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Does Rural-Urban Connectivity Buffer against Food Insecurity?: A Longitudinal Study of Informal Settlements in Nairobi, Kenya

Running Title: Rural-Urban Connectivity and Urban Food Insecurity

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ABSTRACT

With rapid urbanization and the growth of informal settlements in Africa, there is increasing concern about urban food insecurity. Economic precarity coupled with limited access to means of food production increase the risk of food insecurity. Connection to a rural "home" through access to crops and livestock, people and migration, may buffer against food insecurity but data limitations have made it difficult to investigate the relationship. We draw on 8 years of data from two slum communities in the Nairobi Urban Health and Demographic Surveillance System to 1) analyze the relationship between rural connectivity and food insecurity in the whole sample and stratified by slum community and 2) assess whether type of connectivity matters for urban food insecurity. Our results suggest variation in food insecurity over time peaking around 2008. Overall, we find that rural connectivity decreases the odds of experiencing urban food insecurity but not all types of connectivity are beneficial and the effects vary between slum communities.

The once familiar images of the rural poor – particularly children – coping with chronic and acute food shortages in Africa have been replaced by portrayals of poor urban dwellers facing food insecurity and malnutrition[1]. A recent analysis of slums in Nairobi found a prevalence rate of 50% for severe food insecurity[2]. With urbanization well underway in many African countries accompanied by the rapid growth of informal settlements[3], there is growing concern that the urban poor are unable to sustain even basic livelihoods. One critical component is food security, which is essential for sustaining physical health and supporting cognitive development in children. Unlike their rural counterparts who can grow their own food, urban residents are heavily dependent on purchasing food, which presents substantial difficulties where employment opportunities are scarce. At the same time, however, we know that urban residents retain strong ties with their rural "homes" in many African contexts through relationships with kin as well as links to the land itself. Therefore, it might be expected that these linkages offer protection from food insecurity for urban dwellers. In this analysis, we draw on longitudinal data from two slum settlements in Nairobi, Kenya to address three questions: 1) Is there a relationship between urban-rural connectivity and food insecurity in urban households? 2) Does type of connectivity matter for urban food insecurity? and 3) Does this relationship vary across slum communities?

The importance of this study can be appreciated in several ways. First, it contributes to the growing scholarly interest in urban livelihoods amidst economic precarity in sub-Saharan Africa. Second, it further underscores the need to pay close attention to how urban and rural spaces are connected in Africa. Much of the research on labor migration focuses on the effects for rural households with far less known about how migration based connections impact urban places. Third, this analysis is one of the few to explicitly address differences *across slums* in urbanized African contexts. We tend to think about "slums" as monolithic spaces of poverty and not appreciate the role of localized political economies and specific histories that influence how rural connectivity plays out. Lastly, the findings can inform ongoing discussions about appropriate intervention options to improve the well-being of the urban poor.

Background

Urban Food Insecurity

The growing concern among academics and policy makers regarding livelihoods of the urban poor has increasingly turned to the question of food insecurity. In sub-Saharan Africa (SSA), the number of people experiencing food insecurity is estimated at 239 million, and likely to increase in the near future if food prices continue to rise[4]. The persistent vulnerability of the region to food insecurity was underscored in 2011 when the worst drought in 60 years led to 12 million people suffering from starvation in the Horn of Africa and needing food assistance[4,5]. Food insecurity in African cities is a consequence of rising prices for imported food and declining wages for workers[6,7]. Driven by lack of access to production, urban residents are almost entirely dependent on buying food[8], which is difficult when economic opportunities/employment are so fragile[9]. As a result, a rise in staple food prices has a profound effect on the poor urban population[10] as they spend a large proportion of their income and expenditure on food[11,12] and are very limited in substituting food sources[13]. In Kenya, the 2005/06 Integrated Household Budget Survey reported that urban poor households spend 57% of their budget on food[14] and a more recent study, using 2012 and 2013 data on Nairobi urban poor, found that slum residents spent 52% of their income on food[15].

