# INCREASING EQUITABLE FOOD ACCESS WITHIN FOOD DESERTS IN URBAN AREAS: A CASE STUDY OF THE KANSAS CITY METROPOLITAN AREA

A THESIS IN

Environmental and Urban Geosciences

Presented to the Faculty of the University of
Missouri-Kansas City in partial fulfillment of
the requirements for the degree

MASTER OF SCIENCE

By

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Kansas City, MO

2022

INCREASING EQUITABLE FOOD ACCESS WITHIN FOOD DESERTS IN URBAN AREAS: A CASE STUDY OF THE KANSAS CITY METROPOLITAN AREA

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ABSTRACT

There has been growing interest in the factors that contribute to poor health outcomes, particularly in areas where health disparities are pronounced. The locations of food deserts, or unhealthy food environments, correspond to areas with the highest proportions of minority residents, populations suffering from higher rates of many chronic conditions, including obesity and diabetes. As well, food deserts tend to be located in areas with higher rates of poverty throughout the United States. This study seeks to enhance our understanding of the role of the neighborhood environment on residents' food access by studying the effects of a local Urban Farming Network on the local food buying system. Growing food in urban areas could solve a multitude of problems. This study was developed to evaluate whether the inclusion of an Urban Farming Network to a food desert will increase residents' access to healthy food. This case study included an analysis of survey and focus group as well as a spatial analysis focusing on the local urban farms in the Kansas City Metropolitan area. Spatial statistics were run on the locations of the local urban farms in an effort to determine significant clustering. This study approaches the issue of food deserts with a focus on the socioeconomic dynamic of the urban area as well as a spatial analysis to show the

potential of a microtransportation food delivery system from local growers to consumers. With the analysis of the local farms in the Kansas City Metropolitan area, there were shown to be gaps in where food can be purchased and where the addition of an urban farm could help to resolve the issue.

APPROVAL PAGE

The faculty listed below, appointed by the Dean of the College of Arts and Sciences have examined a thesis titled "Increasing Equitable Food Access Within Food Deserts in Urban Areas: A Case Study of the Kansas City Metropolitan Area" presented by Courtney Lauderback, candidate for the Master of Science degree, and hereby certify that in their opinion it is worthy of acceptance.

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## ACKOWLEDGEMENTS

My deepest gratitude is to my advisor and mentor, Dr. Jejung Lee who continuously supports me in my study and research. His patience, motivation, enthusiasm, and immense knowledge helped me overcome many difficulties and finish this thesis. His time and effort have been crucial in the development of this thesis.

I am also deeply grateful for Dr. Sookhee Oh as her knowledge and expertise was invaluable to my research and finishing this thesis as well as serving on my Supervisory Committee.

I would also like to express how thankful I am to Dr. Fengpeng Sun for serving in my Supervisory Committee, spending time reading this thesis and encouraging me throughout my coursework.

I am also grateful to every member of the Food Oases group as each and everyone of these people had expertise and knowledge that helped shape the outcome of my research. I would especially like to thank the Principal Investigators Dr. Kiruba Krishnaswamy, Dr. Carlos Sun, and Dr. Sejun Song.

I am thankful to Mark Samborski and Maggie St. John of Antioch Urban Growers and Neil Rudisill of the Ivanhoe Neighborhood Council and Woodland Farm for your expertise and openness in sharing your farm spaces and community connections in order to help with this research.

Most importantly, I am heartily thankful to my family and friends who have my endless gratitude for their support and care during the pursuit of my research. Finally, I am most grateful to my partner, Joe, whom this thesis is dedicated to. He has mentally

and emotionally supported me and helped me achieve the high standards I set for myself in all aspects of life.

Lastly, I would like to thank my pets: Lucy, Crosby, Rabbit, Squirrel, and Cricket as their existence reminds me of the beauty in life and makes everyday worth it.

# CHAPTER 1

# INTRODUCTION

## 1.1 Statement of Problems

There has been growing interest in the factors that contribute to poor health outcomes, particularly in areas where health disparities are pronounced. Having healthy food in one's immediate neighborhood from places such as grocery stores, farmers markets, or community gardens influences one's food choices and what one eats. A selection of healthy foods can reduce one's risk of obesity and diet-related diseases including diabetes and cardiovascular disease (Smith & Miller, 2011). As well, perception of a better selection and quality of fresh produce is associated with increased fruit and vegetable consumption (Beaulac, et al., 2009). Supermarkets and grocery stores can offer a variety of affordable and healthy foods such as fresh fruits and vegetables, whole grains, and dairy. Without supermarkets close to home, residents tend to depend more on convenience stores and fast-food restaurants for their food sources (Spence, et al., 2009). Areas with poor access to large food outlets are known as "food deserts".

The United States Department of Agriculture (USDA) defines a food desert when a census tract meets the following two criteria (USDA, 2014):

1. Low-income community - poverty rate of 20 percent or higher, or a median family income at or below 80 percent of the statewide median family income
2. Low-access community - urban census tracts with more than 33 percent living more than one mile from a supermarket or large grocery store or rural census

tracts (geographical region containing 1,000 to 8,000 people) that are more than 10 miles from a supermarket or large grocery store.

The 2010 Census food desert analysis strayed from the established USDA definition stated above. A low-income community requires 40 percent of the population to have an income at or below 200 percent of federal poverty thresholds for family size (Ver Ploeg et al., 2012). Using the alternate low-income classification, 29.7 million people live in low-income census tracts more than 1 mile from a supermarket. Specifically, 9.9 million individuals residing in urban areas or 18 percent live in a food desert (low-income areas more than 1 mile from a supermarket) and 18.3 million individuals or 10 percent residing in rural areas live in a food desert (low-income areas more than 10 miles from a supermarket) (Ver Ploeg et al., 2012). Food deserts that exist within urban areas in the United States affect groups of people already living with a wealth disparity in their communities as urban food desert locations tend to be located in areas with higher poverty rates according to data from the U.S. Census Bureau.

Residents living in a food desert experience lower access and availability to healthy, nutritious foods. Food deserts typically are populated by lower income communities and disproportionately impact communities of color. The locations of food deserts, or unhealthy food environments correspond to areas with the highest proportions of minority residents and populations suffering from higher rates of many chronic conditions, including obesity and diabetes. A food desert is a part of a metropolitan area where healthy, affordable options for food are scarce. This issue is then further complicated by issues of limited transportation within low-income communities. The term food insecurity refers to the USDA's measure of lack of access, at times, to enough food for an active, healthy life for all household members and limited or uncertain availability of nutritionally adequate foods. Food insecure households are not necessarily food insecure all the time. Food insecurity may reflect a household's need to make trade-offs between important basic needs, such as housing or medical bills, and purchasing nutritionally adequate foods. There has been extensive research about food deserts across multiple disciplines, however, none have yet been able to yield a lasting impact on those experiencing food insecurity. Many studies have been performed and show that simply introducing a new supermarket into a food desert and areas of low food security does not tend to improve access to healthy food for the local residents (Ghosh-Dastidar et al., 2017). I aim to take a newer approach in this research and analyze whether there is a relationship to be found for improving food security with the integration of urban farming into the local food system. This study seeks to enhance our understanding of the role of the neighborhood environment on residents' food access by studying the effects of an Urban Farming Network on the local food buying system, as growing food in urban areas could solve a multitude of problems. This study was developed to evaluate whether adding an Urban Farming Network to a food desert could increase residents' access to healthy food. With this research, I plan to find if the addition of a local food grower and distributor in food desert areas and areas of food insecurity could help to bridge the gap of food access to people in need.

Key Concepts to note in understanding this research:

- Food desert: part of a metropolitan area where healthy, affordable options for food are scarce.

- Food insecurity: household-level economic and social condition of limited or uncertain access to adequate food.
- Urban Farming Network: Network of local growers in an urban community providing food to local residents and community members.
- Food Access: Spatial accessibility and affordability of food retailers.
- Food Choice: How people decide what food to buy and eat.

