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RESEARCH ARTICLE

ASSESSING FOOD SECURITY AND LOCAL FOOD SYSTEMS FOR HEALTHY, LIVABLE AND SUSTAINABLE COMMUNITIES IN NORTH ALABAMA

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ABSTRACT

Food security, a condition in which "... all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2006), is one of several conditions essential to a healthy and well-nourished population (Coleman-Jensen, 2013). This research focused on food access and sources of food, along with the roles of local food systems in North Alabama, one of the fastest growing regions in Alabama. The overall goal was to develop a geographic picture of the Huntsville Metro region and the cities at risk for food insecurity. By noting places with high food insecurity risk and comparing them to places where food is available, analysis indicates areas of unmet need. The methodology was adapted from a study by Wauchope and Ward (2012) of the Carsey Institute using census tracts as a proxy for neighborhoods. Results indicate that in the Huntsville Metro region, one of the wealthiest regions in the State of Alabama, 55 percent of the population had a high risk of food insecurity with 45 census tracts identified as high risk and 71 percent with poverty rates greater than 10 percent. However, seven census tracts located in the City of Huntsville were observed to be hot spots for having significantly high percentages of its population that were located beyond 1 mile for urban areas from a supermarket.

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INTRODUCTION

From the dawn of time food has been a major consideration for the location of human settlements. As human populations increased, communities developed largely around areas of greatest food resources. The ability of populations to feed themselves has also been a major indicator of the economic progress of settlements. Human development and economic progress as we know it today could not have evolved as they have done without a stable food supply. It is believed that numerous civilizations have both evolved and collapsed because of failure of their system of food production and distribution. In addition, the quality and variety of available food, often reflects the health of people and their communities. However, even with recent technological advancements in

agriculture, transportation, and trade, the concern over food has not diminished over time. These advancements have in fact, contributed to increasing the distance between human settlements and their food source. This greater distance has been to the detriment of the quality and cost of available food. According to Baranyi et al., (2012) the global food supply is playing an increasingly significant role in the national and global economic and political landscape particularly in light of two factors. On one hand, food demand is expected to increase by 50 percent by 2030, but on the other hand, global food transport has been increasing at an exponential rate, faster than food production itself. In addition, the changing financial markets, the global economy, and international environment have resulted in the instability in food supply and prices (Naylor and Falcon, 2010). This instability compounded by income and wealth inequality has given rise to areas of high food insecurity and inadequate supply of and access to affordable, healthy and nutritious foods. Food security has become a major national and global issue as well as a leading

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public health concern in the United States and worldwide. According to Schmidhuber and Tubiello (2007), food security comprises of four main components - access, distribution, the stability of the food supply and the use of food. The UN News Center (2011) indicates that long-term lack of food security becomes hunger on the household level and eventually, extreme lack of food security becomes famine on a population level. Access to sufficient food by a country to meet dietary energy requirements was the definition originally used to describe "food security" (Pinstrup-Andersen, 2009). However, the early definition focused on the availability and price stability of basic food items at the national and global level (Clay, 2002). Criticism of this definition also included its failure to address the adequacy in the supply and nutritional value of food as well as access to it (Pinstrup-Andersen, 2009; Food and Agriculture Organization of the United Nations (FAO), 2006; Clay, 2002). Thus, the current widely accepted definition of food security is the one adopted during the 1996 World Food Summit. "Food security exists 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" (FAO, 2006).

The focus of this study is on one component of food security – food access - which ultimately involves households possessing sufficient income to purchase adequate and appropriate food and includes proximity and the ability to travel to sources that offers such food. In hundreds of neighborhood throughout the United States, nutritious, affordable, and high quality food is largely absent (Morland et al., 2002, Franco et al., 2008). These areas have been defined as food deserts where, instead of supermarkets and grocery stores, these communities may be primarily served by fast food restaurants and convenience stores that offer few healthy, affordable food options (Bell, et al., 2013). The lack of access contributes to poor diets and can lead to higher levels of obesity, diabetes, heart disease and other diet-related conditions. Studies that measure food store availability and availability of healthy foods find major disparities in food access by race and income (Raja et al., 2008).

This research examined food access through a spatial assessment of the food store environment. It assessed a variety of indicators of populations that have low incomes and low access to a supermarket or large grocery store. The overall goal was to develop a geographic picture of the Huntsville Metro region's food store environment and its cities which may be at risk for food insecurity. An identification of the neighborhoods with high risks of insecurity would indicate areas of unmet need and provide invaluable information to local policy makers to develop programs and policies to reduce these risks. In addition, the research examined options regarding the cost and benefits of a local food system for North Alabama and potential public benefits of expanding local foods systems for improving food security. The goals of the research was supported by Raja, Born, and Russell (2008) who indicate that planning would play a significant role in shaping the food environment of communities ultimately facilitating healthy eating and sustainable communities.

