessed in 2007/2008 with low-income residents being disproportionately affected by price spikes.

References

- Barrett, Christopher B. 2010. "Measuring Food Insecurity." *Science* 327 (5967): 825–28.
- Battersby, Jane. 2017. "Food System Transformation in the Absence of Food System Planning: The Case of Supermarket and Shopping Mall Retail Expansion in Cape Town, South Africa." *Built Environment* 43 (3): 417–30.
- Blekking, Jordan, Cascade Tuholske, and Tom Evans. In Review. "An Institutional Analysis of Urban Food Systems and Market Governance in Sub-Saharan African". *Sustainability*.
- Caesar, Mary, and Jonathan Crush. 2016. "Urban Food Deserts and Climate Change in Africa's Hungry Cities," Hungry Cities Partnership, , June. <http://hungrycities.net/wp-content/uploads/2016/06/Hungry-Cities-Discussion-Paper-No-3.pdf>.
- Cohen, M. J., and J. L. Garrett. 2010. "The Food Price Crisis and Urban Food (in) Security." *Environment & Urbanization*. <http://journals.sagepub.com/doi/abs/10.1177/0956247810380375>.
- Crush, Jonathan, and Bruce Frayne. 2010. *The Invisible Crisis: Urban Food Security in Southern Africa*. AFSUN Cape Town.
- . 2011. "Supermarket Expansion and the Informal Food Economy in Southern African Cities: Implications for Urban Food Security." *Journal of Southern African Studies* 37 (4). Routledge: 781–807.
- Ericksen, Polly J. 2008. "Conceptualizing Food Systems for Global Environmental Change Research." *Global Environmental Change: Human and Policy Dimensions* 18 (1): 234–45.
- FAO. 2017. "The State of Food and Agriculture 2017." Food and Agriculture Organization.
- Fay, Marianne, and Charlotte Opal. 2000. *Urbanization Without Growth: A Not So Uncommon Phenomenon*. World Bank Publications.
- "Food Security Policy Brief." 2006. *Food and Agriculture Organization*. June. <http://www.fao.org/forestry/13128-0e6f36f27e0091055bec28e830f46b3.pdf>.
- Fox, Sean. 2012. "Urbanization as a Global Historical Process: Theory and Evidence from Sub-Saharan Africa." *Population and Development Review* 38 (2). Wiley Online Library: 285–310.
- Frayne, Bruce, Wade Pendleton, Jonathan Crush, Ben Acquah, Jane Battersby-Lennard, Eugenio Bras, Asiyati Chiweza, et al. 2010. "The State of Urban Food Insecurity in Southern Africa," June. <http://dx.doi.org/>.
- "GDP per Capita Growth." 2017. *The World Bank*. <https://data.worldbank.org/indicator/NY.GDP.PCAP.KD.ZG?end=2016&locations=ZF-ZM-ZA-KE-GH&start=1982>.
- Hansen, K. Tranberg. 2004. "Who Rules the Streets? The Politics of Vending Space in Lusaka." *Reconsidering Informality: Perspectives from Urban Africa*, 62–80.
- Heath, Tom T., Alison H. Parker, and E. Keith Weatherhead. 2012. "Testing a Rapid Climate Change Adaptation Assessment for Water and Sanitation Providers in Informal Settlements in Three Cities in Sub-Saharan Africa." *Environment and Urbanization* 24 (2). SAGE Publications Ltd: 619–37.
- Hove, M., E. Ngwerume... - ... Security and Development, and 2013. 2013. "The Urban Crisis in Sub-Saharan Africa: A Threat to Human Security and Sustainable Development." *Stabilityjournal.org*. <http://www.stabilityjournal.org/article/view/sta.ap/>.
- Kimani-Murage, Elizabeth W., L. Schofield, F. Wekesah, S. Mohamed, B. Mberu, R. Ettarh, T. Egondi, C. Kyobutungi, and A. Ezech. 2014. "Vulnerability to Food Insecurity in Urban Slums: Experiences from Nairobi, Kenya." *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 91 (6): 1098–1113.
- Martin-Prevel, Yves, Elodie Becquey, Sylvestre Tapsoba, Florence Castan, Dramane Coulibaly, Sonia Fortin, Mahama Zoungrana, Matthias Lange, Francis Delpéuch, and Mathilde Savy. 2012. "The 2008 Food Price Crisis Negatively Affected Household Food Security and Dietary Diversity in Urban Burkina Faso." *The Journal of Nutrition* 142 (9): 1748–55.
- Mason, Nicole M., Thomas S. Jayne, Antony Chapoto, and Cynthia Donovan. 2011. "Putting the 2007/2008 Global Food Crisis in Longer-Term Perspective: Trends in Staple Food Affordability in