### 1.2 Site Description of the Kansas City Metropolitan Area

The government has mapped food deserts in the United States, identifying communities that have limited access to healthy food choices (Rhone, 2014). This case study will focus on the Kansas City metropolitan area which includes five counties across the Missouri and Kansas state border. The five counties include Jackson County, MO; Platte County, MO; Cass County, MO; Johnson County, KS; and Wyandotte County, KS. The Kansas City metropolitan area was chosen for this study due to its ideal location. The area has an urban hub at its core and is a functioning mid-sized city for scale. The metropolitan area already has a bustling and growing urban agriculture throughout as well as more available green space that can be conceptualized for the scope of this study as potential land for more urban agriculture growth. As well, the metropolitan area has an average poverty rate of 15%, which is higher than the national average, so there is a known sample that this area provides in terms of sample and study. See Figure 1.1 for an illustration of the USDA map for the Kansas City metropolitan area. The green shows areas that are deemed a food desert according to the USDA pertaining to their given definition at Low Income and Low Access to supermarkets or a place to access healthy foods.

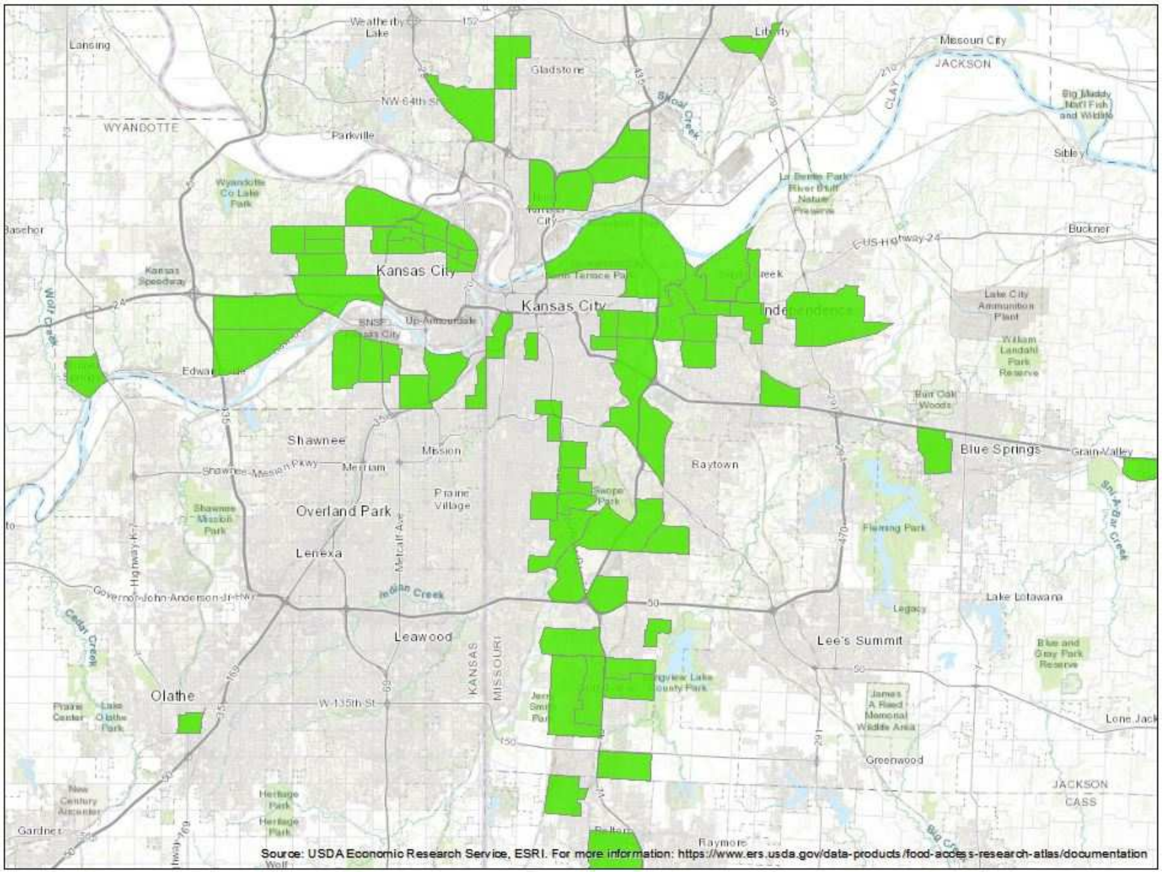


Figure 1.1: USDA Map of Food Deserts in the Kansas City Metropolitan Area (https://www.ers.usda.gov/data-products/food-access-research-atlas/go-to-the-atlas/)

According to the U.S. Census Bureau, Kansas City has a poverty rate of 15%, which according to the previously mentioned USDA definition, Kansas City as a whole does not meet the qualification of a food desert. However, like most urban areas, it is not the city as a whole that is the issue. Large urban areas often are broken up into many different sections of wealth, so Kansas City has many areas that are well below the poverty rate and others that are well above the poverty rate. See Figure 1.2 for a map showing the poverty rate throughout the Kansas City area.