Food Security, Access, and Measurements

Godfray et al. (2010) contend that a new set of overlapping intricacies has prolonged conditions where a substantial proportion of populations continue to have inadequate access to

food that would sustain their energy requirements despite advances in food production. Recognizing these challenges, analyzing food security has now evolved from the food production perspective into a more comprehensive food systems approach (Ingram, 2011). This approach recognizes the connections between and within biogeophysical and human environments, which defines the inputs and the corresponding impacts of its outputs (Ericksen, 2008). Relevant to this discussion has been the issue of access to food as compared to simply availability (Ingram, 2011; Pinstrup-Andersen, 2009; Ericksen, 2008; FAO, 2006; Clay, 2002). The ability to transform a variety of people's financial, political, and other assets into food, be it either produced or purchased, characterizes their access to food, which underlines the disproportion in food distribution and allocation built on income, political and social power (Ericksen, 2008). Due to increasing number of people not growing their own food, a perspective of food security that gives focus to access and incomes has been a growing concern amidst the significant growth of urban areas (Ericksen, 2008; Ruel et al., 1998).

Studies have underscored the importance of measuring food security, which provides a viewpoint of the condition of household and personal well-being of a population (Bell, Mora, Hagan, Rubin, and Karpyn, 2013; Pinstrup-Andersen, 2009). In addressing the need for better monitoring and assessment of the nutritional state of the American people, the US Departments of Agriculture (USDA) and Health and Human Services (DHHS) developed a food-security core survey module that measured food security, insecurity and hunger (Bickel et al., 2000). With this tool, the food security status of each household was determined to fall along a continuum extending from high food security to very low food security. The USDA (2016) defined food security to include at minimum "the ready availability of nutritionally adequate and safe foods, and the assured ability to acquire acceptable foods in socially acceptable ways". In addition to this measure, the National Center for Health Statistics (NCHS), which is part of the Centers for Disease Control and Prevention (CDC) has also developed and administered the National Health and Nutrition Examination Survey (NHANES). It is a program of studies designed to assess the health and nutritional status of adults and children in the United States by combining both interviews and physical examinations (CDC, 2014).

Demographic, socioeconomic, dietary, and health-related questions were included in the NHANES interviews. As access to healthy and nutritious food was linked to major public health problems, the USDA in 2008 was tasked to evaluate the extent of the problem of limited access, which resulted in the Food Access Research Atlas (FARA) initiative (Ver Ploeg, 2010). FARA is a web-based mapping tool that allows users to investigate access to food stores at the census-tract level (Rhone et al., 2017). There continues to be the need for research that would enable policy formulation and implementation of programs that would ensure healthy food accessibility to all (Bell, et al., 2013). Spatial and GIS capabilities could be utilized by planners in order to further analyze the variables associated with local food environments, and understand the spatial configuration and disparities in the communities (Raja, et. al., 2008). Neighborhood revitalization and community health improvements would be some of the benefits of ensuring a community's access to healthy food (Bell, et al., 2013).

Food Systems and Food Insecurity

Dialogue on local or community-based sustainable food systems has exploded in public policy circles over the past five years. Campbell et al., (2013) points to the growing public interest in links between food, health, and the environment which has sparked exponential growth in local and regional food system projects. Feenstra (1997) indicates that the long-term health of a community's food system is an important indicator of a community's strength and sustainability and that a logical and appropriate way to revitalize a community is by the development of a local food economy. Feenstra (2002) defines a community food system as a system in which sustainable food production, processing, distribution, and consumption are integrated to enhance the economic, environmental, and social health of a particular place. Donald et al. (2010), however, point to concerns that the conventional agro-industrial food system has not effectively provided a nutritious, sustainable and equitable supply of food to the world's population. They indicate that technological innovations have provided cheap food to millions, but at costs such as soil and water depletion, food safety alarms, declining rural communities, rising obesity and diet-related health problems in urban areas, as well as growing food insecurity. The character of the food system and the nature of food policy are both changing due to urbanization, technical change and industrialization (Maxwell and Slater, 2003). Lang (2003) refers to this change as "a revolution in the nature of the food supply chain characterized by unprecedented changes in how food is produced, distributed, consumed and controlled". Food issues have typically been regarded as agricultural issues, grounded in rural settings. However, with accelerating rates of urbanization, the urban food system has become more visible due to its increasing contribution to community health and welfare, particularly to the development of metropolitan economies and through connections to other urban systems such as housing, transportation, land use, and economic development (Pothukuchi and Kaufman 1999).

The American Planning Association (APA) (2007) speaks to the paucity of research and education on food systems planning in academia. They indicate that "...food is a sustaining and enduring necessity. Yet among the basic essentials for life — air, water, shelter, and food — only food has been absent over the years as a focus of serious professional planning interest". APA (2007), however, notes that interest in food system issues is clearly on the rise in the academic community, but how planning operates to balance the need for an efficient food system with the goals of economic vitality, public health, ecological sustainability, social equity, and cultural diversity will present a formidable challenge. USDA's Economic Research Service notes that local food systems may be a way to circumvent problems of increasing food insecurity, lack of food access (food deserts), and diet-related health problems (Martinez et al., 2010). However, an understanding of the potential public benefits of expanding local food systems, particularly as they relate to public policies and programs that support local foods need to be studied to fill knowledge gaps.

