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THE HUNGRY CITIES FOOD PURCHASES MATRIX: A MEASURE OF URBAN HOUSEHOLD FOOD SECURITY AND FOOD SYSTEM INTERACTIONS

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Abstract

Recent theoretical work has suggested that urban food security is the result of food system interactions. This work highlights the challenge of assessing household-level food insecurity and relating it to the broader food system. One priority is to develop food security metrics that incorporate household interactions with the food system retail environment. The Hungry Cities Food Purchases Matrix (HCFPM) is one such metric that has been developed for situating household food sourcing behaviour within the urban food system. The matrix has been successfully administered in a number of cities in the Global South by the Hungry Cities Partnership. This paper discusses the administration of the HCFPM in a 2014 household survey of Maputo in Mozambique and illustrates how it can provide unique insights into the interactions between households and the broader food system. The HCFPM therefore paves the way for a new frontier in urban food system research in cities of the Global South.

Keywords

Introduction

The Food and Agriculture Organization (2008: 1) defines food security as existing "when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." This definition has at least four dimensions: food availability (sufficient quantity), access (enough entitlements to obtain food), utilization (consumption of diverse, safe and culturally-appropriate food), and stability (stable access over time) (Carletto et al 2013). Given the complexity of these four different dimensions of food security, it is difficult for current food security metrics to "measure up" to the task of comprehensively and reliably capturing information on individual and collective food insecurity (Lappe et al 2013). As a result, there is considerable debate on the nature and accuracy of individual and household level food security metrics (Bilinsky and Swindale 2010, Coates 2013, Coates et al 2007, Headey and Ecker 2013, Jones et al 2013, Maxwell et al 2014, Swindale and Bilinsky 2005).

Leroy et al (2015) suggest that one of the main challenges in the measurement of food security is that different measures have different goals and sensitivities. In general, approaches to food insecurity measurement are either subjective or objective in nature (Coates 2013, Headey and Ecker 2013). The most widely used cross-cultural household food security measures are the Household Food Insecurity Access Scale (HFIAS), the Household Food Insecurity Access Prevalence (HFIAP) measure and the Household Dietary Diversity Score (HDDS) developed by the FANTA project (Coates 2013). At the individual level, objective biometric measures (such as caloric intake, the Body Mass Index, and measures of stunting and wasting) are common. The importance of combining household and individual metrics is illustrated by Quisumbing's (2013) study of food security measures in Uganda which shows considerable inequality in the distribution of food consumption within households.

Food security metrics pitched at the household or individual level do not provide a sufficient explanation for why urban food insecurity exists and persists, however. For this, greater understanding is needed of the multiscalar food system in which households are embedded. Food insecurity is increasingly conceptualized as the outcome of the operation of the food system as a whole. Barrett (2002), for example, underscores the importance of connecting micro-level vulnerabilities with macro-level urban food system risks in order to better understand the drivers of food insecurity. Ecker and Breisinger (2012) suggest that systems models are best suited for conceptualizing food security. Ericksen (2008) provides a conceptual model of how the various dimensions of food security are linked to the broader food system, defined according to the human-environment interactions involved and human activities (and their outcomes) in the production, distribution and consumption of food. This model is also designed to capture all of the food system processes linking production, distribution, access and utilization (Ericksen 2008).

The multifaceted nature of modern food systems makes the development of effective measurement tools particularly challenging. While traditional food systems involved shorter supply chains (from producer to consumer), modern food chains are far more complex with several different scales of interaction (Clapp 2011, Ericksen 2008). As a result, the food being distributed through modern food systems can be from global or local sources or a mixture of both (Hinrich 2003). Given the diversity of food sources and supply chains, the ability to trace the source and pathways of food products into and within cities is an important research objective (Regattieri et al 2007). The multiscalar nature of modern food systems can also complicate vulnerability assessment, as different threats can present at different scales (Fraser 2006). As a result, measurement proxies have been developed to assess food system operation and vulnerabilities, including food price indices, biomass flows and urban food desertification (Battersby 2012, Clapp 2009, Crush and Battersby 2016, Timmer 2000).

