DESERTS IN NEW ORLEANS?

ILLUSTRATIONS OF URBAN FOOD ACCESS AND IMPLICATIONS FOR POLICY

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Abstract

Food access among low-income populations has long been a concern in the United States. Recent research on the geographic dimensions of access has focused on economically deprived areas with little retail food activity, referred to as 'food deserts.' We illustrate concepts of urban food access in this descriptive case study from post-Katrina New Orleans. We augment conventional definitions of food deserts by considering a variety of retail food outlets from a complete mapping of the city and by incorporating data on in-store contents on availability and shelf space of fruits and vegetables from a stratified sample of outlets. We show that the existence of food deserts depends on the definitions employed; commonly-used constructs in the food desert literature result in prevalence rates for New Orleans of anywhere from 17% to 87% of the city's 175 census tracts. Ambiguities inherent in the construct do not diminish the fact that long travel distances to procure food do increase at-home food costs and that contextual effects on individual health and community development are often associated with areas of impoverished food resources. Describing poor geographic access can improve assessments of household resource inadequacy; we illustrate how transport costs can be used to inform federal food assistance policy. We also show how identifying areas of need can be used at the local level to prioritize retail food projects. Given the current problems of over-nutrition, the paper concludes by suggesting a more useful geographic metaphor would be “food swamps,” areas in which large relative amounts of energy-dense snack foods, inundate healthy food options.

Introduction

Access to adequate food has long been a concern to advocates, policymakers, and the general public in the United States. In modern times, documentary footage of hunger in America, combined with several reports by physicians groups in the late 1960s placed the issue in the national consciousness (Eisinger, 1996, McGovern, 2001). In the early 1970s, national nutrition surveys, including the Ten State Nutrition Survey, and the first National Health and Nutrition Examination Survey confirmed this anecdotal evidence that poor diet and nutritional outcomes were associated with poverty (USDHEW and CDC, 1971, USDHEW and NCHS, 1974). The tremendous growth of food assistance programs at this time was in part a response to these developments and other subsequent studies that documented that the diets of some Americans were not adequate.

The interest in food access among low-income populations has been well documented in opinion polls, congressional hearings, and presidential reports that Americans object to hunger in a land of plenty on grounds of fairness (Breglio, 1992; U.S. House of Representatives, 1992; White House Conference on Food, Nutrition, and Health, 1969; President's Task Force on Food Assistance, 1984). But the interest in how well a nation's citizenry eats should be motivated by more than just humanitarian concerns. Previous research has documented that poor nutrition affects resistance to disease (Dallman, 1987), behavior and intellectual development of young children (Walter, et al., 1989), child mortality (Pelletier, 1995), and the productivity of adults (Thomas and Strauss, 1997, Viteri, 1974). Thus, there are long-term economic consequences of a nation that is sub-optimally nourished.

Historically, inadequate access was viewed as a problem related to inadequate household resources. The nation's vast network of food assistance programs in one way or another has targeted that problem. The Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program) expands the food purchasing ability of households through electronic credits redeemable for food at most supermarkets and groceries (Oliveira, 2007). The Supplemental Nutrition Program for Women, Infants, and Children (WIC) grants vouchers to buy specific nutritious foods at authorized grocery stores. The National School Lunch and Breakfast Programs subsidize prepared meals for children. These and other programs all contribute to the overall resources of the household, influencing consumption through income as well as substitution effects.

Household demand is a function of both prices and income. Although all food assistance has focused on expanding household incomes, clearly prices matter. Simply put, where prices are high, dollar-based food assistance, such as SNAP credits, are worth less. The importance of food prices has not gone unnoticed. Since the 1960s, economists and other social scientists have asked the question, "Do the poor pay more?" resulting in a remarkable number of articles with a similar title (Chung and Myers, 1999, Goodman, 1968, Kaufman, 1997, MacDonald and Nelson, 1991). These studies have investigated both purchasing patterns and shopping behavior of the poor as well as the prices of fixed bundles of goods by type and location of stores. This work planted the seeds for considering geographic dimensions of food access, since studies began to compare prices of foods at supermarkets in city centers with those in suburban areas.

By the 1990s, researchers, community activists, and policymakers expanded their focus beyond the household to include community and neighborhood environments in the discussion of food access. Despite extensive overall food availability in the United States, there was documentation from the literature mentioned above of unevenness in the location of supermarkets and the prices they charged. A number of studies documented disparities in the access to supermarkets by economic or racial-ethnic groups (Alwitt and Donley, 1997, Morland, et al., 2002). The first wave of studies associating dietary outcomes to proximity to supermarkets also began to appear (Laraia, et al., 2004, Morland, et al., 2002, Rose and Richards, 2004). In academia, this new perspective on geographic access came about because of cross-fertilization between several disciplines, including public health, geography, community nutrition, and consumer and marketing economics, as well as because of the expanded capabilities of geographic information system technology.

In the late 1990s, policy advocates and researchers in the United Kingdom first began to use the term 'food deserts' to refer to disadvantaged urban areas with poor access to retail food outlets (Beaumont, et al., 1995, Cummins and Macintyre, 1999, Wrigley, 2002). Blanchard (2003) is likely the first to the use the term in North America, referring to rural areas of Mississippi that were outside of supermarket service areas. Since then a number of authors have analyzed the issue with reference to various cities in North America, including Detroit, Chicago, Montreal, London (in Ontario, Canada), and others (Apparicio, et al., 2007, Gallagher, 2006, Gallagher, 2007, Larsen and Gilliland, 2008).

This paper has three main objectives. First, we seek to expand the basis for food desert definitions by supplementing information on supermarkets with data on a variety of stores that sell food (e.g. small, convenience, and drug stores) and by incorporating the neighborhood availability of specific kinds of healthy foods (e.g. fruits and vegetables) that are often found lacking in low-income areas. Our second objective is to illustrate how the existence of food deserts is to a large degree based on the specific definitions used. We show this with data from our empirical work in New Orleans from the fall of 2007. Third, we show how information on access to food can be useful for federal food assistance policy as well as for local planning initiatives.

We begin with a general description of how food deserts have been identified in previous literature. Following that we describe in detail our data collection efforts, including our mapping of retail outlets that sell food and our in-store survey. We then present descriptions of eight neighborhoods in New Orleans, followed by illustrations of how these neighborhoods would be classified under alternative definitions of food deserts. We follow this with a section on inherent ambiguities in the food desert construct and how the need to operationalize this term can result in widely different estimates of the magnitude of the problem. We argue that policymaking may benefit by understanding geographic access, when the federal government wishes to buffer the effects of high transportation costs on its current food assistance investments to needy individuals or when local governments wish to enhance the food supply in underserved areas. After sections that discuss both of these approaches, we conclude with a discussion of "food swamps," a metaphor more useful for current nutrition problems.

A general method for identifying food deserts

Food deserts are commonly defined as deprived areas with poor access to retail food outlets. To operationalize this definition and designate specific geographic areas as deserts, researchers typically consider four interrelated aspects.

First the "food environment" needs to be characterized. Typically this means obtaining a list of supermarkets and geo-coding them. Some studies have gone beyond retail food outlets for at-home use, identifying restaurants, limited service outlets (e.g. fast food places), and other places that provide food consumed away-from-home.

Measures of access are then created by linking individuals (or population groups) to this food environment. Distance measures (e.g. distance to the nearest supermarket) are the most common, but density measures (e.g. number of food stores within a defined radius) are also used. The census tract is a typical unit of aggregation used in this work, though more disaggregated areas, such as the block group, have also been used (Sparks, et al., 2009).

Poor geographic access to stores among high-income populations has not been a concern for public policy, because well-off suburban households, for example, can afford transportation to the store. Thus classifying food deserts also involves designating some areas as disadvantaged. In the United Kingdom, this has involved various types of deprivation indices (Clarke, et al., 2002). In the U.S., researchers have typically used census data on poverty rates to designate an area as disadvantaged.