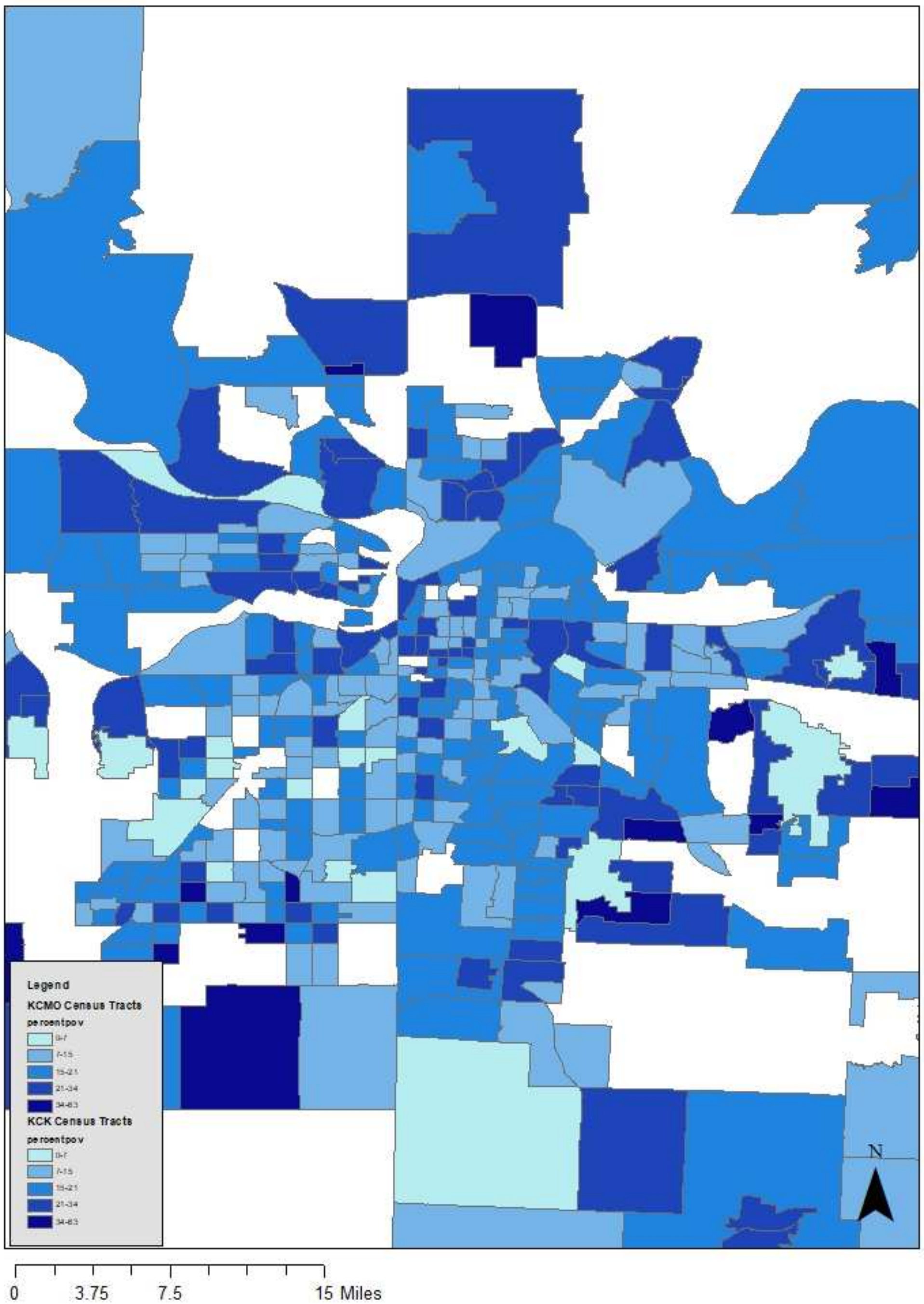


Figure 1.2: Poverty Rate map of the Kansas City Metropolitan Area

Using ArcGis mapping software and available census data, which is publicly available data provided by the United States Census Bureau (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html), Figure 1.2 was created as a way to visualize the poverty rates as they are dispersed throughout Kansas City. By looking at the map, you can see that the concentrations of higher poverty rates (darker blue) are mostly contained to the urban core of the city. When you compare Figures 1.1 and 1.2, there is a clear relationship from where the USDA has said food access is low and where the higher concentrations of poverty exist, which supports existing literature and data connecting the locations of food deserts to areas of poverty (Bitler, 2010). The USDA also has data available that shows the distribution of supermarkets as well (See Fig. 1.3). This data was taken and mapped to show a visualization of where one can access healthy food within Kansas City. This map also displays a 1-mile buffer around each supermarket in order to visualize where the gaps in access exist.

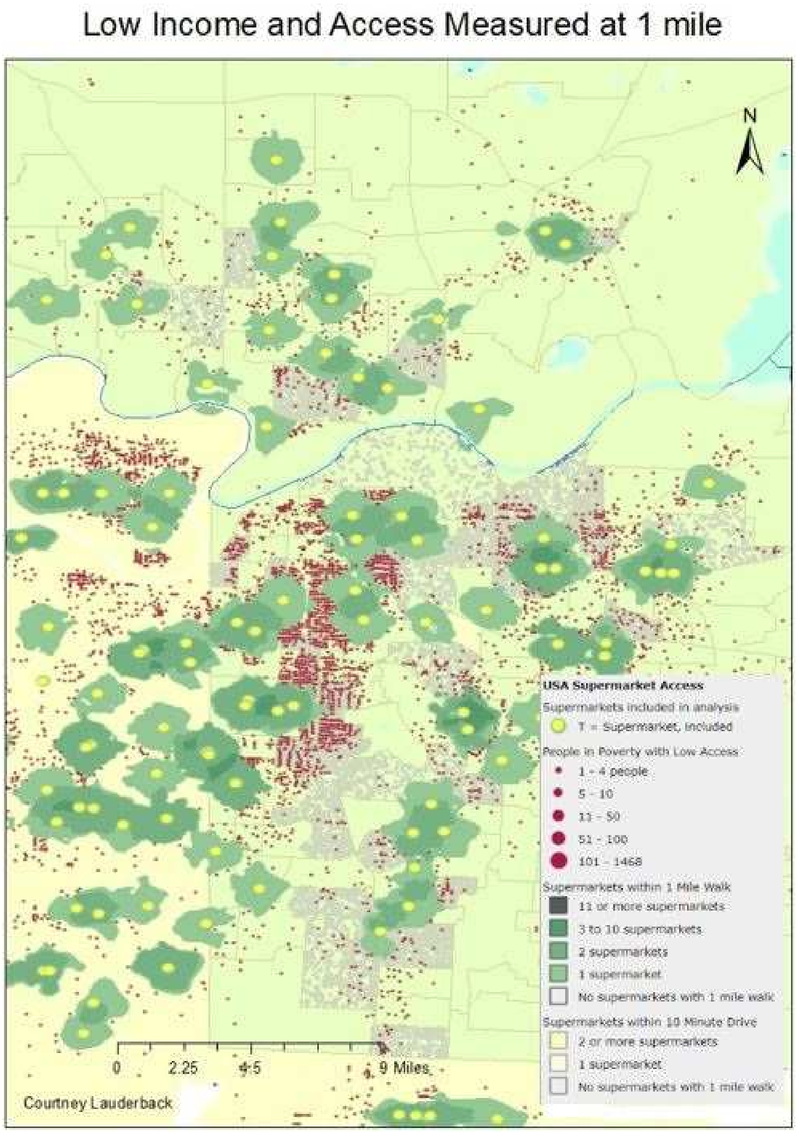


Figure 1.3: Map of USDA Supermarket Locations in Kansas City

The study area focused on selected food desert areas within Kansas City using a mixed methods approach. The mixed methods approach to this study includes GIS mapping, surveys to local residents, focus groups aimed at gaining an in depth understanding of the issue from residents experiencing food insecurity, and a spatial analysis on the data collected. This study approaches the issue of the food desert from two separate angles: the supply side which focuses on the supermarkets and spatial mobility such as transportation; the demand side which focuses on individual preference as well as choice and affordability. These areas of focus help to show the two sides to the issue being studied, the side of the food desert residents living in areas where they are unable to access an equitable amount of healthy food in their day to day lives; and the side of the supplier, the local urban farm in this case study, as being a potential solution for where the gap in access exists. This case study includes an analysis of survey and focus group data as well as a spatial analysis focusing on the local urban farms in the Kansas City Metropolitan area. Statistics (Global Moran's I, Local Moran's I, and Average Nearest Neighbor) were run on the locations of the local urban farms in an effort to determine clustering in an effort to statistically and spatially understand the environment and be able to apply resolutions to the area.

# CHAPTER 2

# LITERATURE REVIEW

Ghosh-Dastidar et al., (2017) posed the question of whether or not opening a supermarket in a food desert changes the food environment. The study aimed to examine the effect of a newly opened supermarket on the effect of healthy food access, availability, and pricing. In order to do so, they performed in-store evaluations at 30 stores on the availability of food and whether it was healthy or unhealthy, the prices of the available food, as well as the overall environment of the store. They also performed surveys in the two low-income neighborhoods where the stores were added, one before the store addition and one after. With this study, they found the biggest change came in the food pricing and that there was actually little impact on the availability of healthy foods, countering what they were hoping to find.

A 2020 study by M. Dekker focused on the impacts of food deserts on rural populations. The aim of the study was to show the link that exists between poverty and poor health. Disparities in health outcomes based on income alone are observed across subpopulations, accounting for social factors like race, ethnicity and education, among other social factors. In addition, a growing body of literature places these social factors, known as social determinants of health, at the root of health inequities. In order to perform the study, the researchers used United States county data for non-metropolitan areas in order to test if food access contributes to the relationship between poverty and poor health (Dekker et al., 2020). They then used this available data to construct a model that was able to describe a measure for the public health and diets of the populations being studied, and then further the impact of this on morbidity and mortality. They created an index consisting of five variables “percentage of adult obesity; percentage of adult diabetic; percentage of low birth weight; percentage of fair/poor health; and years of potential life lost. Higher values of each of these metrics in the public health index are associated with poorer overall levels of health” (Dekker et al., 2020). The overall findings from the study supported their hypothesis that higher levels of poverty are associated with poorer health. The big finding with this study was that higher access to food in the rural setting was associated with poorer health, showing essentially the opposite of urban food deserts. Effectively, this means that urban and rural food deserts cannot be studied and understood in the same way, essentially all the research in this field needs to be divided into which type of food desert is in discussion, especially in terms of repeatability of studies to different food desert areas. This led to the researchers explaining that policies need to take a more regional approach when working with the rural food deserts versus the urban food deserts.

In order to visualize relationships within an alternative food network, a study was performed using geo-social data from 110 farms and 224 markets around Baltimore County, Maryland, with 699 connections between them (Brinkley, 2018). The study describes modern alternative food networks as an example of a movement that pushes the current economic norm against the giant industrial food system and challenges for a shift in the power structures as a result of food-system related issues, including health and environmental impacts. Through her study, Brinkley was able to qualitatively find the resiliency that can exist and thrive in the small-world scale with which the study was performed. As well, local people with influence were able to craft informal policy reports, which were directly incorporated in state and local official land-use and economic planning documents, community governance over land-use policy suggests a powerful mechanism for further localizing food systems. The key is to find a way to unify the value systems that exist within a localized food system.