There are ways to mitigate risks of food insecurity. In one study from the same slum communities as the present analysis, the authors show that households with higher educational attainment face lower risks of food insecurity[16]. Another way is through urban gardening and agriculture, which has a long history in in Africa[17,18] and specifically in Nairobi[19–21]. However, a recent comparative study of 15 developing countries by Zezza and Tascioti[22] concluded that urban agriculture, while important, is unlikely to be a major driver of poverty reduction and food security. Therefore, we need to consider other factors. One understudied issue is urban-rural connectivity which Ellis and Sumberg[17] contend is critical in examining access to food for urban dwellers.

Urban-Rural Linkages and Urban Livelihoods

There is a rich scholarship on the importance of urban-rural connections in Africa[23–27] which means maintaining a foothold in a rural community even for long established urban dwellers [28–30]. Indeed, this is the basis of the New Economics of Labor Migration scholarship[31] which emphasizes that migration is a family based decision that expands the safety net for all family members. In the past, this might have meant that urban residents might receive visits from rural family members or neighbors bringing food, or they might even bring back food themselves from a visit to their rural "homeplace"[24]. In recent years, the pattern of travel back and forth to rural areas in Kenya has been replaced, at least in part, by mobile technology that allows communication and money transfers[32] that allow family members to send cash that may be used to purchase food in the city. Research in the same slum community as the present study has shown that while distance to and location of kin do not matter for transfers of financial or emotional support, subjective perception of distance and access does have an impact[33].

The lives of the urban poor are interdependent with the livelihoods of the rural poor, and flows of food and cash occur between family members resident in both locations[34,35]. In fact, Kimani-Murage et al.[2] have documented the positive role of food contributions from rural family members to alleviate food insecurity in slum households. The authors note that "urban residents depend almost entirely on rural areas for their food"[2 (pp13)]. From a 1994 survey in Korogocho, one of the areas included in the present study, Foeken and Mwangi[36] reported that 56 percent of low-income households had access to rural land, although many of the plots did not serve as a source of urban food due to their distance from the city. Based on primary surveys carried out early in 2004, World Bank researchers found that some 60 percent of slum dwellers said they owned land outside of Nairobi and 55 percent owned a house outside the city[12]. Oucho et al.[37], comparing past and recent trends, note that rural-urban transfers of money and food were still reported in interviews in 2012 and 2013. Urban residents see these transfers as critical cushions during the precarious period of adjustment to urban life. Kristjanson et al.[38] employed a unique mixed-methods approach to arrive at estimates of strategies for escaping poverty employed by households

divided into five "livelihood zones," one of those being urban (including Kenya's two largest cities, Nairobi and Mombasa). Among urban households that transitioned out of poverty, three of the most frequently-employed strategies implicated urban-rural connections: building rural enterprises, "help from friends and relatives in country," and agricultural improvements. However, the obligations to support kin in rural communities and, in particular, close kin, may lead to compensatory financial adjustments in the urban households, which, in turn, could increase food insecurity. Moreover, given the extreme challenges of life in urban settlements, return migration has also become a livelihood strategy[39]. In this case, having a rural home to go back to is an indicator of strong connection but may also be a move prompted by livelihood distress in the urban setting.

While urban slum dwellers share common challenges of accessing employment and livelihoods, there are likely to be important differences across specific communities resulting in different outcomes[40,41]. For example, in a recent analysis of 2009 Kenyan census data, Shifa and Leibbrandt[42] find wide differences in the incidence of poverty between administrative districts within Nairobi and[43] found wide disparities in livelihood and health outcomes, especially child mortality and immunization rates, across different slums in the city's divisions. There is a dearth of research on intra-slum differences but Nairobi provides an ideal location to advance this scholarship for several reasons. First, the ethnic composition of slums is different given the salience of ethnic identity in Kenyan social life. Urban residents tend to move to areas where there are co-ethnics who share common linkages to rural origin locations. Second, infrastructure investment varies across slums with some enjoying greater access to services such as clinics, schools and grocery stores. In the Kenyan case, the extent of such development may be associated with ethnic composition. Third is access to employment opportunities in specific communitie,s which would impact population composition of each context.