Finally, geographic thresholds are needed to categorize an area as having *low* food access. In urban areas, 1 kilometer has been used in recent studies to assess food store accessibility by walking, though older studies have used 500 meters (Larsen and Gilliland, 2008).

Mapping retail outlets and their contents in New Orleans

As with previous research our first step in categorizing areas as food deserts was to characterize the neighborhood food environment in New Orleans. We combined a complete mapping of the city's retail food outlets with an in-store survey on a sample of these stores. Each of these two components is described below, followed by our methods for combining the information from both sources.

We first developed a map of all food outlets in the city as of the fall of 2007. We started with a listing of retail food outlets obtained from InfoUSA, a commercial market information firm. The listing included all outlets with primary or secondary North American Industry Classification System (NAICS) codes indicating sales of food. This included supermarkets, grocery stores, and convenience stores, as well as gasoline stations, pharmacies, and general merchandise stores that sold food. Since our focus in this work was based on food for use at home, we did not obtain listings for restaurants, cafeterias, or other limited service establishments, such as fast food outlets. All food stores were mapped using data provided by InfoUSA and ArcGIS 9.2.

Since commercial data are often not acurate, we sent two-person teams out to verify these data. Driving up and down every street of every census tract, an additional 94 stores were identified by our teams, bringing the total number of outlets to 353. Most of the additional stores not listed in InfoUSA and enumerated by our teams were small or mid-sized food stores (27%), or convenience stores (66%), either stand-alone or as part of a gas station. About 19% of stores listed in the InfoUSA database were no longer in business, or were not, in fact, retail food outlets.

For our in-store survey, we randomly chose stores by store type and by Katrina flood zone (i.e. still flooded as of September 11, 2005, two weeks after Katrina hit the city). We initially drew a 30% sample from the InfoUSA list and followed that with an additional 30% random draw from the "new" stores identified on the ground. Eighty-five percent of store owners consented to our survey; our final sample consisted of 90 stores.

Enumerators collected basic descriptive information on the store, including the type of store (pharmacy, gas station, etc.), the number of registers, and the number of aisles. Availability of a predefined set of 14 fruits and vegetables and 5 categories of energy-dense snack foods (salty snacks, cookies and crackers, doughnuts and pastries, candies, and carbonated beverages) was identified. Enumerators also measured shelf space devoted to various categories of foods, including fresh, canned, and frozen fruits and vegetables, and the 5 categories of energy-dense snacks. Measurement was made using a rolling tape device (Rolatape, Model 112, Spokane, WA). Our teams have demonstrated good reliability with this approach, achieving an inter-rater reliability of 0.95 for shelf length of fruits and vegetables (Cohen, et al., 2007).

In order to better characterize the food environment in neighborhoods throughout the city, we combined our in-store data with our map of retail outlets. We used a hot deck imputation approach to assign our in-store data to unobserved stores based on store type. For example, a supermarket that we did not observe in our in-store study was randomly assigned all the in-store data (availability of different products, shelf-length of different food groups, etc.) of a supermarket that we did observe. This probabilistic approach preserves both the means and distributions of our in-store data. We initially considered imputations based on store type and flood zone, but found no difference in store contents by flood zone. Store type is a relatively good proxy for store contents; we have previously demonstrated that there are much larger variations in shelf space between store types, than within stores of the same type. For example, in previous work we have shown that 86% of the total variance in shelf length of fresh vegetables was accounted for by store type (Farley, et al.)

In order to better understand the characteristics of each neighborhood, we merged data from the 2000 Census at the census tract level. This included data on the proportion of households with incomes below the poverty threshold and the proportion of households that did not own cars (i.e. "no-car rate"). We also merged on 2007 population estimates from the Environmental Systems Research Institute. This included the number of households by different ethnic groups in each tract.

Illustrative New Orleans neighborhoods

To illustrate our characterizations of food access in New Orleans we identified eight census tracts from different neighborhoods that represent aspects of the diversity of the city and the food access landscape.[1] Table 1 presents the demographic characteristics of these tracts, and they are shaded black on the map in Figure 1.

One tract was chosen from the *French Quarter*, the oldest neighborhood in the city. Although outsiders will recognize this area as the home of Bourbon Street and associated revelry, there is a sizable residential population that lives in the Quarter. It is mostly white and economically well-off, with a relatively high rate of households that do not own cars, 44%. The *Lower Ninth Ward*, originally a cypress swamp, has always been prone to flooding. The Industrial Canal, built in the 1920s to link the Mississippi River to Lake Ponchartrain, separated the Lower Nine from the rest of the city, and it was the failure of this canal wall that caused the devastating flooding in this part of the city. This part of the city is largely African-American with poverty and no car ownership rates above 30%, but home ownership above 60%.

Tremé is the neighborhood where free people of color first congregated. It is the oldest African-American neighborhood in the country, home to "Congo Square," the birthplace of jazz. It is mostly African-Amercan with high poverty and no-car rates. It borders on the French Quarter. *Uptown* is a relatively well-off neighborhood, mostly white with low poverty and low no-car rates. Audubon Park, Tulane and Loyola Universities are uptown, though not in this census tract. *Pontchartrain Park* is a middle-class African-American neighborhood, sparsely populated with a suburban feel. Originally swampland, it was developed in the 1950s. There are low poverty and no-car rates.

Central City is densely populated, largely African-American with the highest poverty and no-car rates of the tracts we selected. *English Turn* is an exclusive neighborhood on the West Bank of the Mississippi, quite a distance from the rest of the city. It is home to bank presidents and basketball stars. *Village de L'est* is in New Orleans East and home to the largest percentage of Vietnamese-Americans in the city. It is distant from the city center, with relatively high poverty and no-car rates.

Food deserts based on access to supermarkets

We begin our illustration of food deserts in New Orleans, with the simplest and most frequently used measure of food access. This is a measure based on distance, specifically, the distance to the nearest supermarket. We used "network distance," that is, the minimum distance to get from point A to point B using the network of streets in the city, rather than pure straight-line distances. Since we did a tract-level analysis, our origin in each case is the center point, or centroid, of each tract. We explored two cut-off points for distance, 1 kilometer and 2 kilometers. These distances, of course, are arbitrary. Older studies on food deserts in the United

[1] Note that for purposes of illustration, we have selected individual tracts within neighborhoods; specific demographic characteristics of the entire neighborhood will vary from those displayed in Table 1. Neither the neighborhoods, nor the tracts within them, are statistically representative of the city.

Kingdom considered 500 meters as a distance that would represent accessibility by walking, whereas newer studies in Canada have used 1 kilometer (0.62 miles) (Larsen and Gilliland, 2008). American cities tend to be even more spread out, so we also used the 2 kilometer (1.24 miles) threshold.

Table 2 presents the results of various definitions of food deserts based on distance to the nearest supermarket and poverty and no-car rate thresholds. Most tracts in the city (87%) did not have a supermarket within 1 kilometer of the centroid, but some of these tracts, such as those in the French Quarter, Pontchartrain Park, or English Turn were not economically deprived areas and would not be considered food deserts. The prevalence of food deserts, of course, declines when a 2 km distance is used, or when both poverty and no-car rates are considered jointly. The selected tract in Central City, for example, would not be considered a food desert because there was a supermarket within 2 km of the center. The Lower Ninth Ward, Treme, and Village de L'est would still be considered food deserts, even with the strictest criteria presented here.

Figure 2 outlines in red stripes tracts that had low access to a supermarket, i.e. those in which the tract centers, or "centroids," were greater than 2 km from the nearest supermarket. All of the example tracts, except those in Uptown and in Central City fell into this category. Without a poverty criterion as part of the definition, over 60% of the tracts would be considered "food deserts". In Figure 3, food deserts (tracts with red stripes) were defined as those in which the tract centroid was greater than 2 km from the nearest supermarket and the poverty rate was greater than 20%. Of the example tracts, only the Lower Ninth Ward, Treme, and Village de L'est would be considered food deserts. Using this definition, other tracts without supermarket access (e.g. English Turn, French Quarter, Pontchartrain Park) were too well off to be considered food deserts. Adding the poverty criterion drops the overall citywide "food desert" rate from 62% down to 46% of tracts.