One of the challenges confronting food security research is how to connect conceptual models and proxy measurements of the urban food system with food security measures at the household level. In an attempt to bridge this gap, the African Food Security Urban Network (AFSUN) developed a simple household food sourcing matrix which asked households where they normally obtained their food and how often they patronized each source. The aim here was to better understand the ways in which households interacted with the food system at the point of food procurement and purchasing. The results of this, and other related survey questions, were discussed in a series of thematic papers and city case studies (Crush and Battersby 2016). Among the key findings for Southern African cities were (a) the relative insignificance of urban agriculture and formal and informal social protection; (b) the critical importance of the informal food economy as a daily food source in most cities and (c) surprisingly high levels of patronage of supermarkets by low-income households. The AFSUN food sourcing matrix also had several weaknesses including insufficient disaggregation of food sources, little ability to determine where households purchased individual food items such as staples and processed foodstuffs, and no insights into the geographies of food procurement.

To address these issues, and to provide greater insight into the interactions between households and the urban food system, the Hungry Cities Partnership built on the AFSUN approach and developed the Hungry Cities Food Purchase Matrix (or HCFPM) in 2014. The HCFPM has been administered in the following seven cities in the global South as part of the HCP baseline household food security survey: Bangalore (India), Cape Town (South Africa), Kingston (Jamaica), Maputo (Mozambique), Mexico City (Mexico), Nanjing (China) and Nairobi (Kenya). The rich potential of the HCFPM has already been demonstrated in an in-depth analysis of the urban food system and household food security in Nanjing (Si, Scott, and McCordic 2016). In this paper, we discuss the aims and structure of the HCFP and illustrate the argument with data from Greater Maputo in Mozambique. We also demonstrate how the HCFPM could be further refined to provide additional analytical insights.

The Hungry Cities Food Purchasing Matrix

The Hungry Cities Food Purchase Matrix (HCFPM) is a household-level measure of food purchasing and sourcing behaviour. First, a list of food items sold by retail outlets in a city is constructed. There is no limit on the number of items that can be included in the matrix, other than the logistical constraint of survey administration time. The items are city-specific and adapted to local cultural preferences, consumption patterns and terminology. The list can include commonly consumed foods (including fresh, packaged and frozen foods), a diversity of food products, and food items of particular interest (such as wild foods, for example). For each food item, the HCFPM measures (a) whether a household purchased it in the month prior to the survey, (b) if so, the frequency of purchase during the month, (c) the source(s) where the item is normally purchased, and (d) the geographical location of the purchase source(s) (Table 1).

The frequency of purchase choice generally has four options: at least five days per week, at least once

TABLE 1: Hungry Cities Food Purchasing Matrix Template

Food items	Whether purchased (yes/no)	Frequency of purchase	Purchase source	Purchase source location
Food item 1				
Food item 2				
Food item 3				

per week, at least twice per month, and at least once in the past month. The purchase source refers to the type of retail outlet where the food item was purchased. This is tailored to local circumstances as the types of purchase source vary from city to city. In most African cities, the matrix has as many as nine different options: supermarket, small formal shop, small informal shop (with different names in different countries), butchery or bakery, takeaway (fast food), restaurant, formal market, informal market, and street sellers/vendors. The purchase source location has been used in two ways: either according to convenience of access (for example, in the neighbourhood, on the way to work, in the central business district, and so on) or according to physical distance from the household (for example, less than 1 kilometre, 1-5 kilometres, 5-10 kilometres and so on).

The design of the matrix can also vary depending on the goals of the research. While the frequency of purchase follow-up question is administered as a "select one" multiple-choice question, the purchase source and purchase source location can be administered either as "select one" or "select multiple" (depending on whether the data being captured refers to the most commonly used source or all sources used to purchase a given food item). The administration of these questions can also be couched as a series of follow-up questions or a set of cascading questions which provide specific details of each food item purchased with a specific frequency,

at a specific purchase source, and at a specific purchase source location.

To further illustrate the potential of the HCFPM, we draw on data and findings from the HCP baseline household food security survey of Greater Maputo (Maputo City and Matola) in 2014. The total sample size was 2,071 households drawn from 19 randomly selected wards in the city. The sample sizes for each ward were determined by proportional allocation using the most recently available census data at the time (2007). Within each ward, the survey enumerators used systematic sampling to select households. The HCFPM for Maputo itemized a total of 29 separate food items known to be sold in formal and informal retail outlets in the city. For the illustrative purposes of this paper, we have selected 10 foodstuffs from the list (Table 2).