In order to research the prevalence of obesity and the effects from the local food system, a study examined the social dynamics of residents' health-related food-shopping behaviors in 2010–11 in urban Philadelphia, where 500 resident interviews were performed as well as a food environment audit (Cannuscio et al., 2014). In the interviews, participants demonstrated adaptability and resourcefulness in their food shopping; they chose to shop at stores that met a range of social needs, which those needs ranged from practical financial considerations, to fundamental issues of safety, to concerns about convenience, and juggling multiple work and family responsibilities. The majority of participants were highly motivated to adapt their shopping patterns to accommodate personal financial constraints. In addition, they selectively shopped at stores frequented by people who shared their race or ethnicity, income and education, and they sought out stores where they had positive interactions with personnel and proprietors. In deciding where to shop in this urban context, participants adapted their routines to avoid unsafe places and the threat of violence. Participants also discussed the importance of convenient stores that allowed for easy parking, accommodation of physical disabilities or special needs, and integration of food shopping into other daily activities like meeting children at school (Cannuscio et al., 2014).

A study by Choi and Suzuki (2013) took place in Tokyo, Japan aiming to investigate the social exclusion and activity patterns of people as it pertains to food deserts. The authors examine social exclusion calling it a phenomenon that indicates that some people have difficulties obtaining social or personal opportunities. This study focuses on the socio-cultural side of social exclusion and the concept of accessibility. In a general sense, accessibility has been estimated based on the distance from users to destinations. Distance, or often travel time, involves cost and the potential to achieve the objective. However, with this point of view, accessibility can only be described in a physical manner, regardless of personal condition. Salomon and Mokhtarian (1998) stated, "[a]ccessibility is a measure of supply, namely potential mobility, and is not a descriptor of behavior." Furthermore, accessibility should be considered in concert with the traveler's constraints, such as individual socio-economic status (Axhausen et al., 2002; Kwan, 1998; Páez et al., 2010), health condition (An & Sturm, 2012; Lee, 2012; Morland et al., 2002) or personal attitude through psychological mechanisms (Dijst et al., 2008). Accessibility, therefore, can be divided into individual accessibility and locational accessibility (Dijst et al., 2002). Social exclusion problems are highly associated with individual accessibility, i.e., the proximity or number of opportunities that one perceives on a personal level, which is often difficult to quantify.

A paper by Brown and Chung (2006) addresses the conundrum that widely used measures of segregation, such as the Dissimilarity Index (DI), are aspatial, whereas indices such as the Location Quotient or Local Moran's I are highly spatial but virtually never used in studying residential clustering/segregation. Furthermore, the majority of studies in the genre treat the entire urban area as an observational unit and are primarily cross-urban in research design. The authors argue that, in order to advance our understanding of the geography of racial/ethnic residential clustering, local areas need to be given considerably more attention, using measures that explicitly reveal their spatial fabric of residential clustering along racial/ethnic lines. Thus, they criticize global measures for their lack of utility for understanding local segregation issues, using the Dissimilarity Index and one of its spatial counterparts as examples. In the realm of local indices, the Location Quotient and Local Moran's I are highlighted, which are applied to census tracts in Franklin County, core of the Columbus Ohio MSA. Local Moran's I is more precise and conservative in identifying racial/ethnic clusters because of its adjacency requirement, but the Location Quotient better illuminates the entire fabric of racial/ethnic locations, or concentrations, including outliers that indicate spatial trends. Also, using the two measures together captures both the clustering/exposure (LM-I) and concentration-evenness (LQ) dimensions of segregation. (Brown and Chung, 2006)

Several studies have examined supermarket access for low-income residents, but few have explored how access to healthy food changes when a new food retailer such as a farmers' market opens in a place previously known as a 'food desert'. This paper published by Larsen and Gilliland in 2009 uses a 'before and after' approach to examine the impact of the introduction of a farmers' market on the price and availability of healthy food in an underserved urban neighborhood. The farmers' market had a major impact on grocery prices in the neighborhood, which decreased by almost 12% in 3 years. This study demonstrated that the introduction of a farmers' market in a food desert increased the availability of healthy food and lowered the overall food costs for households in the neighborhood. Since the introduction of the farmers' market, residents living in Old East can save over 12% and are now only paying 5.7% more than average supermarket prices. The farmers' market also gives residents a better variety of fresh fruits and vegetables. Food access among residents is significantly better now than 3 years ago. We argue that Old East is no longer a food desert. This study does not suggest everyone in the neighborhood shops at the farmers' market; rather, that a cost-saving opportunity is now available. The fact that this research examined food access at a scale smaller than supermarkets is a significant academic contribution. While most food desert studies have examined access to supermarkets, few have identified how other food retailers can influence life in a food desert. This study has additionally included an innovative 'before and after' approach to assessing food price and availability. The findings indicate that the introduction of a farmers' market can significantly decrease the economic costs of living in a neighborhood without a supermarket. These findings have policy implications for planners and public health managers concerned with improving the health of urban populations (Larsen and Gilliland, 2009).

In a 2017 paper by Elizabeth Mack, Daoqin Tong, and Kevin Credit, the authors explored the global issue of food access. In their research, they realized that few studies have linked food deserts and urban gardens together to analyze whether urban gardening activity may be a step forward in addressing issues of access for food desert residents. In the study, the Phoenix, Arizona metropolitan area is used as a case to demonstrate the utility of spatial optimization models for siting urban gardens near food deserts and on vacant land. The locations of urban gardens are derived from a list obtained from the Maricopa County Cooperative Extension office at the University of Arizona which were geo located and aggregated to census tracts. Census tracts were then assigned to one of three categories: tracts that contain a garden, tracts that are immediately adjacent to a tract with a garden, and all other non-garden/non-adjacent census tracts. Analysis of variance is first used to ascertain whether there are statistical differences in the demographic, socio-economic, and land use profiles of these three categories of tracts. A maximal covering spatial optimization model was then used to identify potential locations for future gardening activities. A constraint of these models was that gardens be located on vacant land, which is a growing problem in rapidly urbanizing environments worldwide. The spatial analysis of garden locations revealed that they are centrally located in tracts with good food access. Thus, the current distribution of gardens does not provide an alternative food source to occupants of food deserts. The maximal covering spatial optimization model reveals that gardens could be sited in alternative locations to better serve food desert residents. In fact, 53 gardens may be located to cover 96.4% of all food deserts. This is an improvement over the current distribution of gardens where 68 active garden sites provide coverage to a scant 8.4% of food desert residents. The study concluded that people in rapidly urbanizing environments around the globe suffer from poor food access. Rapid rates of urbanization also present an unused vacant land problem in cities around the globe. This paper highlights how spatial optimization models can be used to improve healthy food access for food desert residents, which is a critical first step in ameliorating the health problems associated with lack of healthy food access including heart disease and obesity (Mack et al., 2017).