Food deserts based on availability of foods

One consistent argument in the food access literature is that many neighborhoods lack access to healthy foods, such as fresh fruits and vegetables. Previous literature has demonstrated that small stores, which are common in low-income neighborhoods, carry less of these foods and tend to charge more for them (Chung and Myers, 1999, Goodman, 1968). However, recent research suggests that small stores could play a role in provisioning urban residents with fruits and vegetables (Bodor, et al., 2008) and a number of interventions have begun to address the issue of improvements to such stores. A number of census tracts, which would be classified as food deserts using the distance-to-supermarket criterion, did have a substantial amount of retail activity from small food stores. Figure 4 displays the same food desert areas from Figure 3 except that yellow circles have been overlaid on it to indicate the presence of small food stores.

To assess the potential role of these stores, we calculated two different cumulative availability measures. For both measures we made use of our in-store data and summed the total amount of foods available within defined distances of the tract centroid. First we considered aggregate groups of fruits and vegetables that make up the Thrifty Food Plan (TFP), USDA's basket of foods that allows for eating a healthy diet on a low-cost (SNAP) budget (USDA-CNPP, 2007). There are six groups: whole fruits, fruit juices, potatoes, dark-green vegetables (e.g.

spinach), orange vegetables (e.g. carrots), and other vegetables. We assessed how many of these 6 groups it was possible to obtain from all food stores within 1 or 2 kilometers of the center of each tract. (We did not include one of the TFP vegetable groups – i.e. the legume group composed of canned and dry beans, lentils, and peas – in part because this is not a "problem food" for our population and in part because our store instruments did not collect specific data on this.)

In our second measure we assessed the cumulative availability of fresh fruits and vegetables by summing all shelf space devoted to these foods in area stores within the 1 and 2 kilometer thresholds. The early marketing literature has demonstrated that increased shelf space leads to increased purchases (Curhan, 1974, Curhan, 1972, Wilkinson, et al., 1982). Here we viewed shelf space availability in a defined area for an aggregate group, such as fresh vegetables, as an overall proxy for the quality, intra-group variety, and cost of this food. This sort of variable allowed us to aggregate across store type, i.e. the fresh vegetable contributions from small and medium groceries as well as supermarkets and other stores can be added up. There is no literature on "normative" amounts of shelf space, i.e. what is a minimum desirable amount. So we arbitrarily chose a threshold, in this case, equivalent to half the shelf space of a median supermarket. This allowed us to observe areas that might be distant from neighborhood supermarkets, but would have sufficient retail food activity to be the equivalent of half of a supermarket.

Table 3 displays descriptive data from our in-store survey. All of the supermarkets offered all 6 types of fruits and vegetables in the Thrifty Food Plan. Shelf space devoted to fresh fruits and vegetables was markedly more abundant in the supermarkets. But small and mid-sized stores did have some space devoted to fresh fruits and vegetables. Twelve percent of small stores carried items from all six of the TFP fruits and vegetable groups.

The two definitions of food deserts based on cumulative measures are presented in Table 4. Citywide, in 21% of tracts, poverty rates were above 20% and residents would not have been able to find all 6 types of fruits and vegetables in the Thrifty Food Plan within two kilometers of the tract center. However, in Treme and Village de L'est, there were enough adequately stocked small stores to meet this criterion. The Lower Ninth Ward would still be considered a food desert. Using the shelf space criterion (1/2 the amount for fruits and vegetables in a median supermarket) and the 20% poverty rate, we found that 17% of census tracts in the city would be considered food deserts. There is no change in classification of any of our selected tracts from the food desert definition that used the TFP bundle of 6 fruits and vegetables.

In Figure 5, food deserts (tracts with red stripes) were defined as those in which one would not have found items from all 6 Thrifty Food Plan fruit and vegetable groups in any type of market within 2 km from the tract centroid and the poverty rate was greater than 20%. Of the example tracts, only the Lower Ninth Ward would be considered a food desert. Using this definition, other tracts without supermarket access (e.g. Village de L'est, Treme) were not considered food deserts, because small food stores supplied needed commodities. Using this sort of food access criterion dropped the food desert rate from 46% to 21% of tracts. Note that areas with lots of yellow circles (small stores) were no longer considered deserts. Some areas with a

few small stores were still considered food deserts. In general, small food stores were not well stocked with healthy foods – only 12% sold items from all 6 TFP groups.

Are there food deserts in New Orleans and why should we care?

Much of the food desert literature has focused on answering the question of whether, in fact, food deserts exist. But the very nature of the conceptual definition of food desert ensures that some investigators will be able to find deserts, where others do not. A perusal of typical definitions reveals that there is much ambiguity to the concept. For example, here are four definitions of this concept. The first two are early ones from the United Kingdom and the last two are recent definitions from North America:

(1) "areas with poor food facilities" (Caraher, et al., 1998);
(2) "populated areas with little or no food retail provision" (Cummins and Macintyre, 1999);
(3) "socially deprived areas within cities that have poor access to food retailers" (Apparicio, et al., 2007); and
(4) "an area in the United States with limited access to affordable and nutritious food, particularly such an area composed of predominantly lower-income neighborhoods and communities" (U.S. Farm Bill, 2008).

As with all social constructs, these conceptual definitions need to be operationalized. What specifically is meant by "poor food facilities" or "limited access"? Does "food retail provision" include service-based facilities (i.e. restaurants) for away-from-home eating? How would one define "affordable" or "nutritious food"? Depending on the answers to these questions, one can get very different results on whether a food desert exists in a given locale.

Our exploration of this issue in New Orleans showed that, depending on the definition used, there was a tremendous range in the percentage of tracts classified as food deserts. Rates changed substantially if the definition was based on "socially deprived areas," (e.g. poverty rate above a certain threshold) or simply on "areas" (no poverty criterion). For example, defining socially deprived areas as tracts with a poverty rate greater than 20% (and an access threshold of 1 km distance to the nearest supermarket), 61% of tracts were classified as deserts, as opposed to 87% when no poverty criterion was used. If "limited access" means the distance to the nearest supermarket is greater than 2 km, the food desert rate was found to be 46%, instead of the 61% rate with a 1 km threshold. If "food retail provision" refers to finding significant quantities of fresh foods sold in a neighborhood, the food desert rate was 17%, whereas if it means finding a supermarket within 2km, the rate was 46%. Of the eight tracts we chose for purposes of illustration and reviewing all the different definitions of food deserts, only one tract (in Uptown) was never classified as a food desert and only one tract (in the Lower Ninth Ward) was always classified as a food desert. Citywide, our food desert rates ranged from 17% to 87% depending on the operational definition. In sum, there *are* food deserts in New Orleans, but the extent of the problem is clearly open to debate.

Researchers can easily differ on the specific definitions to be used for food deserts, either because of the data to which they have access, the specific cultural and geographic context of their study population, or simply because of their background, experience, and disciplinary

training. And more extensive data availability will not change this. Bitler and Haider (2009) rightly point out that to identify food deserts using a concept such as 'limited access to affordable and nutritious food' requires a substantial amount of data. But no matter how much data are brought to a situation, there will always be disagreement on specific cut-points delineating when access is "limited" or what bundle of items is sufficient to constitute "nutritious food."