Using this conceptual framework, we offer the following hypotheses:

1) Urban households that maintain some type of rural connection are less vulnerable to food insecurity than those that do not;

2) However, the type of connection is associated with different effects
    a. We expect access to rural crops or livestock to be beneficial in supporting urban food security
    b. We expect in and out migration to be associated with lower risk of experiencing urban food insecurity because it demonstrates active rural ties that could be called upon in times of need
    c. We expect having a parent in a rural community to be a liability because they are a drain on scarce urban resources
3) The effects of urban-rural connectivity differ between slum communities

Site and Data Description

The data for this analysis are drawn from the Nairobi Urban Health and Demographic Surveillance System (NUHDSS) and cover two adjoining informal settlements – Korogocho and Viwandani. These settlements share similar characteristics with other informal settlements in urban Africa, namely, inadequate access to basic services, poor housing, limited employment opportunities and crime. The communities are made up of both recent migrants and more established residents, most of whom work in the informal economy. Most households experience a constant struggle to remain out of poverty[44]. The area also has elevated rates of infant and child mortality as well as HIV and domestic violence[45,46]. There are, however, some important differences between the two communities. Viwandani is more populated than Korogocho and better off because of its strategic location near the major source of formal-sector employment in the city (the industrial area) and being home to younger and more educated industrial workers[43]. The housing structures are mainly made of iron sheet and tin walls and iron sheet roofs[47]. Korogocho, by contrast, is poorer and is one of the most congested slum areas, with most dwelling units made of mud and timber walls and tin cans as roofing materials. Korogocho is adjacent to the Dandora waste site, the dumping ground for most of Nairobi's solid waste.

The African Population and Health Research Center has been administering the surveillance system since 2002, completing a full census of data on fertility, mortality, migration and marriage in both settlements two or three times a year. In addition, household asset holdings and other socioeconomic indicators such as education have been updated every two years since 2006. The number of households in the site has varied yearly from a low of 21,000 to a high of 30,000; the 2015 population for the two communities was approximately 65,000 individuals.

Key Variables and Analysis

Dependent variable: Food security is adapted from Ballard et al.'s[48] widely used hunger scale, using responses to 4 questions: 1) whether the household had enough food during the last 30 days; 2) whether, in the last 30 days, the household was unable to obtain more food once food was finished; 3) whether, in the last 30 days, any child in the household failed to eat for a whole day and/or slept hungry at night because there wasn't enough money for food; and 4) whether, in the last 30 days, any adult in the household failed to eat for a whole day because there wasn't enough money for food. The responses are used to create a four-category variable: severe insecurity, moderate insecurity, mild insecurity, security. These are further collapsed into a dichotomous measure: food secure (0) and food insecure (1).

Explanatory variables: Rural-urban connectivity is measured through three dichotomous indicators: 1) whether the household has anyone who owns livestock or has access to crops in rural areas; 2) whether anyone in the household has migrated from or to a rural area; and 3) whether anyone in the household has a parent living in a rural community.

Sample and Method

Of the 73,060 households enumerated at least once in the DSS site from 2006-2015, we narrowed the range of years to 2007-2014 resulting in 64,343 households. Our analysis follows several steps. First, we present descriptive tabulations and trends in food security. Second, we conduct Kaplan Meier estimation to show survival times to first experience of food insecurity for a household conditional on not having

experienced it at first observation. Time to event variable is calculated as years from first observation to the event or loss to follow up or end of observation. Last, we employ discrete time logistic regression models to estimate the odds of a household experiencing food insecurity in a given year, with urban-rural connectivity as the main time-varying explanatory variable.

Our sample for this analysis is 88,968 household-years, derived from multiplying the 64,343 households by the number of years of observation for each household (1-8). A large proportion of households (58.7%) experience food insecurity at the first observation and therefore only contribute one year of observation which explains why the N for household years is not as high as one might expect. Control variables include ethnicity, slum area, household size, female headship, educational attainment of household head (dichotomized as high and low, with high meaning completion of at least secondary education), wealth quintile based on a household asset index, age dependency ratio and number of years of data for the household to control for differences in exposure to event occurring. We also include a dummy variable identifying left-censored households to address the bias that may be introduced from having a large number of households experience the event of food insecurity in the first wave of observation[49]. The odds ratios for the left-censoring dummy variable are not interpretable because that variable perfectly predicts the outcome. As a sensitivity check, we ran models without the left-censoring variable and found that the effects of the rural connectivity indicators were much larger and, in some cases, in the opposite direction. This is evidence that the effects are sensitive to the disproportionately large number of households that experienced the event very early and it is essential to account for this variation to attain more robust results.