Access to varied, healthy and inexpensive foods is an important public health concern that has been widely documented. Consequently, there is an increasing interest in identifying food deserts, that is, socially deprived areas within cities that have poor access to food retailers. In this paper we propose a methodology based on three measures of accessibility to supermarkets calculated using geographic information systems (GIS), and on exploratory multivariate statistical analysis (hierarchical cluster analysis), which we use to identify food deserts in Montréal. First, the use of three measures of accessibility to supermarkets is very helpful in identifying food deserts according to several dimensions: proximity (distance to the nearest supermarket), diversity (number of supermarkets within a distance of less than 1000 meters) and variety in terms of food and prices (average distance to the three closest different chain-name supermarkets). Next, the cluster analysis applied to the three measures of accessibility to supermarkets and to a social deprivation index demonstrates that there are very few problematic food deserts in Montréal. In fact, census tracts classified as socially deprived and with low accessibility to supermarkets are, on average, 816 meters away from the nearest supermarket and within 1.34 kilometres of three different chain-name supermarkets. We conclude that food deserts do not represent a major problem in Montréal. Since geographic accessibility to healthy food is not a major issue in Montréal, prevention efforts should be directed toward the understanding of other mechanisms leading to an unhealthy diet, rather than attempting to promote an even spatial distribution of supermarkets. (Apparicio, 2007)

An organization called Feeding America exists to fight the issue of food insecurity and food deserts in the United States. They are constantly working on projects and releasing the latest data. At the beginning of 2020, COVID-19 and the ensuing pandemic began to threaten the lives and livelihoods of people throughout the world. Decisions were being made that tried to argue the economic cost against the lives of people in the United States, and no matter the outcome, the most vulnerable members of society are in position to fare the worst. The individuals who are at highest risk for serious illness associated with COVID-19 – including seniors, people with chronic illness, and people of color – are, in many cases, the same individuals who are being most adversely affected by the economic recession that began as a result of the pandemic. I will be analyzing the impact of COVID-19 on food insecurity. Households that experience food insecurity lack access to enough food for an active, healthy life for all household members. Before the COVID-19 crisis began, more than 35 million people, including nearly 11 million children, lived in a food-insecure household. Pre-pandemic data reflects the lowest food insecurity rates in the United States in the last 20 years, but the current crisis has reversed improvements made over the past decade since the Great Recession. Now, millions of people are newly experiencing food insecurity, alongside those who were already experiencing it. Feeding America has been releasing datasets that show the 2019 and 2020 rates and then also include 2021 projections which show projected increase in food insecurity for the foreseeable future due to the effects of the pandemic (https://www.feedingamerica.org/, 2020).

Researchers have begun studying urban sprawl and the effects on the urban food system and access to supermarkets and grocery stores (Mead, 2008). The study posits that the move of many people out to suburban areas once it became a very common for households to have a vehicle plays a big role in the "disappearance" of as many grocery stores in the urban core. The study showed that the supermarkets seemed to follow the people. The analysis continues by including having a car because he highlights that for true changes to be made, this will come at the hand of the policy makers. However, the study shows a big disconnect here with transportation. That is, when we talk about food deserts and food insecurity, we are talking about accessibility being a major component. Mead (2008) suggests that the issue with policy makers is that many times they don't consider accessibility because we live in the age of "everyone has a car" and they might not consider how large of a population of people do not have access to transportation. Access to a vehicle is a contributing issue to food insecurity in all urban areas, which is addressed in the survey performed in Kansas City, MO for this case study (See Table 1).

Thapa et al., (2021) studied the outcome of a strategic placement of urban agriculture on the enhancement of the alternate food supply, physical activity, and promotion of social interactions. While social and health benefits are critical priorities when planning new urban agriculture locations, no widely accepted site selection methods have been established. This study developed a spatial optimization model to identify new urban agriculture locations in the City of Indianapolis, Marion County, Indiana. Considering block groups with vacant parcels as potential locations, the study uses p-median optimization to identify the 25 best locations that would minimize travel from any block group in the city to potential garden locations. Each block group was weighted based on food access and prevalence of obesity, where food access was characterized on three dimensions: economic, geographical, and informational. The model was simulated for three policy scenarios with equal, stakeholder-driven, and obesity-driven weights, and the results were compared with randomly selected locations. The study found that optimally selected locations were 52% more efficient than randomly chosen locations in terms of the average distance traveled by residents based on the p-median solution. However, there was no significant difference in travel distance among the three policy scenarios. The spatial optimization model could help policymakers and practitioners strategically locate urban agriculture sites.

On the local level, food deserts are a huge problem in Kansas City as well as many other metropolitan cities, however, it is clear that adding more supermarkets is not the solution. Many urban farmers and growers exist in these areas of need and could be a potential solution to providing access to those that do not have it. For urban farmers to become a viable solution, transportation of goods will be key. There is a need to answer the question of how to get the food to the people that need it. Physical access to food is not the only problem that has to be solved when looking at the issue of food insecurity and access, the issue is much deeper. The problem is systemic and other issues have to be considered. For example, a person already living in poverty is likely already overworked and grocery shopping may be possible, but there is the further issue of being able, having time to cook, access the equipment or supplies to cook the food, or even knowing what to do with the healthy food they could buy. Many residents of food deserts are looking for as many calories as possible for as cheap as possible, and quickly.

The purpose of this research is to evaluate whether the integration of an Urban Farming Network into the local food buying system will increase residents of a food desert's access to healthy and equitable foods. Based on previous research, we know that the addition of a supermarket or grocery store alone within a neighborhood does not result in an increase in food access. This experiment integrates an Urban Farming Network which includes a physical food buying space as well as a community effort within the neighborhood to increase interaction between the grower and the consumer to increase access to healthy foods. An Urban Farming Network, defined for this study, is a network of local growers in an urban community providing food to local residents and community members. This network includes a physical pick-up space within the given neighborhood to purchase and receive goods as well as the ability for direct interaction between the grower and consumer, which can lead to the building of community relationships with food desert residents.

# CHAPTER 3

# METHODOLOGY

## 3.1 Socioeconomic Survey

The preliminary research for this study began with four separate focus groups aiming at better understanding the food deserts and food accessibility in Kansas City by speaking to those who understand this issue and/or are experiencing it themselves. The focus groups were formed and populated during the COVID-19 pandemic, which served as an obstacle for observations and studying this subject. However, the focus groups were all able to be done via Zoom, acknowledging possible participant limitations to those with access to internet and a computer or phone with Zoom capabilities. Participants were selected using recommendation from partnerships established with local farmers and those that work closely with the food insecure community. Once we established a group of ideal focus group participants, we compiled a list of proper contact information for all those we hoped to participate in the focus groups. Email invitations were then sent to those that were determined to be a good voice for the issue and subject matter of the focus group itself, which is determined to be purposive sampling. The focus groups had four different discussion topics and the participants that chose to join reflected the topic. The four topics consisted of the following:

- IoT Sensor Network – Enhancing food productivity with less cost for profitable farming (Convened by Dr. Sejun Song in Computer Science at the University of Missouri – Kansas City).

- Micro-transportation – Connecting farmers and residents in food deserts with minimal cost (Convened by Dr. Carlos Sun in Civil and Environmental Engineering at the University of Missouri).
- Socioeconomic – Advancing socioeconomic benefits to growers and low-income residents (Convened by Dr. Sookhee Oh in Sociology at the University of Missouri – Kansas City).
- Food and Nutrition – Post-harvest processing from growers enhancing the freshness of food and preserving food nutrition for consumers (Convened by Dr. Kiruba Krishnaswamy in Sustainable Food Systems Engineering at the University of Missouri).

Each focus group had 90-minute discussions with around 12 participants as well as the principal investigator. The discussions always centered around low-income residents' needs and issues for healthy food accessibility based on either their own experiences or secondhand experiences. The participants in the focus groups mostly included urban farmers, non-profit organization staff, and food desert residents. It was noted that the participants that are food desert residents were a highly underrepresented demographic for the focus group discussions. COVID-19 likely played a role in this underrepresentation of the food desert residents as having the focus groups through Zoom was limiting in participation possibilities. The focus group discussions were all completed in January and February 2021.

With the value and information provided by the focus group participants, a survey for local residents was then developed to distribute (See Table 1) at two local farmers' markets located in food desert areas, Antioch Urban Growers and Ivanhoe Farmers'

Market. The survey included demographic questions as well as questions about the participants' current food buying practices and thoughts on their personal situation with food and health. The survey questions were developed with heavy influence from the socioeconomic focus group which painted a picture of the major barriers to healthy food accessibility for low-income residents.