If conceptual aspects are ambiguous, data requirements are so extensive, and operational definitions are subject to disagreement, is it pointless, then, to look for food deserts? We would argue to the contrary. It *is* useful to consider the issue of geographic access to healthy food and identifying *areas of poor access* can be useful for informing policy directed at improving nutrition, food security, and community development. Poor geographic access to food is a concern for policymakers because it increases the cost of at-home food for low-income households. If food assistance programs, such as Food Stamps, are important because they raise the purchasing power of the poor, the effectiveness of such programs would be reduced in areas where the cost of food access is high. Beyond a concern with individuals, there are contextual problems for neighborhoods with poor access to food. A growing body of literature has highlighted the relationship between geographic context and health and dietary outcomes. Development of depressed neighborhoods is also desirable for political reasons, or for concerns with social justice. Although the "food desert" indicator is not perfectly matched to these social concerns, the term may be useful for eliciting change. Grocery stores are often viewed as an integral part of neighborhoods (Moudon, et al., 2006) and may also lead to other retail development.

In the following two sections we explore policy initiatives that can be used to address the problems of low food access. At the national level, we explore the potential for adapting federal food assistance, in particular the SNAP program, to deal with the increased cost of access faced by some individuals or households. At the local level, we explore initiatives to increase food retail in underserved areas through incentive programs.

Policy intervention at the national level: adjusting for the cost of poor food access

Research on food deserts can be seen as a part of the long tradition of evaluating constraints of low-income households and the effects of these constraints on access to food. One important objective of this research is to improve the ability of current food assistance programs to address problems of access. Living in a food desert raises the cost of access to food, either because of higher prices in corner stores, or because of transportation costs to get to supermarkets. In this section, we explore an idea for adapting federal food assistance, in particular the Supplemental Nutrition Assistance Program (SNAP), to deal with the increased cost of access faced by some households.[2]

[2] Focus on this particular aspect of SNAP is not meant to suggest that other federal efforts are not needed, or not already occurring. Changes to the food package in USDA's Supplemental Nutrition Program for Women, Infants, and Children (WIC) call for increases in whole grains, fruits and vegetables. Authorized vendors will need to carry these products, and they can be assured that participants will buy them because of the WIC vouchers. This may have a profound effect on changing the profile of foods sold at small stores. Making available vouchers for purchase of fresh fruits and vegetables at farmer's markets (through WIC and Seniors' programs), increases the success of such markets and the likely availability of such products to neighborhood residents.

In principle, SNAP benefits are designed to ensure that households can afford a healthy diet. Maximum allotments are updated monthly based on the costs of the Thrifty Food Plan (TFP), a food basket that meets current dietary recommendations (USDA-CNPP, 2007). However, the TFP is based on national averages and no consideration is given to acquisition costs, i.e. the cost of traveling to the store. Knowing, at a disaggregated level, the overall cost to acquire a healthy diet, including both purchase price and store travel costs, would allow one to integrate concerns about 'desertified' areas with the traditional concerns for household resource constraints embodied in SNAP's benefit structure.

It is currently infeasible to consider a complete analysis involving disaggregated prices,[3] but a far simpler approach that may hold merit is to simply estimate the travel costs to the nearest supermarket. Supermarkets do have the greatest availability of foods, and usually have the lowest prices. In our own data, we saw that 100% of supermarkets carried all 6 types of Thrifty Food Plan foods, whereas only a minority of small food stores (12%) carried these foods. Substantial previous literature has demonstrated that supermarket prices are lower than prices at other stores (Chung and Myers, 1999, Kaufman, 1997), and have far better availability. Prior literature on the Food Stamp Program also indicates that the overwhelming majority of participants, upwards of 90%, shop at supermarkets (Rose and Richards, 2004).

The information obtained from such an analysis could be used to target residents of low-access areas with a supplement to increase their SNAP benefits (formerly known as Food Stamps). Similar to shelter deductions or deductions for child care, a certain percentage of transportation costs to access stores for residents of 'food deserts' could be deducted from net income, thus allowing for greater SNAP benefits, and overall spending on food.

We conducted a preliminary exploration of this approach using nationally representative data on shopping behaviors from the National Food Stamp Program Survey (NFSPS)(Cohen, et al., 1999), our own data from New Orleans, and similar methods used previously for a Food Stamp population (Feather, 2003). We calculated costs to the nearest supermarket by mode of transport, TC_m, as a sum of out-of-pocket expense and the value of time in transit:

$$TC_m = (C_m)*D + (T_m)*D*w,$$

where C_m is the cost per kilometer traveled, T_m is the time per kilometer traveled, D is the network distance from the tract centroid to the nearest supermarket, and w is the minimum wage.

The results of this exercise are presented in Table 6. In New Orleans, 26% of individuals who did not own cars walked to the store where they last shopped, whereas 42% got a ride with a relative or friend. Not surprisingly, 89% of car-owners drove their car to the store. Even among those that reported that nobody in the household owned a car, 19% of individuals claimed they

[3] Price data are notoriously difficult to obtain, especially at localized levels. Moreover, such an analysis would involve a complex optimization exercise, i.e. for each census tract, what is the lowest cost for acquiring a Thrifty Food Plan bundle of foods, subject to the prices of foods in areas stores, the distance to these stores, and transportation costs. Even if one could outline a basket of specific food items to provide a healthy diet (the TFP foods are only general in nature), and find prices for them at area stores, the complexity of the retail food environment implies that such an optimization exercise would not be trivial.

used a personal or family car to get to the store, an anomaly also seen in national data.[4] Costs and time inputs per kilometer traveled were calculated by mode of transportation from NFSPS data on urban households. We used these data to calculate the monthly cost of round-trip travel to the nearest supermarket, assuming residents shopped 3 times per month and traveled back and forth from their residence each time.[5] Not surprisingly, taxis and buses were the most expensive ways to get to stores, while driving a car was the cheapest.

We calculated weighted average costs for car owners and non-owners using behavioral data from our own research on the proportion of individuals using different modes of transportation conditional on household ownership of a car. We also calculated an overall weighted travel cost based on these mean costs and the proportion of car owners per tract. Overall average costs for those not owning a car were 2.7 times greater than for car owners. We also calculated the average cost differences between those living in census tracts with poor access (> 2 kilometers) and good access (< 2 kilometers) to supermarkets. For bus riders the difference was about $34 per month. At an aggregate level, the overall mean difference in costs between tracts with poor access and those with good access was about $11 per month.

This exploratory exercise was undertaken to illustrate how the problem of poor geographic access to food, embodied in the 'food deserts' issue, could be addressed by current policy.[6] SNAP benefits are based on a household's size and its net income, which is calculated from gross income, with deductions for various items including shelter costs, utilities, and child care expenses. Transportation costs for those with poor geographic access could become such a deduction. Our exercise, though preliminary and focused exclusively on New Orleans, indicates that the additional cost represented by poor access is relatively minor, somewhere on the order of deductions for a phone bill embodied in SNAP's Standard Utility Allowance (USDA-FNS, 2008). Nonetheless, national data could be used to identify tracts with difficult access to supermarkets, and states, as they do for other shelter deductions, could calculate average transportation costs, given, for example, bus prices and transit speeds. Such deductions could be applied for those that do not own cars in poor access tracts.[7]

[4] As a check, we analyzed similar data from a nationally representative sample of Food Stamp participants using the 1996-97 NFSPS, and found a reasonable, though not perfect correspondence. For urban non-car owners, the distribution was 33, 10, 42, 7, and 5 percent for walking, driving, getting a ride, bus, and taxi, respectively. For car-owners it was 5, 76, 18, 0, and 0 percent for the same respective modes of transportation. Some differences may have been due to the specific wording of survey questions.

[5] NFSPS respondents living in urban areas reported an average of 3.0 food shopping trips per month. This did not include "trips to pick up just a few items." For sake of convenience, we are assuming that all shopping trips originate from home and that the tract centroid is a reasonable geographic proxy for an individual's residence.

[6] There are, of course, many caveats to this calculation ranging from the quality and timeliness of the data (problems with the wording of questions, sample cell sizes are small, NFSPS is old, out-of-pocket travel costs are often fixed, not variable) to the potentially biased nature of the intermediate estimates used (decisions about transport mode and number of shopping trips are made jointly based on distance to store, travel costs, value of time, etcetera).