Findings

We begin with an overview of what households in the sites looked like in 2014 (Table 1). The N represents all households enumerated in the site in that year.

Insert Table 1 here.

A number of notable features deserve mention. While about 36.3% of all households are categorized as food secure, the difference between slum communities is striking. Whereas only 20.7% of households in Korogocho are food secure, the comparable figure for Viwandani is 44.9%. The percentage of households with head having at least secondary school education is higher in Viwandani, while households in Korogocho have higher age dependency ratios compared to households in Viwandani and are larger on average. These differences are consistent with structural differences between the two communities that favor Viwandani in terms of formal-sector employment opportunities and better economic outcomes. Both Korogocho and Viwandani have similar percentages of households with migration in and out of rural areas, 17.9% and 20% respectively. Viwandani, however, has a higher percentage of households with access to rural food or livestock (24.7%) than does Korogocho (14%). On ethnic composition, the most striking differences are the presence of a large Kamba community in Viwandani and the existence of more Luhya and Luo in Korogocho. (We combine these two ethnic groups in the multivariate models discussed below.) Next we move to examining trends over the 8-year period in food security in these populations, as shown in Figure 1.

Insert Figure 1 here.

The percentage of households categorized as food secure starts at a high of 40% in 2007 and dips to a low of 30% in 2009 – following the election violence of 2007-2008 – and rises again to just under 40% in 2014. On the other end, the trend for severely food insecure households starts at 35% in 2007, rises to 40% in 2008-2009, and falls to a low of 27% in 2014. The prevalence of intermediate levels of food insecurity has remained fairly stable over the period. Figure 2 shows Kaplan Meier curves for time to experiencing the first occurrence of food insecurity (conditional on being food secure at first observation) for the whole sample of households, with Figure 3 stratified by slum community.

Figures 2 and 3 here.

A few features stand out from these graphs. One, nearly every household experiences an event of food insecurity by the end of the observation period, though the proportion is slightly lower in Viwandani. Two, nearly 25% of households do so within the first year of observation. Three, there is a much higher proportion that experiences food insecurity in the first year in Korogocho (50%) compared to Viwandani (22%). The differences by slum area are statistically significant at the .001 level as determined by a Mantel-Cox log-rank diagnostic. To better understand the correlates of this variation, we turn to discrete time regression models.

Does rural connection make a difference to urban food insecurity?

Table 2 shows the results of discrete time logistic regression models predicting the odds of experiencing food insecurity, with rural connectivity included as a dichotomized indicator of any connection (access to crops or livestock, in- or out-migration, or a parent living in the rural area). The first model (I) includes just main effects, the second (II) includes an interaction term of connectivity and slum.

Insert Table 2 here.

Supporting our initial hypothesis, having a rural connection decreases the odds of experiencing food insecurity by 25% in all the models. Models I and II also show that living in Viwandani means significantly lower odds (43%) of experiencing food insecurity compared to living in Korogocho. However, the non-significant interaction effect in Model II shows that the effect of rural connection does not depend on the slum community. This is somewhat surprising because Viwandani has a large number of Kamba who hail from the Eastern province which is only a one-hour commute away from Nairobi. Korogocho, on the other hand, has a high Luo/Luhya (Western Kenya) concentration rendering the distances to place of origin much farther.

Larger households increase the odds of food insecurity as would be expected but female headship offers a marginal benefit in buffering against food insecurity, at least in Viwandani. Household wealth, as expected, serves to decrease the likelihood of food insecurity. Interestingly, being a member of any ethnic

group other than Kikuyu increases the odds of food insecurity in the main model. We now move to models testing whether the type of connectivity makes a difference.

Does type of rural connection make a difference to urban food insecurity?