- Urban Zambia and Kenya.” *Food Policy* 36 (3): 350–67.
- Mason, Nicole M., and T. S. Jayne. 2009. “Staple Food Consumption Patters in Urban Zambia: Results from the 2007/2008 Urban Consumption Survey. Food Security Research Project Working Paper No. 42.” Lusaka.
- Maxwell, Daniel. 1999a. “Urban Food Security in Sub-Saharan Africa.” *For Hunger-Proof Cities: Sustainable Urban Food Systems*. <https://books.google.co.uk/books?hl=en&lr=&id=yr9D2-ZK4AwC&oi=fnd&pg=PA26&dq=maxwell+1999+urban&ots=YubG3sVMUs&sig=Eg6VdRTzjuRmP5BIjQqRnxo49fE>.
- . 1999b. “The Political Economy of Urban Food Security in Sub-Saharan Africa.” *World Development* 27 (11): 1939–53.
- Maxwell, Daniel, Carol Levin, Margaret Armar-Klemesu, Marie Ruel, and Saul Morris. 2000. *Urban Livelihoods and Food and Nutrition Security in Greater Accra, Ghana*. IFPRI, Washington, DC, US.
- Maxwell, Simon, and Rachel Slater. 2003. “Food Policy Old and New.” *Development Policy Review: The Journal of the Overseas Development Institute* 21 (5-6): 531–53.
- Morgan, Kevin, and Roberta Sonnino. 2010. “The Urban Foodscape: World Cities and the New Food Equation.” *Cambridge Journal of Regions, Economy and Society* 3 (2): 209–24.
- Moseley, William G., Judith Carney, and Laurence Becker. 2010. “Neoliberal Policy, Rural Livelihoods, and Urban Food Security in West Africa: A Comparative Study of The Gambia, Côte d’Ivoire, and Mali.” *Proceedings of the National Academy of Sciences* 107 (13): 5774–79.
- Mulenga, Chileshe. 2013. “The State of Food Insecurity in Lusaka, Zambia,” AFSUN Food Security Series, .
- Peyton, Stephen, William Moseley, and Jane Battersby. 2015. “Implications of Supermarket Expansion on Urban Food Security in Cape Town, South Africa.” *African Geographical Review* 34 (1). Routledge: 36–54.
- Pothukuchi, Kameshwari, and Jerome L. Kaufman. 1999. “Placing the Food System on the Urban Agenda: The Role of Municipal Institutions in Food Systems Planning.” *Agriculture and Human Values* 16 (2): 213–24.
- Reardon, Thomas, and David Zilberman. 2018. “Climate Smart Food Supply Chains in Developing Countries in an Era of Rapid Dual Change in Agrifood Systems and the Climate.” In *Climate Smart Agriculture*, 335–51. Natural Resource Management and Policy. Springer, Cham.
- Reardon, T., D. Tschirley, B. Minten - ... : transforming African ..., and 2015. 2015. “Transformation of African Agrifood Systems in the New Era of Rapid Urbanization and the Emergence of a Middle Class.” *Fsg.afre.msu.edu*. http://fsg.afre.msu.edu/fsp/ReSAKSS_ATOM_Reardon_et_al_Sept_2015.pdf.
- Rutstein, S. O., K. Johnson, and Orcm Measure. 2004. “The DHS Wealth Index.” ORC Macro, MEASURE DHS.
- Satterthwaite, David. 2014. “Guiding the Goals: Empowering Local Actors.” *SAIS Review of International Affairs*. <https://muse.jhu.edu/article/562594/summary>.
- Sen, Amartya. 1981. *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford university press.
- UN-HABITAT. 2003. *Slums of the World: The Face of Urban Poverty in the New Millennium? : Monitoring the Millennium Development Goal, Target 11--World-Wide Slum Dweller Estimation*. UN-HABITAT.
- . 2015. “Slum Almanac 2015-2016.” United Nations. <https://unhabitat.org/slum-almanac-2015-2016/>.
- UN High Level Taskforce on the Global Food Security Crisis. 2008. “Comprehensive Framework for Action.” United Nations. <http://www.un.org/ga/president/62/letters/cfa160708.pdf>.
- United Nations. 2014. “World Urbanization Prospects: The 2014 Revision, Highlights.” Department of Economic and Social Affairs, Population Division.
- Verpoorten, Marijke, Abhimanyu Arora, Nik Stoop, and Johan Swinnen. 2013. “Self-Reported Food Insecurity in Africa during the Food Price Crisis.” *Food Policy* 39 (Supplement C): 51–63.

World Food Programme, Vulnerability Analysis And Mapping Branch. 2008. "Food Consumption Analysis." World Food Programme.