The surveys (See Table 1) were distributed in person at two farmers' markets in Kansas City qualifying the sample of the survey as an Availability sample method.

| **Survey Question** | **Answer Options** |
|---|---|
| How often do you eat fresh produce? | a. None<br>b. 1-2 times a week<br>c. 3-4 times a week<br>d. 5-7 times a week |
| Where do you most commonly shop for food? | a. Convenience Store/ Gas Station<br>b. Discount Store (Family Dollar, Dollar General, etc.)<br>c. Supermarket, Farmer's Market<br>d. Eat at restaurants/ Fast Food<br>e. Community Supported Agriculture (CSA)<br>f. Online Shopping and Delivery |
| How do you usually get to the store? | a. Car/Truck<br>b. Bus<br>c. Bike<br>d. Walk<br>e. Friends/Family |
| Do you feel that you eat enough fruits, vegetables, eggs, milk, and whole grains? | a. Yes,<br>b. No |
| What is your age? | a. 18-34<br>b. 35-44<br>c. 45-54<br>d. 55-64<br>e. 65 or above |
| How many children do you have? | a. None<br>b. 1 |

| | |
|---|---|
| | c. 2<br>d. 3<br>e. 4<br>f. 5 or more |
| What is your ethnic background? | a. African American<br>b. Hispanic<br>c. Asian American<br>d. Native American<br>e. White (non-Hispanic)<br>f. Mixed Race<br>g. Other |
| What is the highest level of education you have achieved? | a. Less than High School<br>b. High School<br>c. Some college (including Associate's degree)<br>d. Bachelor's degree<br>e. Master's degree or above |
| What is the level of your annual household income? | a. Less than $25,000<br>b. $25,000-$50,000<br>c. $50,000-$100,000<br>d. $100,000-$200,000<br>e. More than $200,000 |
| . What is your address? | Named by participant |

Table 1: Survey given to local residents

There were a total of 131 surveys collected from the two farmers' markets. The survey aimed to better understand the eating and food shopping patterns and community needs among farmers' market shoppers. The information provided from the surveys was analyzed using SPSS statistical analysis software. Descriptive statistics were run on each of the questions in order to determine the distribution of answers and better understand the issues happening in the study area. The distribution of the answers were also able to be compared to the demographic questions like race and income in order to gain an even more in depth idea of the issues effecting residents living in food desert areas. Analysis of the survey data was performed using SPSS, a statistical software tool. In order to analyze the results from the survey, each survey question is coded using Nominal, Ordinal, Interval, and Ratio levels of measurement. Each survey question is coded individually in order to run descriptive statistics for each question and given its own analysis.

### 3.2 Spatial Analysis

After analyzing the data collected from both the focus groups and the distributed surveys, we were able to begin a spatial analysis of the data. To begin, census data was compiled for the five main counties that make up the Kansas City metropolitan area. The geographic unit of analysis for this study was the zip code. Zip codes do not technically represent a geographic area, but they are a network of roads and addresses utilized by the United States Postal Service to provide delivery services. There can be a large amount of variability from one zip code to another in terms of size. Despite this variability, zip codes often are used as the unit of analysis given their geographical context. The zip codes are used in two different analyses in this study. Firstly, zip codes were used in mapping the Kansas City metropolitan area. In the mapping of Kansas City using GIS, layers were added to the maps showing median household income by zip code and its distribution throughout the city. This information is used to help determine what areas are designated a food desert. The study areas we focused on for the study were determined due to the zip code and location within a food desert as well as being a place with an already existing infrastructure for urban farming and food cultivation. Zip codes were also used for the analysis of surveys that were distributed to local residents at a farmer's market within the designated study area. The zip codes were used to visualize the distribution of the residents that took the survey in order to better understand where the food buyers were coming from within the city to purchase food at the farmer's markets that existed in the food desert; this helped to understand whether or not the people living in a food desert and experiencing food insecurity were also the purveyors of the Urban Farming Network that already exists in close proximity to their place of residence.

For this study, food deserts within the Kansas City Metropolitan area were identified using the United States Department of Agriculture's (USDA) Food Access Research Atlas (https://www.ers.usda.gov/data-products/food-access-research-atlas/go-to-the-atlas/). This atlas uses census data as well as data on supermarkets and grocery stores in order to designate a food desert. The Atlas defines a census block as being Low Access by a distance designation, "a tract in which at least 100 households are located more than one-half mile from the nearest supermarket and have no vehicle access; or at least 500 people, or 33 percent of the population, live more than 20 miles from the nearest supermarket, regardless of vehicle availability" (Coleman-Jensen et al., 2021). Food security means access by all people at all times to enough food for an active, healthy life. USDA's Economic Research Service (ERS) plays a leading role in research on food security and food security measurement in U.S. households and communities. Most U.S. households have consistent, dependable access to enough food for active, healthy living, considered food secure. However, some households experience food insecurity at times during the year, meaning their access to adequate food is limited by a lack of money and other resources. USDA's food and nutrition assistance programs aim to increase food security by providing low-income households access to food for a healthful diet, as well as nutrition education. USDA monitors the extent and severity of food insecurity in U.S. households through an annual, nationally representative survey.

There was no official record of urban farms that existed in Kansas City at the time of this study. In order to compile this information for the analysis, I explored many sources to compile the farms to locate in the Kansas City Metropolitan area. The sources included discussion with urban farmers from the surveys and focus group discussions, the use of search engines for any with traceable information on the internet, information from the KC Food Circle having a list of many existing urban farms, as well as information from farmer's markets and existing CSAs (community supported agriculture). This information was used to compile a verified list of urban farms currently operating within the Kansas City area, which amounted to a total of 74 farms. These newly acknowledged urban farms and their locations were compiled to create a GIS database for this study. In order to analyze for spatial autocorrelation, Global Moran's I was performed on the urban farm location data. Moran's I is a correlation coefficient that measures the overall spatial autocorrelation of your data set. The Global Moran's I measures spatial autocorrelation based on both feature locations and feature values simultaneously (See Figure 3.1). Given a set of features and an associated attribute, it evaluates whether the pattern expressed is clustered, dispersed, or random. The tool calculates the Moran's I Index value and both a z-score and p-value to evaluate the significance of that Index. P-values are numerical approximations of the area under the curve for a known distribution, limited by the test statistic. The Moran's I computes the mean and variance for the attribute being evaluated. Then, for each feature value, it subtracts the mean, creating a deviation from the mean. Deviation values for all neighboring features (features within the specified distance band, for example) are multiplied together to create a cross-product. When values for neighboring features are either both larger than the mean or both smaller than the mean, the cross-product will be positive. When one value is smaller than the mean and the other is larger than the mean, the cross-product will be negative. In all cases, the larger the deviation from the mean, the larger the cross-product result. If the values in the dataset tend to cluster spatially, the Moran's Index will be positive. When high values repel other high values, and tend to be near low values, the Index will be negative. If positive cross-product values balance negative cross-product values, the Index will be near zero. After computing the Observed Index value, the Expected Index value is computed to compare to each other. Given the number of features in the dataset and the variance for the data values overall, the tool computes a z-score and p-value indicating whether this difference is statistically significant or not.

The Moran’s I statistic for spatial autocorrelation is given as follows:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{\sum_{i=1}^{n} z_i^2}$$

1.)

Where Zi is the deviation of an attribute for feature *I* from its mean (*xi – X)*, *wi, j* is the spatial weight between feature *i* and *j, n* is equal to the total number of features, and $S_o$ is the aggregate of all spatial weights:

$$S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j}$$

2.)

The *zI*-score for the statistic is computed as:

3.) $$z_I = \frac{I - \mathrm{E}[I]}{\sqrt{\mathrm{V}[I]}}$$

Where:

4.) $$\begin{aligned} \mathrm{E}[I] &= -1/(n-1) \\ \mathrm{V}[I] &= \mathrm{E}[I^2] - \mathrm{E}[I]^2 \end{aligned}$$

With this, it was then necessary to perform a Nearest Neighbor Analysis on the data in order to determine whether the data were dispersed or clustered. The Nearest Neighbor Analysis measures the distance between each feature's center point and its nearest neighbor's center point. It then averages all these nearest neighbor distances. If the average distance is less than the average for a hypothetical random distribution, the distribution of the features being analyzed is considered clustered. If the average distance is greater than a hypothetical random distribution, the features are considered dispersed. The average nearest neighbor ratio is calculated as the observed average distance divided by the expected average distance, with expected average distance being based on a hypothetical random distribution with the same number of features covering the same total area (Ebdon, 1985). See Figure 3.2 for the calculations used in order to run the Nearest Neighbor Analysis on the dataset.