Table 3 shows results of discrete time models predicting the odds of experiencing food insecurity, disaggregating rural connectivity into each of the three indicators. The first model (I) includes just the main effects of rural crops or livestock, in- or out migration, and having a parent in the rural area while; the second (II) includes interaction effects of each of these connectivity variables and slum area.

Insert Table 3 here.

Access to rural crops and livestock decreases food insecurity and the significant interaction effect in Model II tells us that the beneficial effect of having crops/livestock in Viwandani is more pronounced than in Korogocho. This offers some support for our hypothesis that, while access to crops and livestock increases the safety net, it is sensitive to slum specific contextual factors. Migration and having a parent in a rural area decrease the odds of experiencing food insecurity in all the models. This supports our hypothesis that migration is an effective means of connecting to support networks but it refutes our expectation that having a parent in a rural community is a liability. The strong slum effects are similar to those in Table 2 as are the effects of the control variables.

Discussion and Future Work

Our findings are consistent with other scholarship that emphasizes the benefits of rural - urban connectivity. Our focus on urban households and variation across urban communities is a much needed addition to the literature. Given well known migrant selection effects based on education, age and marital status, it is often taken for granted that the flow of resources moves from urban to rural. At the same time, however, the tenuous position of migrants in urban spaces necessitates the maintenance of rural ties through agriculture, movement, and people. However, not all urban residents enjoy the same benefits. By focusing on variation between slum communities, we demonstrate the value of disaggregating the "slum

monolith" into distinctive communities exhibiting variations in employment opportunities, infrastructure, connection to governing authorities and ethnic composition, a point we turn to next. Our findings show that not only are Korogocho residents in an even greater position of vulnerability than those in Viwandani but that the benefits of rural connectivity are also muted there.

Two key limitations need to be appreciated in interpreting these results. First, our measures of urban-rural connectivity are quite simplistic and should be treated as proxies for the substance of connections. Ideally, we would want more detailed data on the type of transfers in both directions, involvement in rural agriculture and the value of land holdings, and duration of visits with kin in both directions. Second, while longitudinal data provides some space to consider temporal variation in modeling (i.e. time varying covariates), our estimates are likely biased by selection and unobserved heterogeneity. For example, we do not know the household's history of food insecurity prior to entering the observation period.

Despite these issues, this analysis makes an important contribution to the growing scholarship on urban well-being in sub-Saharan Africa and hold potential value for policy makers grappling with the challenges of improving living conditions and expanding livelihood options for slum dwellers. Whether further investments will be made in promoting urban agriculture is unclear but there is little doubt that connectivity to kin and land continues to figure prominently in livelihood strategies of the urban poor., Specifically, policy makers should consider both the benefits and liabilities of rural connectivity in conjunction with localized political economic conditions when designing interventions. Future research should examine these processes in other settings in East Africa and beyond to identify macro level factors (e.g. the casualization of labor) that may engender similar effects.

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Table 1. Dependent and Independent Variables, NUHDSS 2014

	Total	**Korogocho**	**Viwandani**
Food security (%)***			
Mild food insecurity	11.3	23.7	4.4
Moderate food insecurity	18.5	11.3	22.4
Severe food insecurity	22.5	34.5	15.9
Food secure	36.3	20.7	44.9
Missing	11.4	9.8	12.3
Rural crops or livestock (%)***			
Yes	20.9	14.0	24.7
No	55.1	63.6	50.4
Missing	24.0	22.4	24.9
Rural migration (%) ***			
Yes	19.2	17.9	20.0
No	80.5	81.9	79.8
Missing	0.2	0.2	0.2
Parent lives in rural area (%)***			
Yes	72.9	64.1	77.8
No	26.9	35.7	21.9
Missing	0.2	0.2	0.2
Household size (mean)***	2.65	3.07	2.42
Female headed (%)***			
Yes	23.0	29.0	19.7
No	76.9	70.9	80.3
Missing	0.0	0.1	0.0
Age dependency ratio (mean) ***	.47	.62	.39
Household head has at least secondary school education (%)***			
Yes	49.7	32.6	59.2

No	46.8	63.7	37.4
Missing	3.5	3.7	3.4
Ethnicity (%) ***			
Kikuyu	25.8	33.4	21.5
Luhya	13.1	18.0	10.4
Luo	9.2	18.8	3.8
Kamba	28.0	7.3	39.4
Other	23.5	21.7	24.5
Missing	0.5	0.7	0.5
N	30757	10997	19760