METHODOLOGY

The methodology was adapted from a study by Wauchope and Ward (2012) of the Carsey Institute using census tracts as a proxy for neighborhoods. In the study, they created a geographic picture of the towns and cities at risk for food

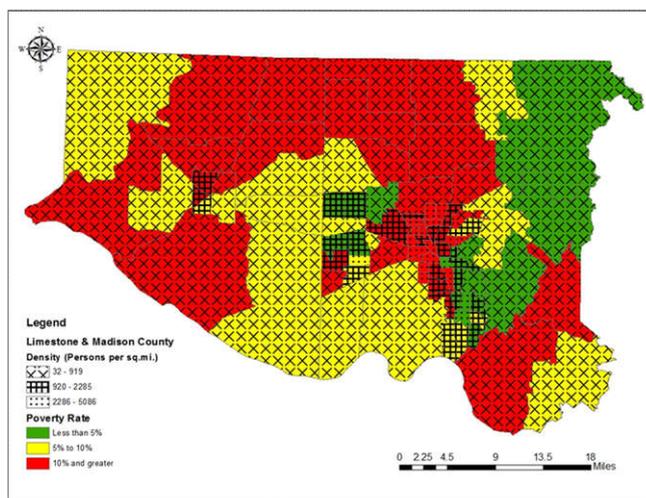
insecurity as well as the food resources available across the state. Places with high food insecurity risk were detailed in the study and compared to places where food is available. Maps produced showed areas of unmet need. Similarly, this study utilized data at the census tract level and mapped the population and its income attributes to create a geographic picture of food insecurity risks. The study area was the Huntsville Metro region, one of the fastest growing regions in the state of Alabama. The region, located in the northern portion of the State consists of Madison and Limestone counties. Madison County has 73 census tracts while Limestone County has 16. Further analysis was conducted utilizing data from the Food Access Research Atlas (USDA, 2015) on food access rate to identify statistically significant spatial clusters of high values (hot spots) and low values (cold spots) using the Getis-Ord G_i^* statistic (ESRI, 2014). Food resources available within the area were also mapped to provide a comprehensive representation of food security in the area. Establishments considered for this study were those that had current food service permits. They were retrieved from the Food Establishment Scores database of the Alabama Department of Public Health. In addition, the food resources were overlaid with the developed land cover within the two counties of the Huntsville Metro regions (Limestone and Madison) to substantiate results regarding food insecurity risks. The developed land cover layer was derived from the 2011 National Land Cover database (Homer et al., 2015). The study also reviewed recommendations from a study commissioned by the Food Bank of North Alabama to gauge the economic potential of a sustainable local food system for the Huntsville Metro region.

RESULTS AND DISCUSSION

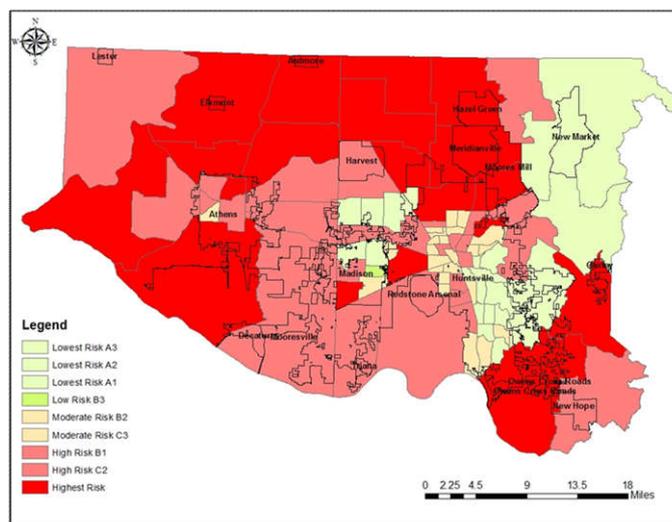
Food Insecurity Risk

There are several complex causes of food insecurity, however, poverty combined with other socioeconomic and political problems, is unmistakably the driving factor in the lack of resources to procure food. Together they create the bulk of food insecurity around the globe (FAO, 1999). Map 1 identifies the distribution of families at risk for food insecurity in 2010 by census tract. The variables considered were the poverty rate, which was the share of the tract population living with incomes at or below the Federal poverty thresholds and distance to travel to procure food. To estimate the risk of food insecurity at the town/city level, these two indicators were overlapped, substituting an available measure, population density, for distance to travel for food sources. Each indicator was divided into three categories.

Densities ranged from least dense (32 – 919 persons per square mile) to medium density (920 – 2,285) to most dense (2,286 to 5,086). Low density was of interest as it was the measure of accessibility used for this research. The location of food stores may contribute to food insecurity. The assumption is that the lower the density the further away populations would be from food stores. Towns with the largest percentage of families living below the federal poverty level (10 percent and greater) were shown in red; 5 – 10% in yellow and less than 5% in green. A scale of Food Insecurity Risk was created by combining the two indicators, as shown in Map 2. The census tracts in the highest risk of food insecurity category were those with the largest percentage of families in poverty and located in the least dense areas.



Map 1. 2010 Population Density and Poverty Rate in Limestone and Madison Counties, AL Source: USDA, 2015

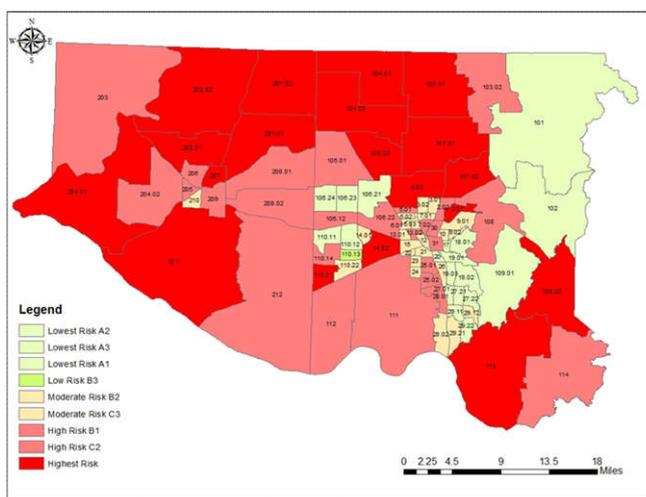


Map 3. 2010 Food Insecurity Risks by Census Tracts and Towns and Cities in Limestone and Madison Counties, AL. Source: US Census Bureau