[7] An alternative would be to give an outright supplement for those with the highest travel costs. Currently about a third of participants – the poorest – receive the maximum allotment, so additional deductions would not help this vulnerable group.

Policy intervention at the local level: incentives for increasing fresh food retail

The interest in food deserts extends beyond just a concern for individuals who have increased transportation costs associated with shopping. Food deserts are a reflection of contextual problems. A number of articles have demonstrated an association between accessibility of retail food and consumption or health outcomes (Chen, et al., 2009, Jago, et al., 2007, Laraia, et al., 2004, Lopez, 2007, Moore, et al., 2008, Morland, et al., 2006, Morland, et al., 2002, Powell, et al., 2007, Rose and Richards, 2004). Some of the impact of environment on behavior may be related to promotional effects. The early marketing literature on shelf space experiments certainly indicates that supply can drive demand, independent of price (Curhan, 1974, Curhan, 1972, Wilkinson, et al., 1982). Areas of poor access to retail food often have poor access to health care and other basic services. Although it can be argued that general development strategies, such as tax incentives for businesses to locate in these areas, are more appropriate (Bitler and Haider, 2009), incentives to promote retail food outlets, in particular, often garner political support, since most urban communities see such business as desirable.

In 2007, the New Orleans City Council authorized a Food Policy Advisory Committee to draft a report on the food access situation in New Orleans, with recommendations for improvement. The report of this Committee was released in early 2008 and called for strategies to increase fresh food retail activities in underserved areas (New Orleans FPAC, 2008). Currently winding their way through the policy process are three such programs: a fresh food retail incentives program, a community markets initiative, and an urban food gardens initiative. The first, further along in the process, seeks to provide low-interest or forgivable loans for those intending to open or restore a supermarket or other grocery retail outlet in an underserved area, or to current outlets with limited or no produce that intend to substantially improve the stocking of fresh fruits and vegetables.

Supermarkets might not locate in poor areas because of a real or perceived lack of sufficient demand. Supermarkets operate at low margins, and owners tend to be risk averse. Low-interest or forgivable loans, such as those in the initiative described above, might cause reassessment of specific situations, causing store-owners to invest in an underserved area. This, of course, is counter-productive in areas that cannot support a supermarket. Part of the risk in post-Katrina New Orleans concerns how much of the pre-storm population of a given area will return. A city-led reduction in the barriers to "reentry" of grocery stores could actually help precipitate such a return, since former residents might view their neighborhoods as being viable once again. The population of Orleans parish continues to increase, with the most recent estimates indicating it is at 74% of its pre-Katrina size (GNOCDC, 2009).

All neighborhoods cannot support a supermarket, nor are supermarkets the only way to assure access to healthy food. Low density areas of New Orleans, as well as other cities, do support smaller functioning markets. As was seen with the tracts in Treme and Village de L'est, small stores can provide fruits and vegetables, sufficient enough in variety to meet Thrifty Food Plan guidelines and in quantity to be roughly comparable with small supermarkets. The city's fresh food financing initiative also has these types of stores in mind. Retrofitting such markets with extra refrigerators to carry fruits and vegetables could be a more efficient or lasting way to

minimize access costs for area residents. Farmer's or community markets as well as urban gardens may also provide similar benefits.

Grants and loans administered under the New Orleans initiatives will be competitively awarded based on various criteria, including viability of the proposed project, the degree of community need, and expected social and economic impacts. Analytical work on food deserts could assist in the selection of projects to be funded. We suggest that a two-tiered classification system could be used to target underserved areas and could circumvent concerns regarding the arbitrary nature of using just one threshold indicator. The first classification would indicate broad areas of need and be used to establish eligibility. We suggest that eligibility be based on businesses seeking to operate in low-income tracts that are a defined distance from the nearest supermarket (for example, tracts with poverty rates greater than 20 percent and more than 1 km from a supermarket). The second classification could prioritize specific low-income tracts that are particularly distant from retail food establishments (for example, greater than 3 km from the nearest supermarket).[8] Applications for retail food enhancement in these areas could be given priority with a higher score in the grant review process. Such an approach allows for development in many parts of the city and enables selection of grantees based on other important criteria, such as viability of the project or expected economic impacts.

Deserts matter, but swamps are more worrisome

Although identification of food deserts can be important for promoting the effectiveness of federal food assistance, as well as for local community development, there are limits to the usefulness of the metaphor. The development of a food metaphor reflects historic concerns about consumption, particularly under-nutrition. However, the most prevalent nutritional problems in high-income countries (i.e. where this metaphor has been applied) are related to over-consumption, particularly overweight and obese, which are more prevalent among low-income populations (Hedley, et al., 2004). If environment influences consumption, we suggest that the excess of unhealthy food in low-income neighborhoods is a more pressing problem, than inadequacies.

The last several columns of Table 3 shows the extensive amount of energy-dense snack foods relative to fruits and vegetables that are found, on average, in convenience, drug, and general merchandise stores. The fruit and vegetable to snack food ratio is close to 0 for these stores. The relative proportion of fruits and vegetables to energy-dense snack foods is better with groceries and supermarkets (though there is still a lot of shelf space devoted to snack foods, particularly in supermarkets). Convenience and small stores locate disproportionately in low-income neighborhoods (Moore and Diez Roux, 2006). Others have found that fast food restaurants also locate disproportionately in low-income areas. The caloric imbalance that leads to obesity is, of course, an issue about entire diets, not specific foods. But the extensive amount of energy-dense offerings available at these venues may in fact inundate, or swamp out, what

[8] We have intentionally chosen criteria based on minimum information needs (e.g. existence of supermarkets). Although our in-store surveys were useful for research purposes, the resources involved in data collection precludes their use for ongoing city planning. Thus we have not suggested criteria based on the availability of specific items or shelf space devoted to fruits and vegetables.

relatively few healthy choice foods there are. Thus, we suggest that a more useful metaphor to be used is "food swamps" rather than food deserts.[9]

The growing literature on the associations between small stores or fast food restaurants and body mass index indicates this issue has not gone unnoticed by health science researchers (Chen, et al., 2009, Morland, et al., 2006, Powell, et al., 2007). Cause and effect are difficult to explore in this field, since research has been based on cross-sectional work. But research in food marketing, especially early experimental work regarding shelf space, has long indicated that increased availability drives consumption (Curhan, 1974, Curhan, 1972). There is likely to be a promotional aspect at work – the more one is exposed to certain types of foods, the more one desires them, or at least sees them as a normal part of the diet. Although "weighing in" on a food swamp definition is a topic for another paper, we suggest that it should involve *relative* amounts of different types of foods (e.g. an assessment of energy-dense foods swamping out healthier options), and/or retail establishments. The concept of food swamps is no less susceptible to ambiguity than food deserts, nor would its identification be any less challenging. The debates on causality (demand-led versus supply-driven) and desirable solutions (educate versus modify the retail environment versus do nothing), or even whether it is a problem are analogous. But if we are to use ecological metaphors to signal problems with our retail food environment, we suggest the swamp metaphor has more salience. Food insecurity might be a problem for 12% of individuals in the United States (Nord, et al., 2007), but two-thirds are overweight or obese.

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[9] We have not chosen this term out of some partiality to our local ecology here in southeastern Louisiana and we believe the term can be generalized to other areas of the country.