***significant at .001; ** significant at .01 level; *significant at .05 level

Figure 1. Trends in Food Security 2007-2014, NUHDSS

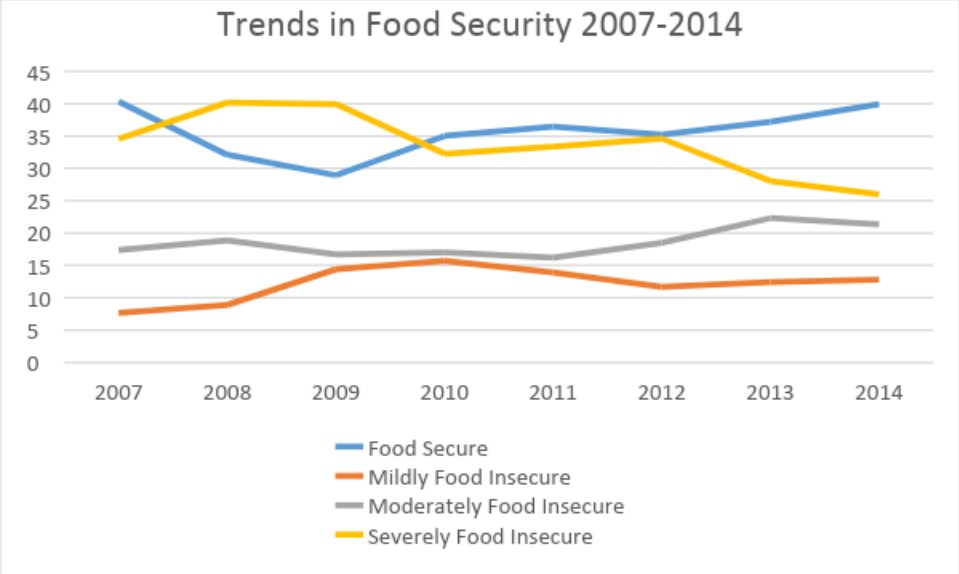

Figure 2. Kaplan Meier estimates for first experience of food insecurity

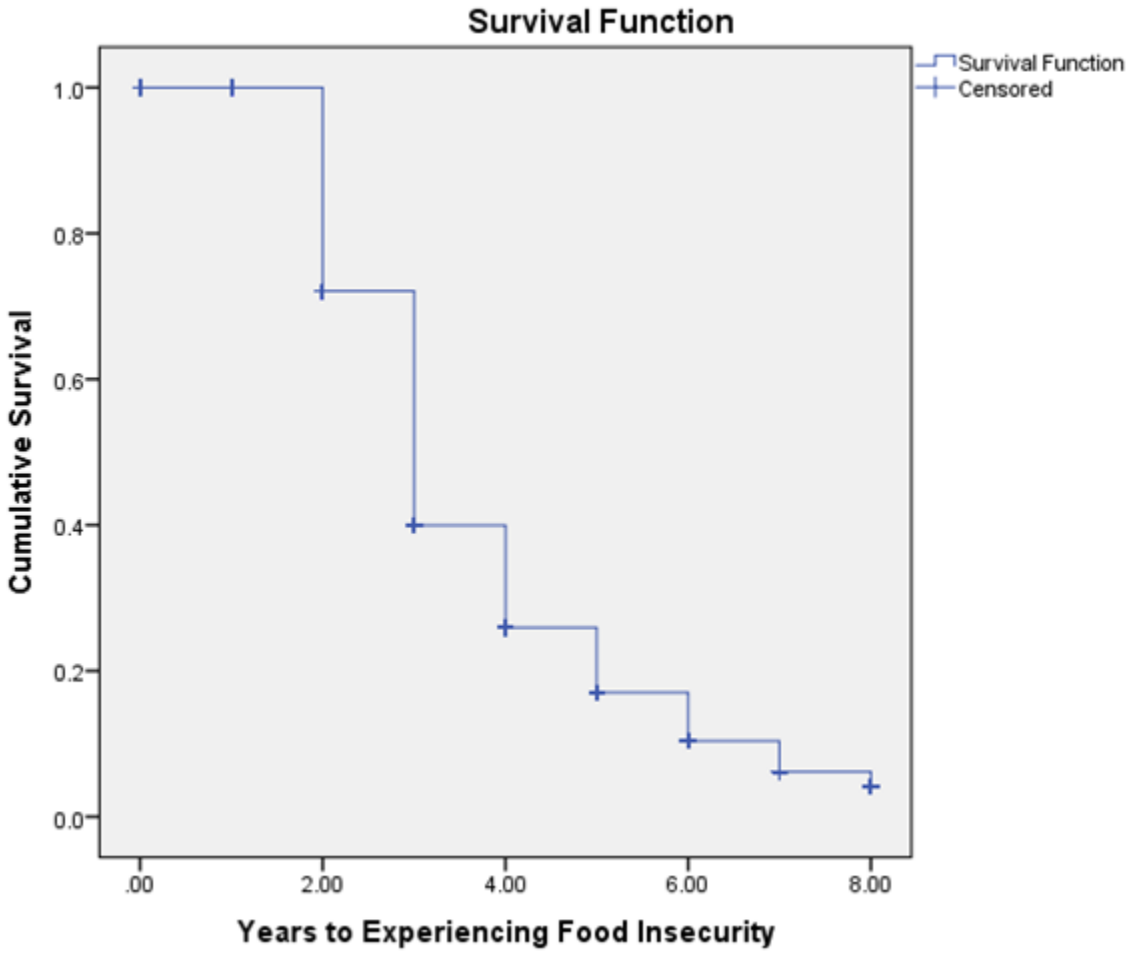

Figure 3. Kaplan-Meier estimates of first experience of food insecurity stratified by slum community