The census tracts with the largest percentage of families in poverty combined with moderate population density and census tracts with the middle percentage of families in poverty combined with the smallest population were classified as high risk as poverty is a stronger risk factor than population density. Census tracts with moderate risk were identified to have a high population density which increases access to food despite the poverty. Out of the 89 census tracts in Limestone and Madison counties, there were 45 (50%) identified to be at high risk of food insecurity based on the lowest population density and poverty rate. It could be observed from Map 3 that the highest food insecurity risk was in the areas of Elkmont, Ardmore, Hazel Green, Meridianville, Moores Mill, Gurley and Owens Cross Road. Based on this, 19 census tracts were identified to be at the highest risk of food insecurity. The population within these census tracts accounts for 23% of the total population in Limestone and Madison Counties. Meanwhile, there were 26 census tracts identified to be with a high risk of food insecurity. The population within these census tracts accounts for 32% of the total population in Limestone and Madison County. Combined, it could be noted that 55% of the population in Limestone and Madison counties were with a high risk of food insecurity. These identified census tracts had an average poverty rate of 17.4%. There was a total of 45 census tracts identified to be with high risks, 71% of which had poverty rates greater than 10%.

Hotspot Analysis

As identified in the previous maps, Limestone and Madison counties have a number of census tracts that are high risk for food insecurity based on the population density and poverty rate. The previous maps provided density information, which identifies where clusters in the data exist, but not if these clusters were statistically significant. Hotspot analysis, which is a tool in the ArcGIS 10.3 software program was utilized to identify the locations of statistically significant hot spots and cold spots in the data. For this analysis, the count of the population who were located beyond 1 mile for urban areas or 10 miles for rural areas from a supermarket was divided by the total population in the census tract to derive the low access rate. The result of the analysis identified if the local pattern of low access were (statistically) significantly different to what is generally observed across Limestone and Madison counties. In Map 4, it could be observed that there were a number of census tracts identified previously as high risk for food insecurity, which was also identified as areas with statistically significant higher low access rate. There were seven census tracts located in the City of Huntsville that were observed to be hot spots for having significantly high percentages of its population that were located beyond 1 mile for urban areas or 10 miles for rural areas from supermarket: Census Tracts 106.21 (53 North) – 99%, 25.02 (Golf/ Chelsea area) – 98%, 24 (McDonnel) – 88%, 18.01 (Monte Sano) – 85%, 9.01 (Chapman) – 87%, 4.03 (Wade Mountain area) – 97%, and 3.01 (Lakewood) – 83%. Other Census tracts that were identified to be hot spots were Census Tract 103.01 (Hazel Green) – 81%, 105.01 (Harvest) – 82%, and 208.01 (partial Athens) – 91%.



Map 2. 2010 Food Insecurity Risk by Census Tracts in Limestone and Madison Counties, AL

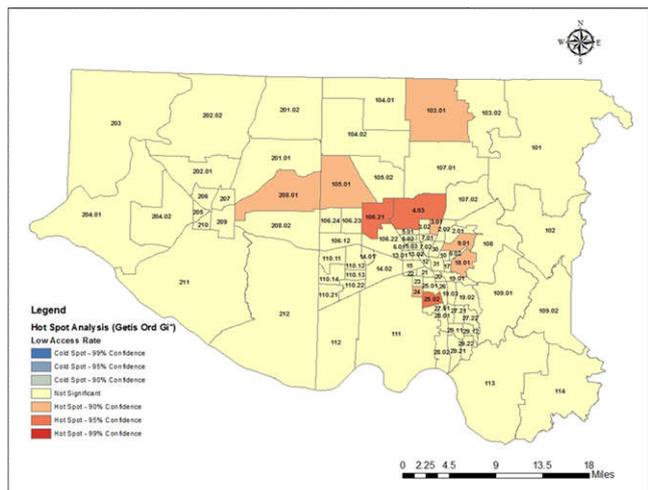
Based on the data from the FARA, four of the identified census tracts were tagged to have 100 households that do not have a vehicle, and beyond 1/2 mile from a supermarket. These census tracts were part of the City of Huntsville, which included census tract 25.02 (Golf Road/ Chelsea), 24 (McDonnel), 9.01 (Chapman), and 3.01 (Lakewood). However, the City of Huntsville’s public transportation currently has bus routes covering these areas, except for census tract 9.01 (Chapman). Although the availability of transportation could help abate the food insecurity risk in these census tracts, the poverty rate in these areas suggests limited incomes, thus food choices could still be unhealthy.

In addition, the population in these areas would be impaired during the occurrence of emergency or disasters, which could immobilize transportation activities because of road closures and stoppage in bus operations.

These are all places where a substantial portion of the vendor's space was used to sell food and beverages. However, the quality of goods sold was not assessed. The distribution of food sources within Limestone and Madison counties were observed to be the highest within the population centers. These were areas with larger developed land cover. The highest number of food sources were in the City of Huntsville, its surrounding areas, and in the City of Decatur. These establishments were also observed to be located along major roads.