Table 2 demonstrates high purchasing frequency (more than 50% of the sampled households) for items such as rice, white bread, sugar, vegetables and frozen fish, and considerably lower purchasing frequency for healthier food items such as brown bread, fruit, milk, meat, chicken and fish. Another important finding is that many more of the sampled households consume frozen chicken, fish and meat than their fresh equivalents. Mozambique is a major importer of rice, wheat and frozen products such as chicken, which indicates that key components of the diet of Maputo households are embedded in global supply chains (Chikanda and Raimundo

TABLE 2: Household Food Purchases by Frequency of Purchase

Food items	Yes (% of sample)	At least 5 days per week (%)	At least once per week (%)	At least twice per month (%)	At least once per month (%)
Rice	88.0	3.5	3.7	9.8	82.9
White bread	84.2	89.4	8.8	1.0	0.7
Sugar	65.1	5.8	13.9	17.5	62.8
Vegetables	62.7	44.5	46.8	4.8	3.9
Fish (frozen)	56.6	4.0	32.4	16.0	47.6
Pasta	44.0	2.1	25.2	18.8	53.9
Chicken (frozen)	43.4	1.3	28.7	23.1	46.9
Fruit	27.2	28.6	54.5	9.8	7.1
Chicken (fresh)	20.7	2.1	37.1	21.7	39.2
Fish (fresh)	17.8	6.2	40.1	17.6	36.0
Brown bread	7.0	44.8	39.3	9.7	6.2
(%)=Percent of sampled food item purchasers					

2016). In terms of purchasing patterns, it is also clear from Table 2 that staples such as rice and sugar are generally bought on a monthly basis (probably in bulk) while foods that spoil quickly, such as vegetables and bread, are purchased almost daily.

The next component of the HCFPM provides insights into the sources for the selected food items and demonstrates how households interact with the urban food system at the point of sale (Table 3). The most common sources for the food items identified are small shops, formal markets and informal markets. As with many surveys into the state of food insecurity or poverty in cities in the South, informality plays a significant role in household livelihoods. The definition of informality, however, is inconsistent and far from being objective. In order to include both formal and informal food sources in the Hungry Cities Food Purchase Matrix, it is important to agree on a definition and provide objective proxies for enumerators to use to identify food types within each category. Within Maputo, informality plays a significant role in the city's retail, housing, and food sectors (Raimundo 2016, Raimundo et al 2016). While no official definition of formality exists in the city, the enumerator team worked with the researchers to determine proxies which were used to distinguish informal from formal markets by giving exemplars of informal food sources.

Most food items seem to be paired with specific food sources. For example, over 70% of the sampled purchasing households obtain their vegetables, fruit, and fresh chicken and fish from formal and informal markets. Reworking the figures, the informal food economy (informal markets plus spazas and street vendors) is the main source of vegetables (70% of households) and fruit (66% of households). The major competition for informal food retailers appears to come not from supermarkets but from small formal shops, although the latter are not a major source of fresh produce. They do dominate sales of a variety of products, including rice, pasta, and frozen fish and chicken. Supermarkets are the prime source for none of the foods on the list in Table 2. Supermarket penetration thus appears to be relatively weak in Maputo, especially compared to other large Southern African cities (Battersby and Peyton 2016, Caesar and Crush 2016).

The finding of the relative unimportance of supermarkets in Maputo speaks to a broader debate about the so-called "supermarket revolution" in food systems in the Global South (Reardon et al 2003, Reardon and Hopkins 2006, Reardon, Timmer, and Minten 2012, Humphrey 2007). It also relates to the debate about the supermarketization of urban food systems in Africa (Crush and Frayne 2011). This process is clearly not taking place as rapidly in Africa as once thought and is not necessarily exercising the predicted destructive impact on the

TABLE 3: Household Food Purchases by Place of Purchase

Food items	Super-market (%)	Small shop (%)	Butchery/ bakery (%)	Takeaway/ restaurant (%)	Formal market (%)	Informal market (%)	Spazas (%)	Street vendors (%)
Rice	15.5	66.0	0.4	0.3	21.0	17.4	0.7	2.8
White bread	8.0	8.4	60.1	0.9	11.9	19.1	0.1	16.4
Sugar	19.5	69.7	0.2	0.4	25.9	21.0	0.5	5.5
Vegetables	4.4	7.5	0.2	0.5	47.2	53.0	0.1	16.2
Fish (frozen)	11.1	68.1	5.8	0.3	26.9	14.2	0.4	1.9
Pasta	24.0	68.2	0.1	0.7	24.2	16.7	0.4	2.4
Chicken (frozen)	24.7	61.3	8.1	1.1	24.2	16.2	0.4	2.2
Fruit	26.4	14.7	0.4	1.4	47.9	41.5	0.2	24.6
Chicken (fresh)	8.8	32.3	2.6	1.6	40.5	38.4	0.0	11.4
Fish (fresh)	8.1	40.6	3.8	1.9	36.8	35.5	0.8	11.0
Brown bread	34.5	22.8	46.2	3.4	24.1	14.5	0.0	9.0
(%)=Percent of sampled food item purchasers								