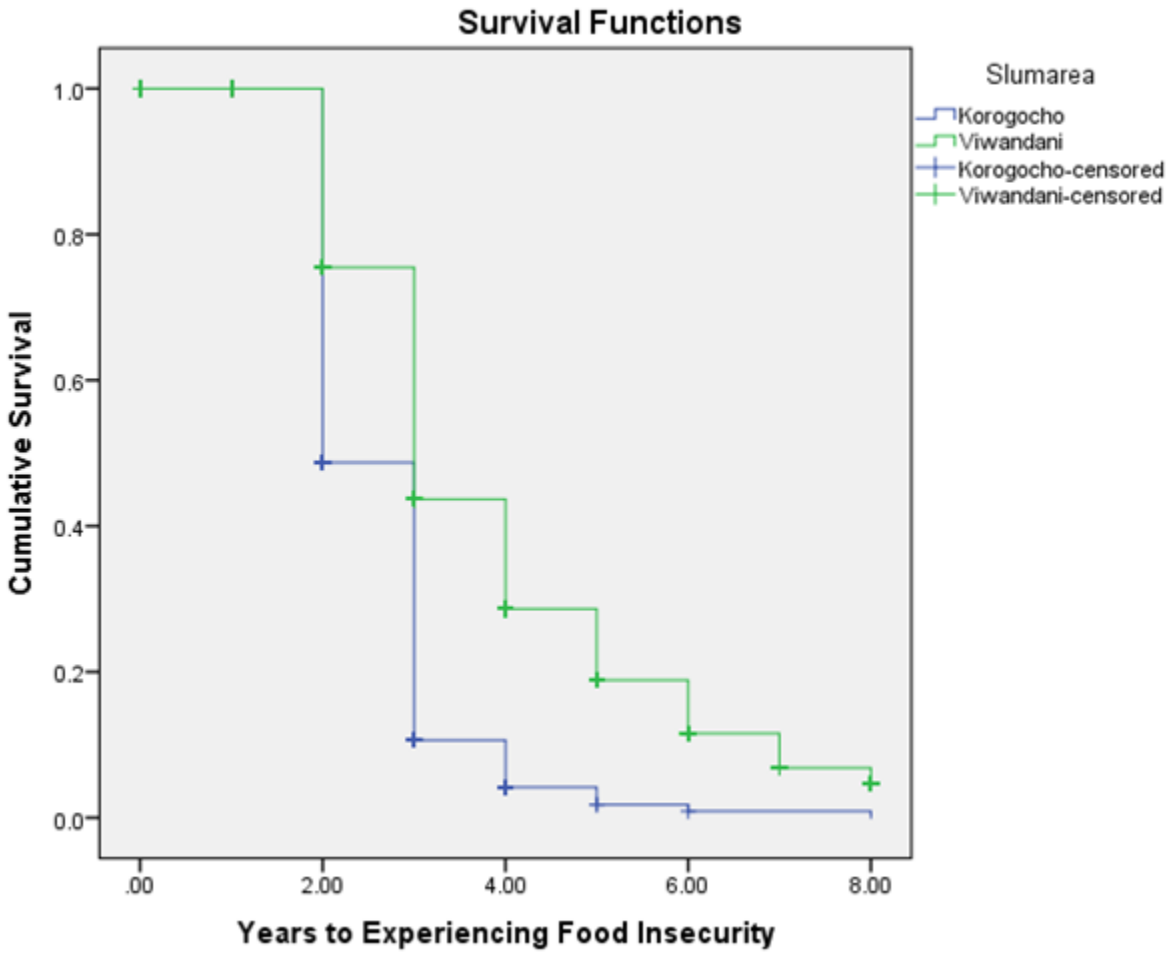

Table 2. Odds of experiencing food insecurity using a dichotomous measure of rural connection, 2007-2014

	Main Effects	w/interaction
Have some rural connection	.75*** (.04)	.74*** (.04)
Slum area		
Korogocho	Ref	Ref
Viwandani	.58***(.04)	.57***(.07)
Household size	1.15***(.01)	1.14***(.01)
Female headed	.94* (.03)	.94* (.03)
Age dependency ratio	1.03(.03)	1.03(.03)
Household wealth quintile	.80**(.01)	.80***(.01)
High educational attainment of household head	1.04 (.03)	1.04 (.03)
Ethnicity	.	
Kikuyu	Ref	Ref
Luhya/Luo	1.13***(.04)	1.13***(.04)
Kamba	1.12***(.03)	1.12***(.03)
Others	1.08*(.04)	1.08*(.04)
Years of data	1.31***(.01)	1.31***(.01)
Rural connection x slum	n/a	1.01 (.08)
Nagelkerke R Square	.767	.767
N	82,589	82,589

***significant at .001; ** significant at .01 level; *significant at .05 level

Note: The dummy variable for left-censored is included in all models to remove bias from having a large proportion of left-censored households; the odds ratios are not shown because the variable perfectly predicts the outcome for these cases.

Table 3. Odds of experiencing food insecurity using type of rural connection, NUHDSS 2007-2014