Census tracts 105.01 and 103.01 were consistently identified to be high risk for food insecurity based on their population density, poverty rate, and low access rate. Within tract 105.01, which had a population of 11,342 in 2010, there were 30 establishments that provided food. These establishments consisted of Restaurants (14), Groceries (2), Retail Stores (7), Daycares (2), Schools (3), and Gas Stations (2). Meanwhile, Census Tract 103.01, which had a population of 8,125 in 2010, had a total of 26 establishments that provided food.

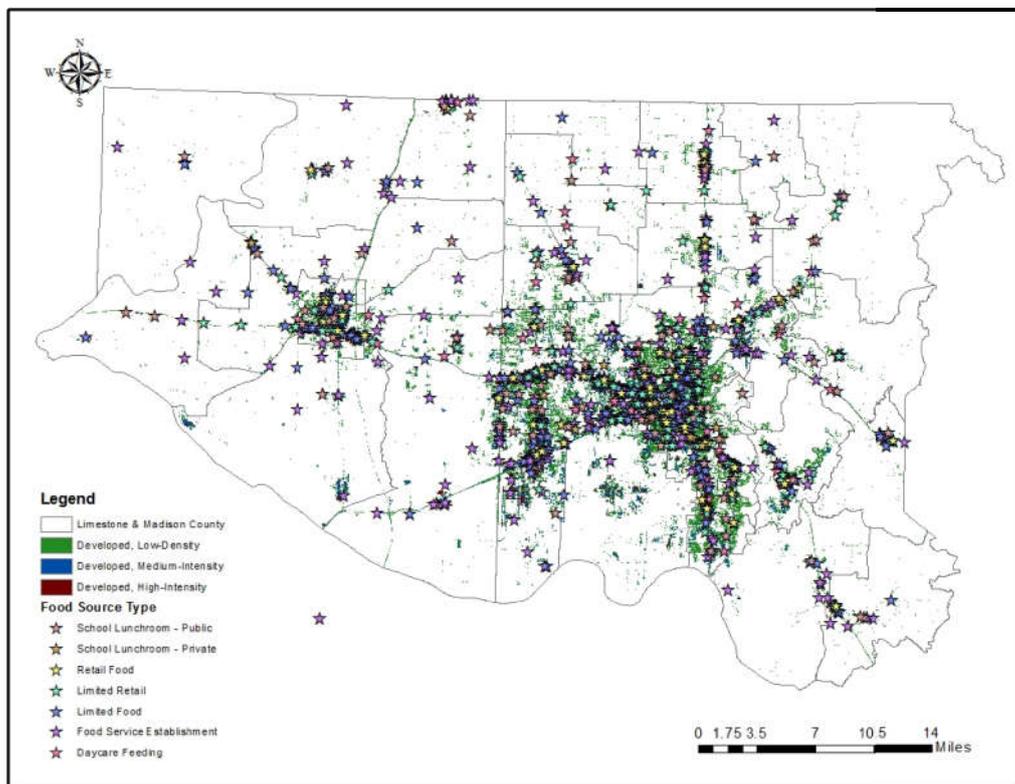
These establishments consisted of Restaurants (12), Retail Stores (4), Groceries (2), School (3), Daycare (4), and Gas Station (1). The source and quality of food sold or provided in the establishments included in this study were not assessed. However, this study recognizes that the source of the foods would have implications not only on the quality, nutritional value and safety of food supplied in these establishments but also includes environmental, and economic consequences as well. The distance between farm and table diminishes food quality and nutritional value for every mile traveled as freshness and condition of the food would be affected by refrigeration and handling (Alzamora, Tapia, and López-Malo, 2000).



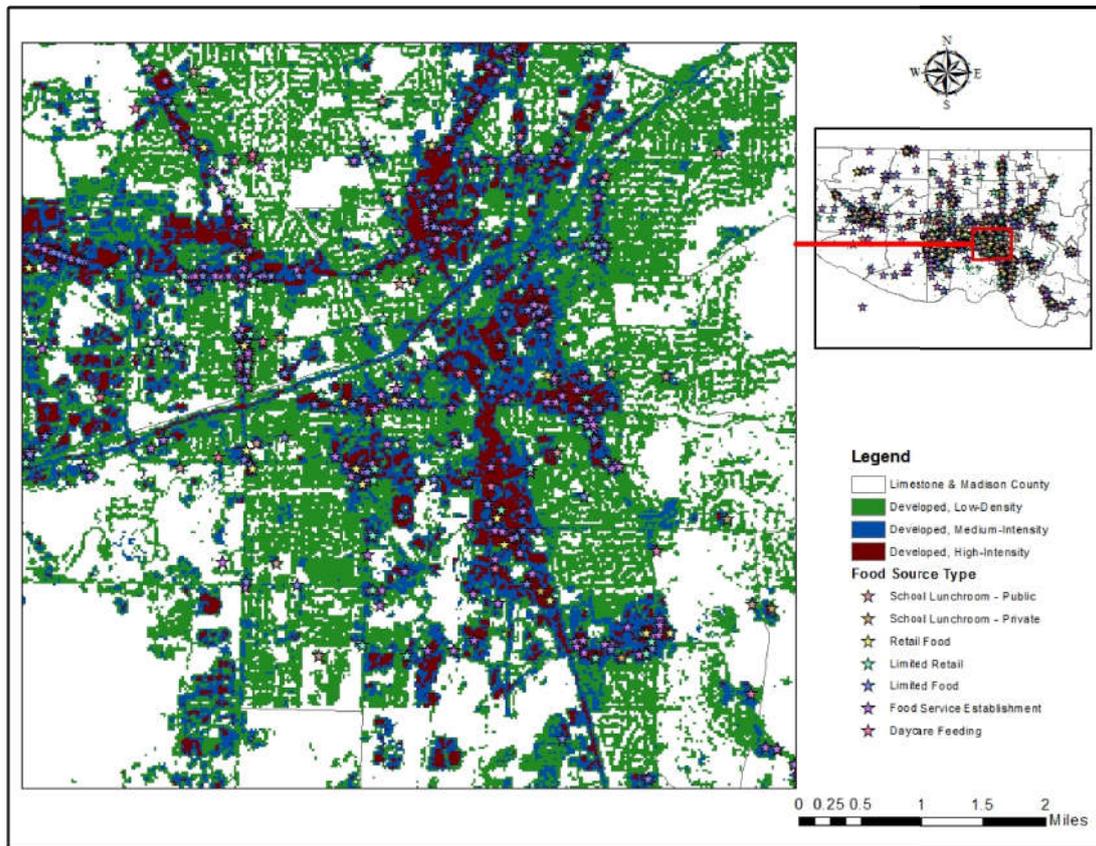
Map 4. Hot Spot Analysis on Low Access Rate for census tracts in Limestone and Madison Counties, AL