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Table 1. Demographic characteristics of selected tracts.[1,2]

Neighborhood	Tract #	Popln (#/sq mi)	Popln Density	Afr-Am (%)	Asian (%)	Median Income ($)	Poverty (%)	No Car (%)
All Tracts (means)		1506	2,180	64.5	1.6	32,065	30.1	30.7
French Quarter	22071004200	1908	3,683	4.4	1.0	35,404	9.0	43.8
Lower Ninth Ward	22071000702	444	381	83.3	0.2	24,266	26.4	39.7
Tremé	22071003900	1,246	2,187	81.2	0.1	25,000	49.1	45.0
Uptown	22071011400	1,865	3,790	4.7	1.0	42,772	9.0	15.8
Pontchartrain Park	22071001701	511	212	97.5	0.0	42,347	10.2	9.9
Central City	22071009302	838	3,595	99.4	0.1	9,508	70.8	84.6
English Turn	22071000612	1,709	93	12.2	8.1	110,062	3.4	1.8
Village de L'Est	22071001742	5,126	2,106	47.2	47.4	26,979	38.0	27.4

[1] Neighborhoods were selected for convenience in illustration and are not statistically representative of all neighborhoods in the city, nor are selected tracts necessarily representative of these neighborhoods.

[2] Data are estimates from ESRI (2007), except for the last 2 columns (poverty, no car rates) which are based on the 2000 Census.

Table 2. Identification of food deserts based on distance to the nearest supermarket and poverty and car ownership rates.[1,2]

Neighborhood	Minimum Distance to Super (meters)	Super > 1 km	Super > 1 km Pov > 20%	Super > 1 km Pov > 20% No car > 20%	Super > 2 km	Super > 2 km Pov > 20%	Super > 2 km Pov > 20% No car > 20%
All Tracts (means)	2,818	0.87	0.61	0.54	0.62	0.46	0.41
French Quarter	3,672	Yes	No	No	Yes	No	No
Lower Ninth Ward	4,300	Yes	Yes	Yes	Yes	Yes	Yes
Tremé	2,521	Yes	Yes	Yes	Yes	Yes	Yes
Uptown	420	No	No	No	No	No	No
Pontchartrain Park	2,133	Yes	No	No	Yes	No	No
Central City	1,824	Yes	Yes	Yes	No	No	No
English Turn	9,606	Yes	No	No	Yes	No	No
Village de L'Est	6,078	Yes	Yes	Yes	Yes	Yes	Yes

[1] Neighborhoods were selected for convenience in illustration and are not statistically representative of all neighborhoods in the city, nor are selected tracts necessarily representative of these neighborhoods.

[2] 'Yes' indicates classification of the tract as a 'food desert' for the given criteria. For the 'all tracts' row numbers are proportions of all 175 tracts in the City of New Orleans. Store distance data are from our NOLA Foods, 2007 study. Poverty and no car rates are based on the 2000 Census.

Table 3. Mean results on availability and shelf space from the in-store survey.[1,2]

	N	Mean # Frt & Veg Groups	% with 6 Frt & Veg Groups	Fresh Fruit Shelf Space (m)	Fresh Veg Shelf Space (m)	Total Fresh Frt & Veg Shelf Space (m)	Total Frt & Veg Shelf Space (m)	Total Snack Shelf Space (m)	Ratio of Frt & Veg to Snack
Supermarket	6	6	100.0	24.5	34.9	59.4	88.7	154.4	0.66
Mid grocery	5	3.6	0.0	2.6	4.2	6.8	14.6	34.7	0.42
Small grocery	33	3.1	12.1	1.6	2.3	3.9	8.7	28.4	0.29
Convenience	33	1.8	0.0	0.4	0.6	1.0	3.2	27.2	0.11
Drug store	10	1.0	0.0	0.0	0.0	0.0	1.6	47.9	0.02
General merch	3	1.0	0.0	0.0	0.0	0.0	5.2	60.3	0.09

[1] Stores were randomly selected from throughout New Orleans. “General merch” refers to general merchandise stores such as “Dollar” stores.

[2] Availability of items from 6 possible Thrifty Food Plan fruit and vegetable groups were observed including fruits, fruit juices, potatoes, dark orange vegetables (e.g. carrots), dark green vegetables (e.g. spinach), and other vegetables. Snack foods include candies, cookies and crackers, doughnuts and pastries, sodas, and salty snacks (e.g. chips). Linear shelf space was measured using a rolling measurement device.

Table 4. Identification of food deserts based on availability of fruits and vegetables and poverty rates.[1,2]

Neighborhood	# of Frt & Veg Groups within 2 km	< 6 Frt & Veg Groups within 2 km; >20% pov	Fresh Fruit Shelf Space (m)	Fresh Veg Shelf Space (m)	< ½ Shelf Space of Median Supermarket within 2 km; >20% pov
All Tracts (means)	5.2	0.21	31.5	46.1	0.17
French Quarter	6.0	No	53	94	No
Lower Ninth Ward	3.0	Yes	0	3	Yes
Tremé	6.0	No	48	84	No
Uptown	6.0	No	56	69	No
Pontchartrain Park	0.0	No	0	0	No
Central City	6.0	No	49	86	No
English Turn	0.0	No	No	0	No
Village de L'Est	6.0	No	37	48	No

[1] Neighborhoods were selected for convenience in illustration and are not statistically representative of all neighborhoods in the city, nor are selected tracts necessarily representative of these neighborhoods.

[2] There were 6 possible fruit and vegetable groups: fruits, fruit juices, potatoes, dark orange vegetables (e.g. carrots), dark green vegetables (e.g. spinach), and other vegetables. Total shelf space was summed across all stores in a tract. 'Yes' indicates classification of the tract as a 'food desert' for the given criteria. For the 'all tracts' row, numbers are proportions of all 175 tracts in the City of New Orleans. Fruit and vegetable availability data are from our NOLA Foods, 2007 study. Poverty rates are based on the 2000 Census.

Table 5. Transport mode, costs per mode, and costs to nearest supermarket. [1,2]

	Mode of transport to store used in New Orleans		Mean travel costs and time rates by mode of transport among U.S. urban Food Stamp households		Tract-level monthly transport costs to shop in New Orleans at the nearest supermarket (n=175)		Monthly cost difference between tracts with poor access (n=109) and good access (n=66)	
	No Car (%)	Owns Car (%)	Cost per km ($)	Time per km (minutes)	Mean	SE	Mean Diff	SE
Transport Mode								
Walk	26.1	5.9	0.00	12.7	21.00	1.37	18.69	1.94
Drive Car	19.5	89.0	0.06	3.0	5.90	0.38	5.26	0.54
Get Ride	42.5	3.6	0.80	5.1	21.90	1.43	19.50	2.02
Bus	6.5	0.8	1.87	4.3	38.70	2.52	34.45	3.57
Taxi	5.1	0.4	3.18	7.8	66.57	4.33	59.27	6.14
Travel Cost (car owner)					7.75	0.50	6.90	0.71
Travel Cost (no car)					20.71	1.35	18.44	1.91
Overall Weighted Travel Cost					11.60	0.66	10.58	0.89

[1] Costs to the nearest supermarket by mode of transport, TC_m, was calculated as a sum of out-of-pocket expense and the value of time in transit, such that $TC_m = (C_m)*D + (T_m)*D*w$, where C_m is the cost per kilometer traveled, T_m is the time per kilometer traveled, D is the network distance from the tract centroid to the nearest supermarket, and w is the minimum wage. Approach is based on Feather (2003).

[2] Mode of transport data (columns 1-2) come from the 2004-05 Louisiana Neighborhood Environment and Consumption Survey (LANECS). Out-of-pocket costs and travel times (data columns 3-4) are based on urban households from the 1996-97 National Food Stamp Program Survey (NFSPS). Monthly costs to shop in New Orleans are determined for each tract, assume transport from the tract centroid to the nearest supermarket, and are based on the cost of round-trip travel for 3 trips per month. (Urban NFSPS households average 3.0 trips per month.) The average travel cost for car owners in a tract is calculated using distributional data on the mode of transport for car-owning households (column 2) as weights. The same approach is used for those that do not own cars. The overall weighted travel cost is an average of travel costs for car owners and non-owners weighted by the proportions of car owners and non-owners in a tract (i.e. from 2000 Census data). Tracts were categorized into poor access or good access using a threshold of 2 km from the centroid to the nearest supermarket.