informal food economy or the small retail food economy. In Asia, similarly, the non-supermarket sector is also demonstrating considerable resilience (e.g. Si, Crush, Scott, and Zhong 2016, Goldman, Krider, and Ramaswami 1999). The application of the HCFPM in Nanjing, China, found that wet markets were the primary source of fresh produce and that supermarkets were only relied on for the purchase of processed foods (Si, Scott, and McCordic 2016).

The HCFPM also provides insights into the role that spatial location and convenient access play in the functioning of an urban food system. Table 4, for example, shows a consistent pattern of access for all of the selected foodstuffs in Maputo for which physical proximity is the overriding determinant. With the exception of the specialty item of brown bread, virtually all the sampled households procure the food items from outlets within walking distance from the home. The only other location where a proportion of the food is procured by the sampled households is shopping areas outside the CBD.

The HCFMP was administered in the HCP household survey in Maputo that was designed with the goal of giving a more comprehensive description of the interactions between households and the food system than that achieved by AFSUN (Raimundo et al 2016). This was true both in terms of the variety of the food items included, as well as

the design of the follow-up questions. With the exception of the purchase-frequency question, these were designed to be select-multiple questions (allowing for all applicable food sources and food source locations to be captured by the matrix). The follow-up questions were therefore not designed to cascade (and refer only to where the particular food item is normally purchased). Although this facilitates aggregated comparisons across the food items (demonstrating the diversity of sources for each food item), it does limit the specificity of the information captured in this matrix and the kinds of analyses that can be undertaken with the Maputo data. For example, it was difficult to get very fine-grained detail in the data regarding exact food items, purchased at an exact frequency, at an exact food source, and at an exact food source location.

Expanding the HCFPM

As this case study of Maputo demonstrates, the HCFPM has considerable potential for unlocking city-wide and statistically representative information about household food sourcing strategies and the interactions between households and the broader urban food system, particularly at the point of sale. The picture that emerges from Maputo is likely to be very different from that in South African cities, for example, where private sector supermarket

TABLE 4: Household Food Purchases by Location of Purchase

Food items	Within walking distance (%)	On road to and from work (%)	Central business district (%)	Other shopping areas (%)	Outside the city (%)	Other (%)
Rice	90.6	3.2	4.4	13.1	1.3	2.2
White bread	96.2	3.6	1.3	7.9	0.3	0.2
Sugar	91.4	6.2	4.0	17.2	1.3	1.2
Vegetables	93.2	2.3	2.1	12.2	1.4	1.3
Fish (frozen)	91.9	3.9	4.3	12.4	1.4	0.4
Pasta	89.2	6.9	5.1	18.0	2.1	0.8
Chicken (frozen)	86.5	6.5	5.9	17.4	3.5	1
Fruit	84.4	13.5	6.6	22.0	3.0	2.3
Chicken (fresh)	90.5	5.3	5.6	14.0	3.0	1.2
Fish (fresh)	84.4	7.5	5.4	17.7	5.9	2.4
Brown bread	73.8	18.6	9.7	25.5	4.1	2.8
(%)=Percent of sampled food item purchasers						

corporations dominate the food system. To date, the HCPFM has only been included by the Hungry Cities Partnership as one set of questions in a much larger survey of household demography, food security, and food consumption, which constrains the amount of information that can be collected.

The advantage of embedding the HCFPM in a larger household survey is that it opens the way for follow-up analysis and cross-tabulations of matrix results with other variables. Table 5, for example, compares the food item purchasing of food secure and food insecure households and households of different income levels. In general, food secure households have a more diverse diet than their food insecure counterparts. This is reflected in the itemized purchasing patterns where food secure households are significantly more likely to purchase vegetables, frozen fish and chicken, pasta, fruit and fresh chicken. Every food item (with the exception of sugar and fresh fish) is consumed by a greater proportion of food secure than food insecure households.