Land Cover and Food Source

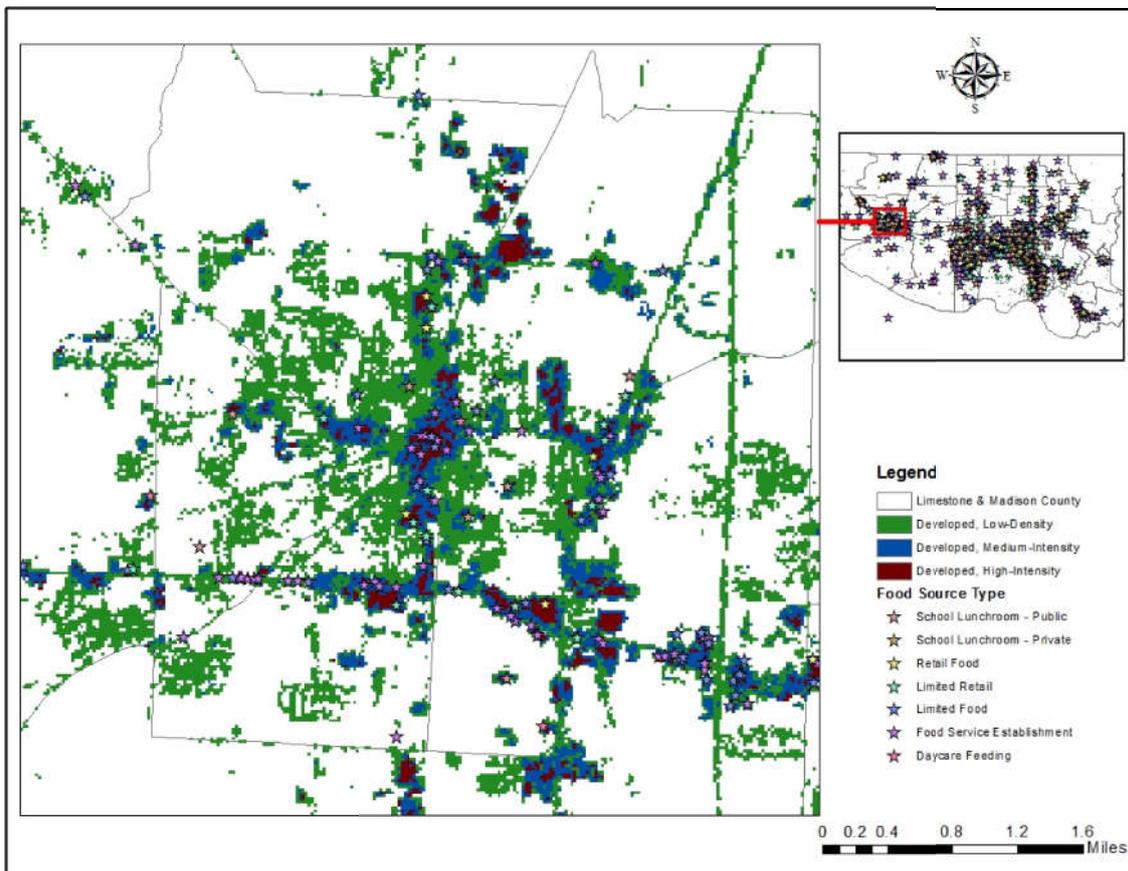
The distribution of places where families could purchase food and developed urban areas in Limestone and Madison Counties could be observed from Maps 5 to 9. Food sources included in these maps were derived from the Alabama Department of Public Health's Food Establishment Scores database. The establishments included retail food outlets, places where families could purchase food from vendors including groceries, convenience and fresh food specialty stores and non-traditional food stores such as pharmacies and so-called dollar stores.