	Main Effects	w/interaction
Rural crops or livestock	.77*** (.03)	1.04 (.09)
Migration to or from rural area	.73***(.03)	.66***(.09)
Parent lives in rural area	.93*(.03)	.92 (.07)
Slum area		
Korogocho	Ref	Ref
Viwandani	.58***(.04)	.59***(.06)
Household size	1.15***(.01)	1.15***(.01)
Female headed	.93* (.03)	.93* (.03)
Age dependency ratio	1.00 (.03)	1.00 (.03)
Household wealth quintile	.79***(.01)	.79***(.01)
High educational attainment of household head	1.02 (.02)	1.02 (.03)
Ethnicity	.	
Kikuyu	Ref	Ref
Luhya/Luo	1.17***(.04)	1.17***(.04)
Kamba	1.13***(.03)	1.13***(.03)
Others	1.10**(.04)	1.10**(.04)
Years of data	1.25***(.04)	1.26***(.01)
Crops/livestock*slum area	n/a	.72***(.10)
Migration*slum area	n/a	1.12 (.10)
Rural parent * slum area	n/a	1.01 (.08)
Nagelkerke R Square	.728	.728
N	66,141	66,141

***significant at .001; ** significant at .01 level; *significant at .05 level

Note: The dummy variable for left-censored is included in all models to remove bias from having a large proportion of left-censored households; the odds ratios are not shown because the variable perfectly predicts the outcome in these cases.