The Average Nearest Neighbor ratio is given as:

$$ANN = \frac{\bar{D}_O}{\bar{D}_E}$$

1.)

Where *Do* is the observed mean distance between each feature and its neighbor.

$$\bar{D}_O = \frac{\sum_{i=1}^{n} d_i}{n}$$

2.)

And *DE* is the expected mean distance for the features given in a random pattern.

$$\bar{D}_E = \frac{0.5}{\sqrt{n/A}}$$

3.)

In the above equations, *di* equals the distance between feature *i* and its nearest neighboring feature, *n* corresponds to the total number of features, and *A* is the area of a minimum enclosing rectangle around all features, or it's a user specified area value.

The average nearest neighbor z-score for the statistic is calculated as:

$$z = \frac{\bar{D}_O - \bar{D}_E}{SE}$$

$$SE = \frac{0.26136}{\sqrt{n^2/A}}$$

4.)

The average nearest neighbor equation above is used to calculate distance (index and z-score) and is based on the assumption that the points being measured are free to locate anywhere within the study area. The p-value is a numerical approximation of the area under the curve for a known distribution, limited by the test statistic. If the index (average nearest neighbor ratio) is less than 1, the pattern exhibits clustering. If the index is greater than 1, the trend is toward dispersion.

For both the Moran's I and the Nearest Neighbor Analysis, the calculation of the z-score and p-value are critical. These calculations are used in order to tell whether you can reject the null hypothesis or not. In the case of this study, the null hypothesis is complete spatial randomness of the features, or the values associated with those features. When the statistics are run on the data, the z-score and p-value will indicate whether the pattern is random or that it exhibits statistically significant clustering or dispersion.

After running the Global Moran's I and Average Nearest Neighbor statistics, it was necessary to run the Local Moran's I statistic. Given a set of features and an analysis field the Local Moran's I analysis identifies spatial clusters of features with high or low values. The tool also identifies spatial outliers. To do this, one calculates a local Moran's I value, a z-score, a pseudo p-value, and a code representing the cluster type for each statistically significant feature. The z-scores and pseudo p-values represent the statistical significance of the computed index values. The calculation works as follows:

$$I_i = \frac{x_i - \bar{X}}{S_i^2} \sum_{j=1, j \neq i}^{n} w_{i,j}(x_j - \bar{X})$$

1.)

Where *xi* is an attribute for feature *i, X* is the mean of the corresponding attribute, *wi, j* is the spatial weight between feature *i* and *j,* and:

$$S_i^2 = \frac{\sum_{j=1, j \neq i}^{n} (x_j - \bar{X})^2}{n - 1}$$

2.)

With *n* equating to the total number of features.

The *ZIi* score for the statistics are computed as:

$$z_{I_i} = \frac{I_i - \mathrm{E}[I_i]}{\sqrt{\mathrm{V}[I_i]}}$$

3.)

Where:

$$\mathrm{E}[I_i] = -\frac{\sum_{j=1, j \neq i}^{n} w_{ij}}{n-1}$$
$$\mathrm{V}[I_i] = \mathrm{E}[I_i^2] - \mathrm{E}[I_i]^2$$

4.)

A positive value for I indicates that a feature has neighboring features with similarly high or low attribute values; this feature is part of a cluster. A negative value for I indicates that a feature has neighboring features with dissimilar values; this feature is an outlier. In either instance, the p-value for the feature must be small enough for the cluster or outlier to be considered statistically significant. Note that the local Moran's I index (I) is a relative measure and can only be interpreted within the context of its computed z-score or p-value. The cluster field distinguishes between a statistically significant cluster of high values (HH), cluster of low values (LL), outlier in which a high value is surrounded primarily by low values (HL), and outlier in which a low value is surrounded primarily by high values (LH). Statistical significance is set at the 95 percent confidence level.

# CHAPTER 4
# RESULTS AND DISCUSSION

## 4.1 Purpose

The purpose of this study was to focus on the equitable access to food for vulnerable communities living in food deserts. We've seen plenty of research throughout the years around the idea of the causation for food desert areas and the keys to solving this problem affecting many people. However, there has yet to be shown a lasting solution to the problem. With this case study, the focal point became the local food growing environment as a key to sustainably become an answer to a difficult issue. After compiling the information necessary in order to understand the urban farming community and network it was necessary to learn about the residents living in the food deserts being studied. The focus groups and later surveys were a way to get direct information from those who are affected in their daily life by the issue at hand.

## 4.2 Surveys, Focus Groups, and Demographics

The focus group discussions were the first steps into understanding the residents living in the food desert area. In the focus group discussions, it was important to identify the socioeconomic issues and needs for economically disadvantaged residents to have enhanced healthy food access in Kansas City. For the focus group, the participants consisted of mostly urban farmers and non-profit organization staff as well as an underrepresented group of residents. This unbalanced group of participants did lend the answers and information in the focus group to lean more toward secondhand accounts being told. For example, the following question and answers were provided during the focus group discussion.

**What are some challenges when you go to shop for food? Is it a matter of time or transportation or your busy lifestyle?**

"*I try to stay out of the grocery store as much as possible, so I use the delivery service. We qualify for free lunch and food stamps but don't use them, but the delivery service we use offers 30% off if you qualify for food stamps since they don't accept it. So that has been good for us in terms of making delivery service more convenient and cheaper than going to the grocery store, which I feel uncomfortable doing right now because I have a young child."*

*"Personally, it's not that bad. We go to Aldi or the city market for our produce at least once a week. But I feel I should speak for those we serve. Many of those folks don't have that luxury because there is not enough money to do that, and often they don't have full access. They rely a lot on my community gardens, harvesters, and many people come to our food pantry and our community kitchen. I think that we can't ignore how many of our people rely on WIC and SNAP, so there's just a lot of uncertainty. It's more than just challenges. Many of them do work odd shifts, so it's tough for them to grocery shop."*

*"No challenges in shopping. The folks we serve - transportation issues, making ends meet."*

*"I'm pretty privileged, so I don't have many challenges shopping. In my work, we see issues around affordability, transportation, and availability of healthy or fresh food."*

This example very obviously shows that the participants in the focus groups are not necessarily a part of the group of people who are experiencing difficulty with food access. Later in the focus group discussion, the question was asked about some challenges you face when you want to consume produce. Most of the answers were similar to the previous, however one respondent said the following:

*"But for people that we work with, affordability, transportation, working non-business hours. For people living in low income houses the closest places to get food are a corner store or dollar store that typically don't carry fresh produce and the quality can be an issue. Some people don't know a lot about cooking, so they are not sure what to do with their produce. They may not have eaten that kind of produce before. There is a variety of things going on there."*

This response essentially echoes the exact problems that exist within food deserts as we know them today, it seems to be a continuation of knowing the issue exists but not having the resources to fix it. The focus groups were very informative. The biggest take aways from that focus group showed the following:

- Time constraints for frequent and regular grocery shopping
- Limited transportation
- Availability of quality produce
- Affordability
- Lack of cooking space and knowledge
- Emotional eating habits

Since the focus group had many local food growers as participants, the discussion was also able to get some understanding of issues they have on the growing side. The barriers for the urban farmers were also addressed, including the financial burden of low return to high investment in the necessary farming infrastructure as well as the legal and policy barriers such as no on-site sale or pick-up due to zoning issues and also bureaucratic hurdles. Through these discussions, the broader socioeconomic issues came to light which included the changing family structure to an increasing amount of single-family households, the challenge for community building, an enlarging economic disparity, and a need for a collaborative food hub as a sustainable local food system.

After the focus groups were completed, this information was then used in order to develop surveys to be distributed at local farmers markets in Kansas City. The survey (See Table 1) was distributed at the Ivanhoe Farmers' Market and the Antioch Urban Growers Farmer's Market. These two markets are in different areas of Kansas City and both exist within food desert areas. These were also the chosen locations due to each organizations extensive efforts and help with this project ongoing.