The relationship between household income and food purchasing is an even stronger one. In every food item category, the proportion of purchasers declines with income. In some cases (such as pasta, fresh and frozen chicken, and fruit), there are twice as many purchasers in the upper income tercile compared to the lower income tercile. The

marked difference in purchasing of frozen products is probably because those in the upper tercile have greater access to refrigeration. When it comes to the three core staples – rice, white bread and sugar – the differences by income are very much smaller. This analysis is purposefully impressionistic and statistically non-rigorous in order to make the general point that food purchasing patterns are clearly related to variables such as level of food security and income. A similar analysis could be performed with a wide variety of other variables including, for example, household type, household size, migrant status, health status, dietary diversity indices and so on. Further, food security status, income terciles and all of these other variables could also be cross-tabulated with the other components of the HCFPM, including frequency of purchase, type of outlet patronized and location.

An alternative strategy that would enhance the analytical value of the HCFPM would be to administer the matrix in a dedicated survey or to make it a major component of a household survey by reducing the number of questions asked on other issues. For example, it would easily be possible to add various other columns to the matrix and collect additional information on products and purchasing behaviour. The matrix as configured for the Maputo survey provides no information on food prices (a critical issue in Maputo where food price rises have precipitated widespread protests in

TABLE 5: Household Food Purchases, Household Food Insecurity and Income

Food items	HFIAP		Income terciles		
	Food secure (%)	Food insecure (%)	Upper (%)	Middle (%)	Lower (%)
Rice	92.5	86.4	90.9	88.3	81.5
White bread	89.0	82.4	83.8	77.5	72.3
Sugar	62.6	66.0	61.9	67.7	59.6
Vegetables	70.3	60.5	65.9	64.3	51.9
Fish (frozen)	68.9	52.1	66.6	61.8	39.8
Pasta	58.1	38.8	53.4	41.2	26.1
Chicken (frozen)	58.4	37.6	51.6	43.1	26.4
Fruit	40.1	21.9	32.8	24.6	17.2
Chicken (fresh)	27.2	18.1	31.3	21.5	10.2
Fish (fresh)	17.0	18.5	21.9	15.1	15.6
Brown bread	12.7	4.8	12.5	2.2	3.2
(%)=Percent of sampled households within each category that purchased food item					

the past), or the quantities purchased (both overall during the previous month and the unit sizes). The HCFPM could also collect information on food branding by assessing consumer preferences for particular brands.

Another modification to the HCFPM would be to refine the over-generalized spatial logic which currently underlies the question about place of purchase. This could be done in two ways: first, it would be possible to have respondents select from a list of actual retail outlets by name. All markets in Maputo, for example, have well-known names that could be incorporated as options into the HCFPM. In cities with a large supermarket presence, a list of supermarkets could be included. Given the growing use of tablet technology with digital surveys, it may also be feasible in future to provide a digital map for respondents to select the actual location of the outlet. This approach would then record an approximate GPS coordinate to pair with each purchase source.

While the HCFPM in its current form provides important insights into purchasing behaviour and household interaction with the food system, explanations for self-reported behaviours are still largely inferential. Additional questions with select-one or select-multiple options could be added to ascertain why consumers choose to purchase particular food-stuffs from particular outlets in particular locations, as well as to illuminate the reasons for frequency of purchase and the cost and other constraints on purchasing outside the neighbourhood.

Conclusion

The Hungry Cities Food Purchases Matrix provides an innovative tool to answer some of the challenges identified in the food systems literature. Its application in Maputo clearly demonstrates that the instrument can capture detailed characteristics of household food purchasing behaviour and how this relates to the character and geography of the food system. In the case of the HCP household survey of Maputo, the matrix identified potential

pairings between food items and sources as well as providing insights into the potential drivers behind the preference for certain food sources based on the food items being purchased. The instrument not only provides insights into food system access at a fine scale (at the household level) but can be paired with food security measures as well. The HCFPM also provides research guidance for understanding upstream aspects of the urban food system. It can be used to generate hypotheses about the nature of the food system which could be tested through research with formal and informal food vendors and retail outlets. This, in turn, is a precursor to other forms and levels of analysis such as the sourcing and locational strategies of retailers or tracking particular products from point of sale along local, national and international supply chains.

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