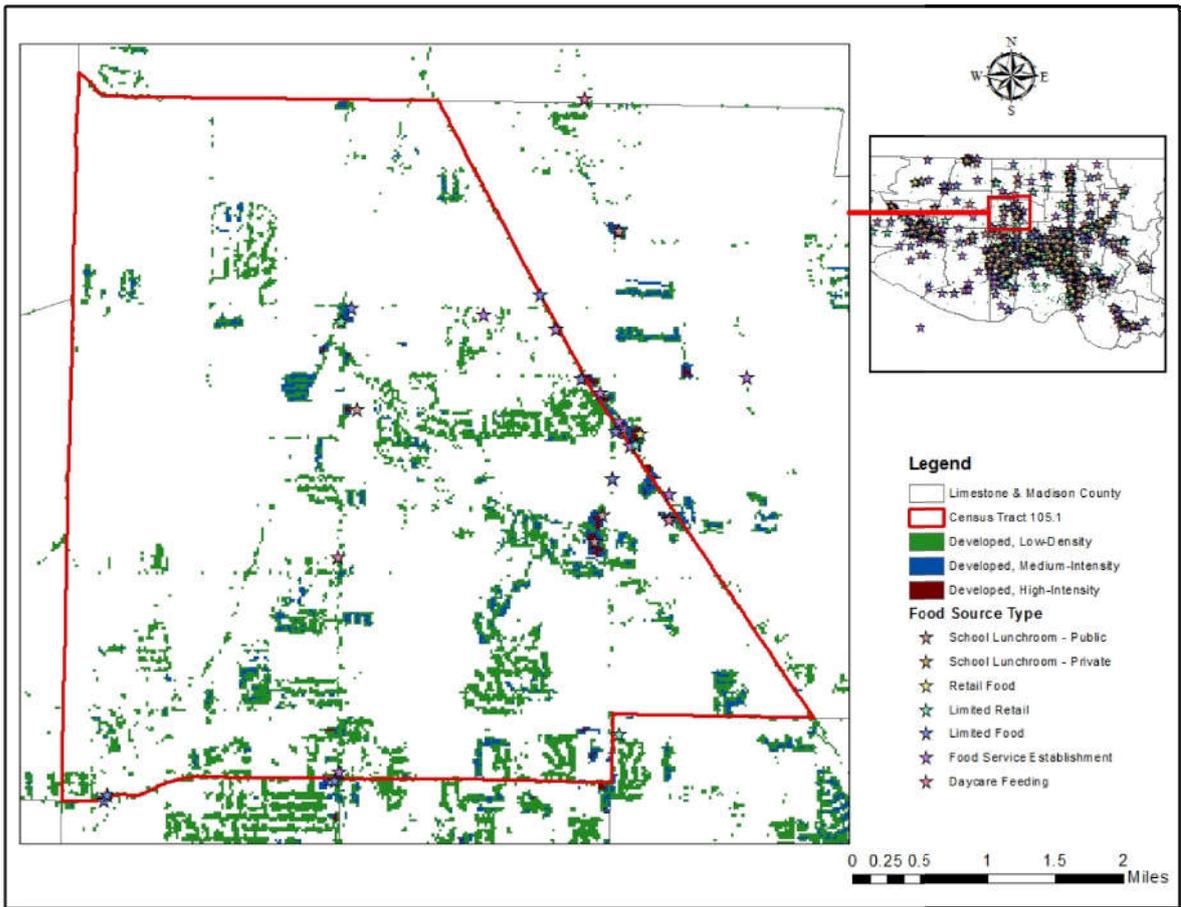
Map 5. Food Sources and Developed Land Cover in Limestone & Madison Counties, AL. Source: Alabama Department of Public Health, 2017



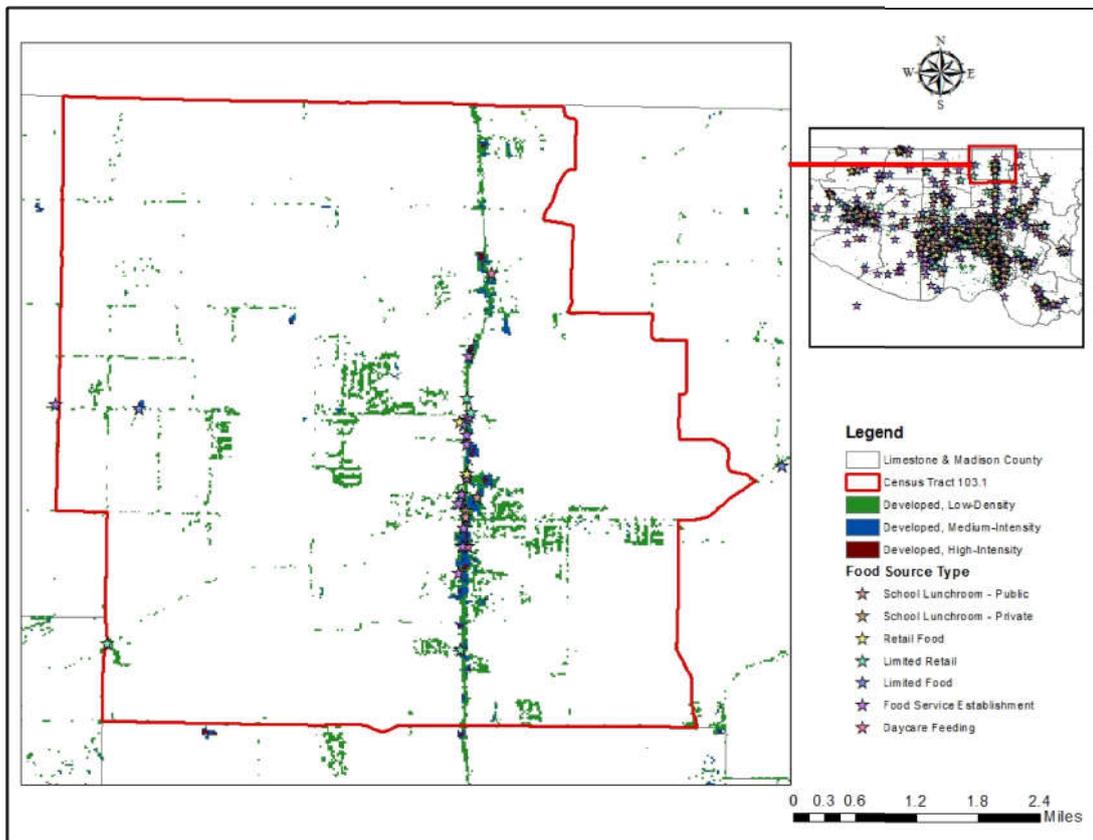
Map 6. Food Sources and Developed Land Cover within City of Huntsville, Madison County, AL