Figure 1. Map of New Orleans with example tracts (in black) and supermarkets (red circles).

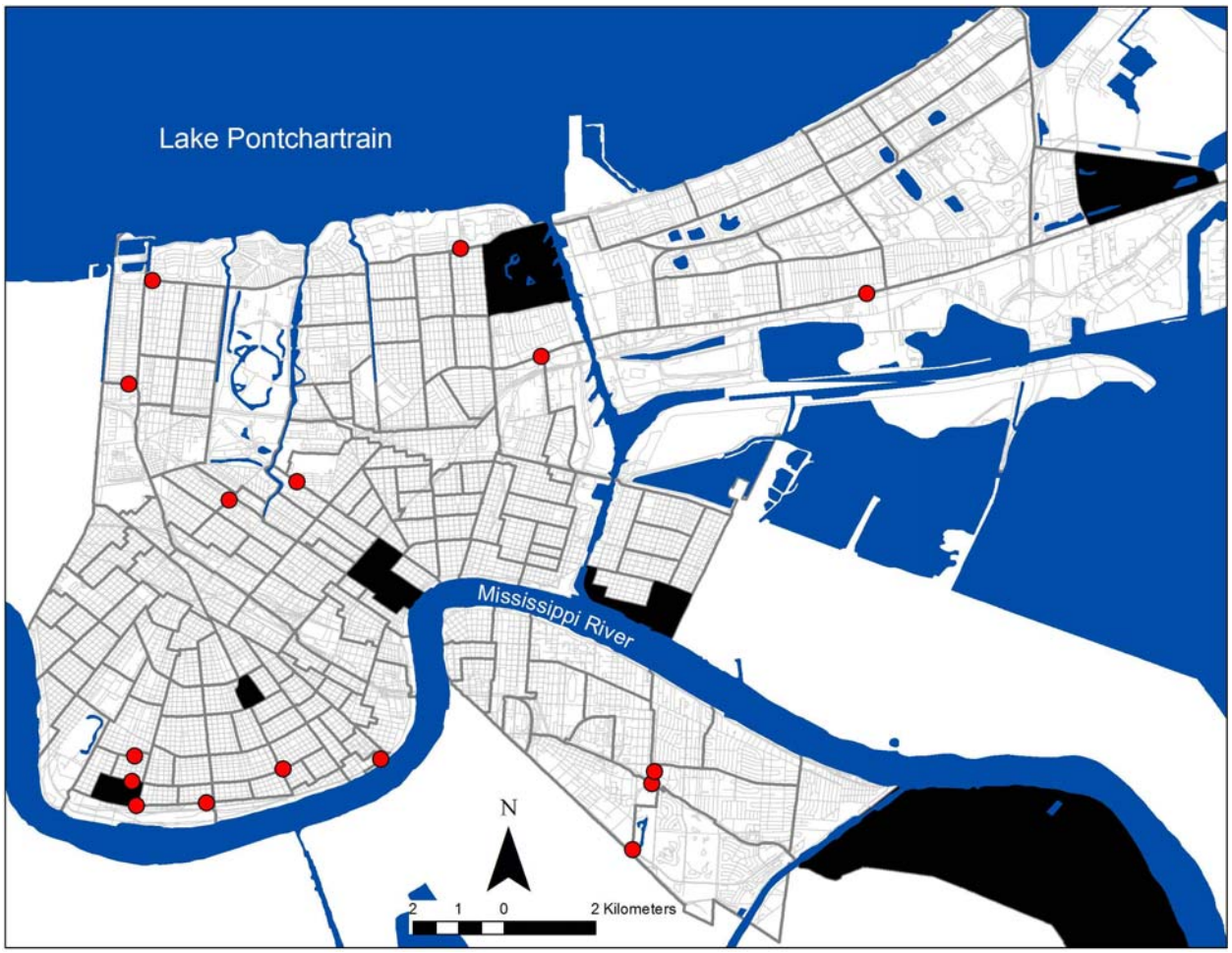

Figure 2. Map of New Orleans highlighting tracts with low supermarket access (shaded red).

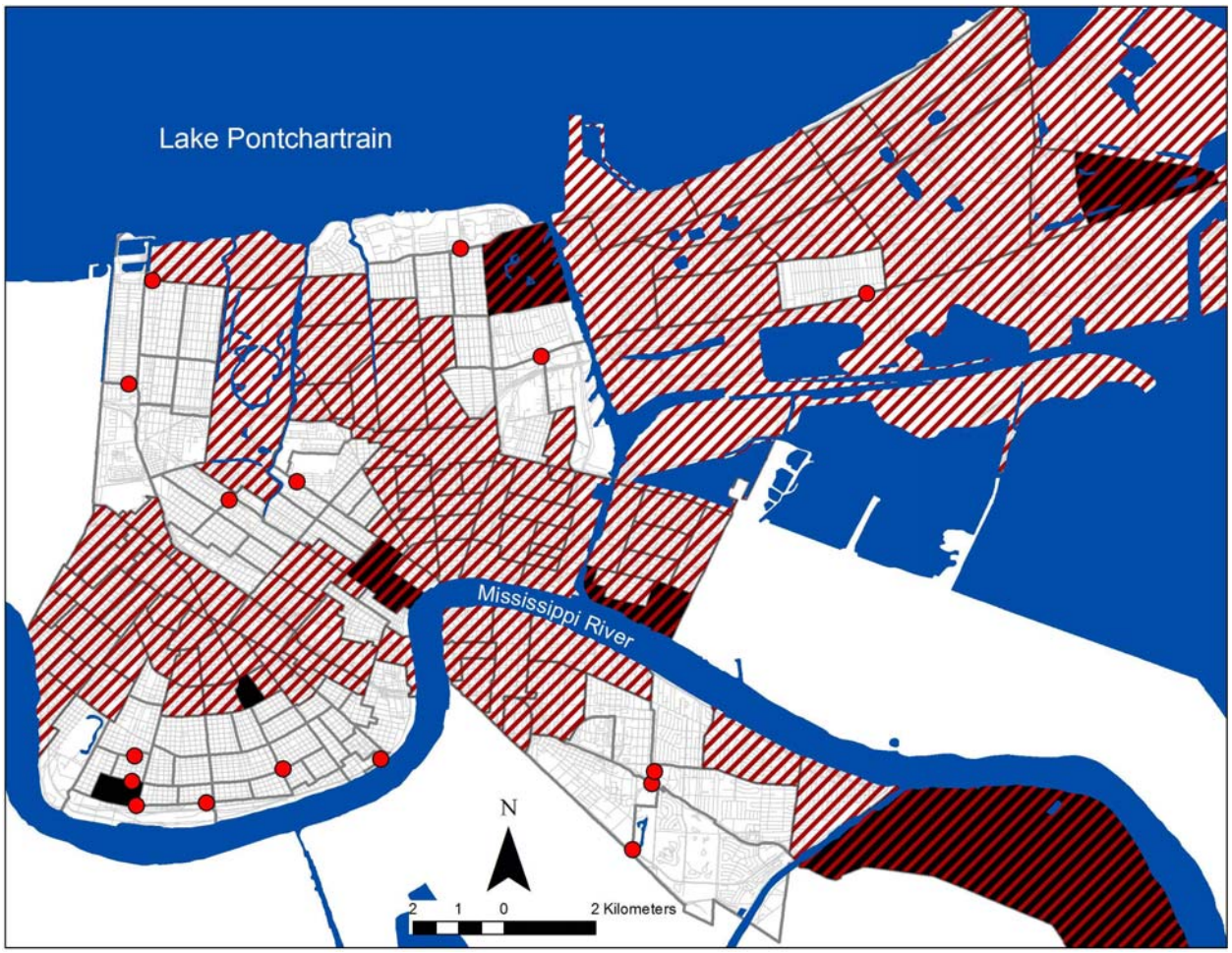

Figure 3. Map of New Orleans highlighting tracts with low supermarket access and poverty > 20%.

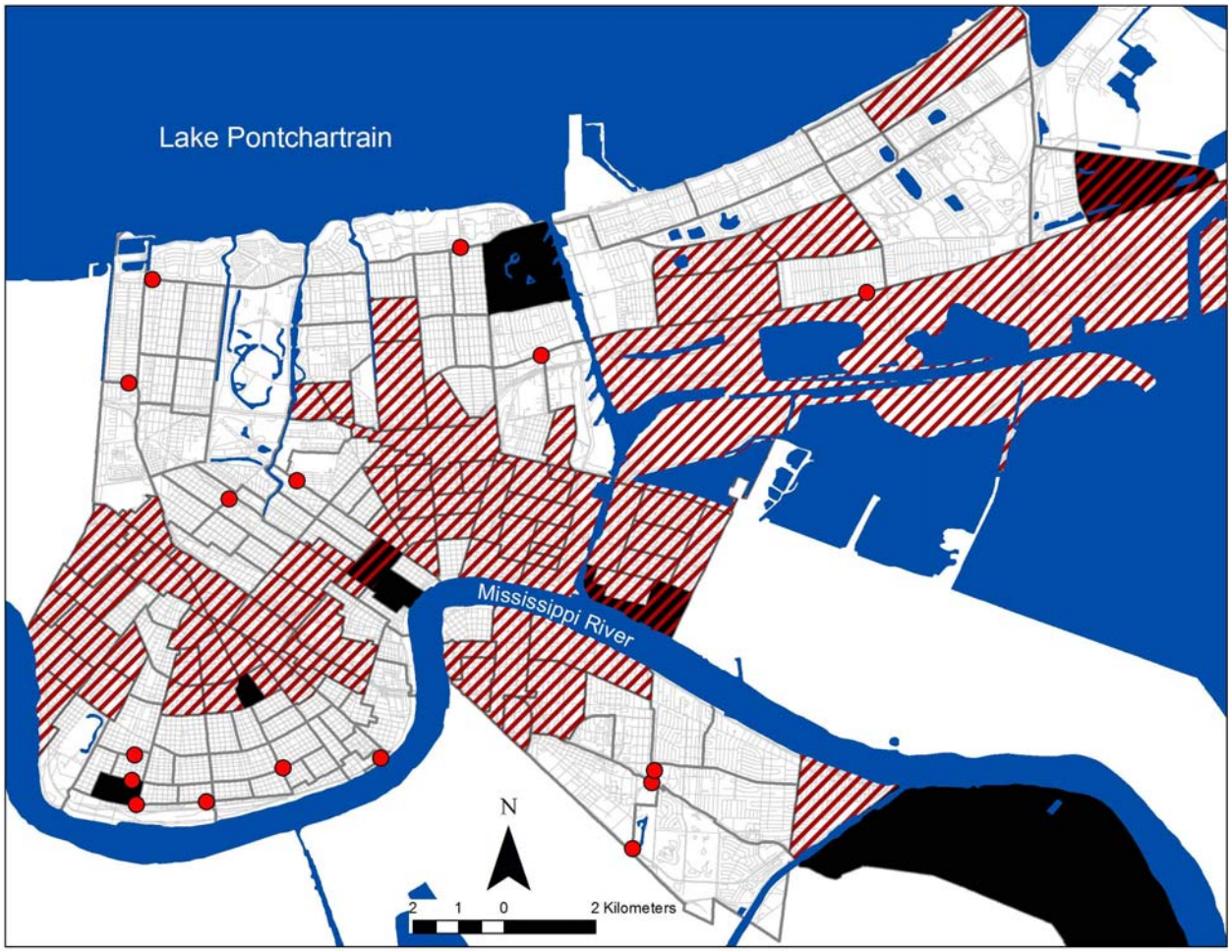

Figure 4. Map of New Orleans highlighting tracts with low supermarket access and poverty > 20% and small stores (yellow circles).

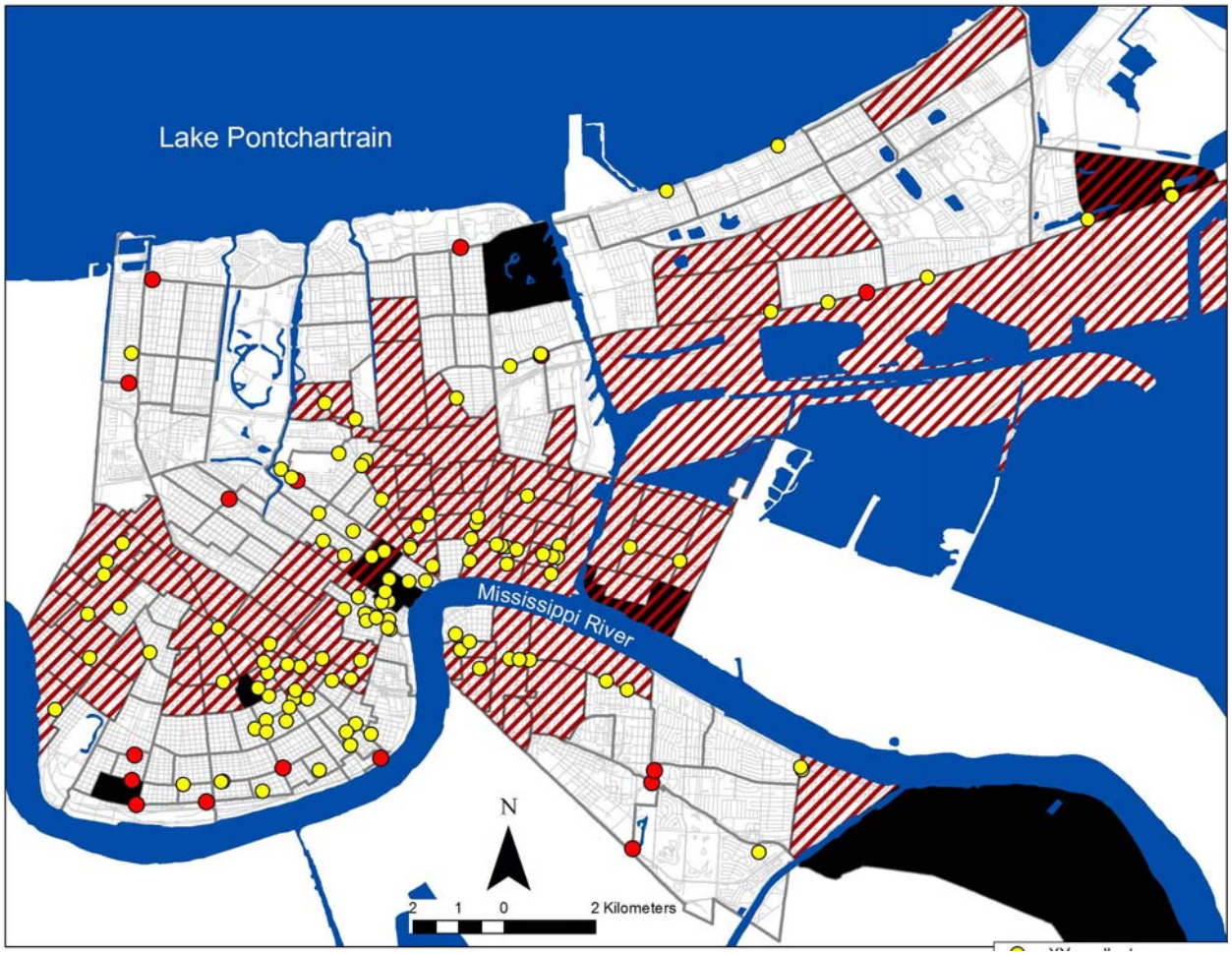

Figure 5. Map of New Orleans highlighting tracts with poor access to fruits and vegetables and poverty > 20%.