Map 7. Food Sources and Developed Land Cover within City of Athens, Limestone County, AL



Map 8. Food Sources and Developed Land Cover in Census Tract 105.1, Madison County, AL.



Map 9. Food Sources and Developed Land Cover in Census Tract 103.1, Madison County, AL.

Food safety would also be in play as there would be an increased potential for contaminated products as a result of sourcing food abroad due to differences in regulatory policies, administration and technological advancements in food processing (Akkerman, Farahani, and Grunow, 2010). Environmental impacts could be attributed to the greenhouse gas emissions resulting from the processing and transportation of these foods (Edwards-Jones, Canals, Hounsome, Truninger, Koerber, Hounsome, and Harris, 2008).

A Local food system for North Alabama

In 2011, the Food Bank of North Alabama commissioned the *North Alabama Local Farm and Food Economy Study* to gauge the economic potential of locally grown food for the region. Result of the study found that in North Alabama approximately \$2.2 billion out of the \$2.4 billion consumers spent annually to purchase or procure food was spent outside of the region (Meter, 2012). In addition, North Alabama farmers gained \$267 million per year producing food products but spent \$733 million buying inputs sourced outside of the region thus the total loss of potential wealth from the region is in the billions of dollars each year. The study implies that there is a piecemeal approach to food systems planning at the urban level and that there is a dire need to take a more comprehensive look at the system. The study concluded that assessing, designing and implementing sustainable, local food systems that are economically viable for producers and consumers, use ecologically sound production and distribution practices, and enhance social equity for all members of the community, is a critical element in the urban development agenda for the North Alabama region.

According to the 2016 USDA - National Agricultural Statistics Services, in 2012 within Limestone and Madison counties, there were a total of 2,263 farms (Limestone - 1,230 farms and Madison - 1,033 farms). In addition, Alabama's Farmers Market Authority (FMA) reported that Limestone County has 2 farmers' markets and 4 farm-stands. Madison County has 10 farmers' markets and 7 farm-stands. It should be noted that in 2007, 50 farms in Limestone County sold \$295,000 of food directly to consumers, and 71 farms in Madison County sold \$283,000 of food directly to consumers (Meter, 2011). Amidst the poverty that persists within Limestone and Madison County, this underscores the potential to develop the already existing local/ regional food systems as an economic strategy. In one study it was noted that in 2008 fruit and vegetable farms with local food sales employed 61,000 workers or 13 FTE employees per million dollars of sales, while fruit and vegetable farms not engaged in local food sales employed only 3 FTE employees per million dollars of sales (Low, and Vogel, 2011). Based on the results of Meter's study, several recommendations were made to capture more local food dollars and advance the local food economy in the Huntsville metro region. Recommendations included using local foods as an economic development strategy using a system approach to integrate and collaborative strategic planning and developing partnerships and collaborations with stakeholders in the food system. Specific policy recommendations also include more support for locally owned business, better access to credit for farm and food-based businesses, expanding market and infrastructure to support local foods process and distribution, encouraging more farmers and farming, improving accessibility to locally grown foods, and reducing and recapturing waste throughout the food system.

Conclusion

Food insecurity and sources of food were examined by this study, along with the roles of local food systems in North Alabama, which would be one of the fastest growing regions in Alabama. A geographic picture of the census tracts in Limestone and Madison counties at risk for food insecurity as well as the food resources available across the region was developed. Areas with unmet needs were identified by noting places with high food insecurity risk and comparing them to places where food was available. Limestone and Madison counties have a substantial food insecurity risk as 50% of its Census Tracts had low population density and high poverty rates. Development of local/regional food systems would be beneficial not only to mitigate existing food insecurity risk but also facilitate poverty alleviation in the area. However, a truly viable and sustainable food system – which consists of all of the processes involved in feeding people, from growing and harvesting, to consuming and recycling – should encompass the goals of social equity and human health, economic vitality, and environmental health. Recommendations to develop such a system much take a comprehensive and systems-thinking approach to bridge the myriad of sectors within the food systems.

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