131 survey responses were collected from the two farmers' markets identified as Ivanhoe and Antioch. 83 responses were from Ivanhoe and 48 were from Antioch. The surveys also showed that of the collected surveys, 29 of the participants had a residence in the Ivanhoe neighborhood and 35 were from the Antioch neighborhood based on the zip code provided by the survey participant. The sample's characteristics found from the survey include the following:

| **Survey Characteristics** | **Distribution of Answers** |
| --- | --- |
| Nativity | Mostly U.S. (96%) |

| | |
|---|---|
| Age | • 18-44 (51%)<br>• 45-64 (33%)<br>• 65+ (16%) |
| Race and Ethnicity | • White (50%)<br>• African American (33%)<br>• Other (17%) |
| College Education | 45% |
| Household Income | • Less than $25,000 (20%)<br>• $25,000-$50,000 (37%)<br>• $50,000-$100,000 (30%)<br>• More than $100,000 (13%) |

Table 2: Results from Farmers Market Surveys

The findings from the survey showed that a majority of participants drive a car (96%) to go shopping for food at a supermarket (77%) and eat fresh produce almost every day (61%). 31% of all of the survey participants responded that they do not have or get enough nutritious food (See Figure 4.1). 45% of African American participants responded that they did not get enough nutritious foods in their diet, while only 20% of white respondents said the same. The nutrition gap is significant by the racial and ethnic groups when controlling for education and income. As well, it was found that the nutrition gap is spatialized. See Figure 4.2 for the result of the same survey question broken down by location. A higher percentage of the participants responded to not having enough nutritious foods from the Ivanhoe Farmers Market.

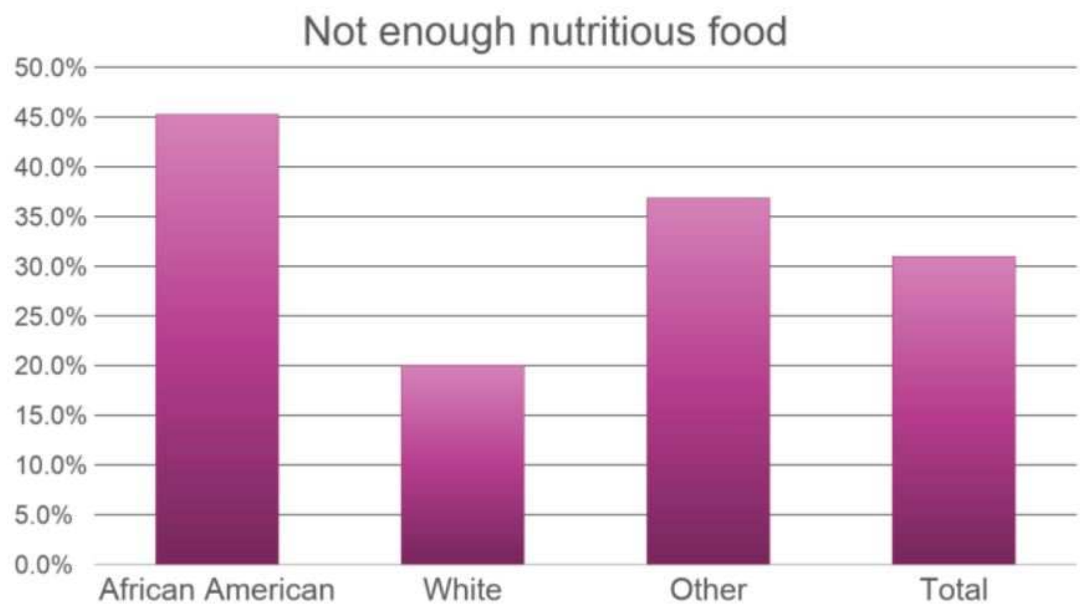


Figure 4.1: Result of Survey Question 4

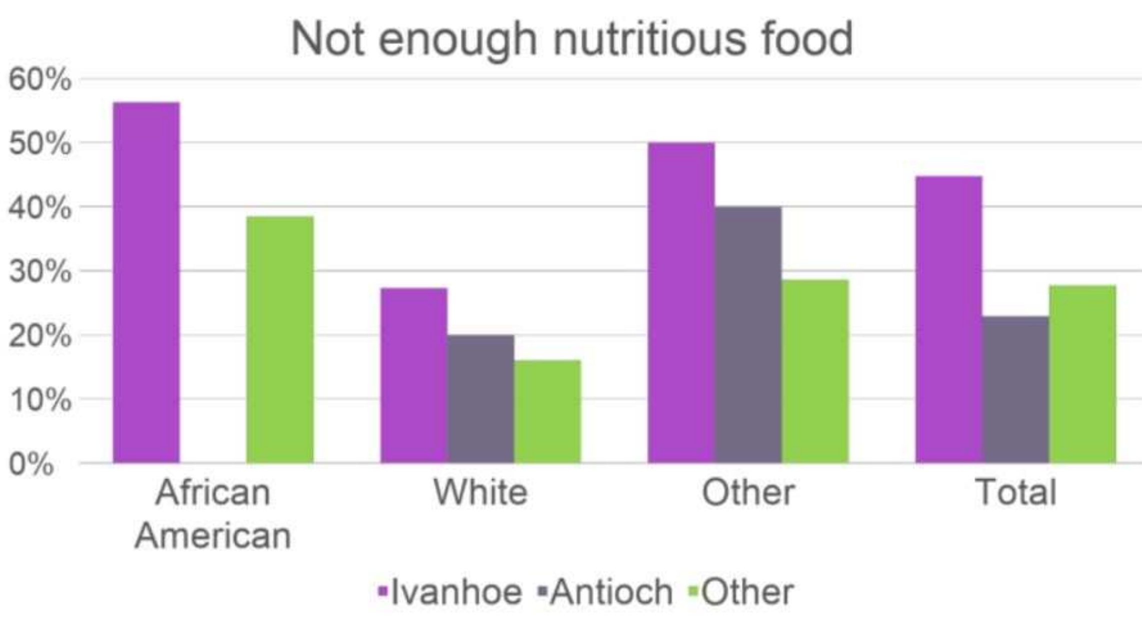


Figure 4.2: Result of Survey Question 4 by Location

As part of the survey, the question was posed to see what additional preference the participants would like to see introduced in the food system. See Table 4 for the distribution of responses.

| Rank | Total | Ivanhoe | Antioch | Other |
|---|---|---|---|---|
| 1 | Free gardening class | Free gardening class | Free or discounted weekly bag of produce from a local farm | Free gardening class |
| 2 | Free or discounted weekly bag of produce from a local farm | Mobile (truck) food market | Free gardening class | Free or discounted weekly bag of produce from a local farm |
| 3 | Free cooking class | Produce available in gas stations/convenience stores | Free cooking class | Mobile (truck) food market |
| 4 | Mobile (truck) food market | Free cooking class | Free farmer's market coupons | Free cooking class |
| 5 | Free farmer's market coupons | Free or discounted weekly bag of produce from a local farms | Mobile (truck) food market | Free farmer's market coupons |
| 6 | Produce available in gas stations/convenience stores | Free farmer's market coupons | Produce available in gas stations/convenience stores | Produce available in gas stations/convenience stores |

Table 3: What would you like in your neighborhood?

From Table 4 we can see that a majority of those who participated in the survey would prefer gardening classes or a free or discounting bag of local produce. This tells us that the preference is for the fresh produce, whether they grow it themselves or get it from a local farmer. The survey gave us a lot of information including an increasing awareness of complex socioeconomic issues and needs at the structural and individual levels for healthy food accessibility. A better approach to tackle a racial and spatial nutrition gap is needed. There are varying needs across different neighborhoods. As well, a collaborative food hub that connects the local growers and low-income residents is needed.

## 4.3 Spatial Analysis in Kansas City

The spatial analysis performed in this study began with locating and compiling all available data about the local farming community as possible. With this information, a geodatabase was created in ArcGIS to show the location of all of the urban farms in Kansas City, the basis of the Urban Farming Network (See Figure 4.3).

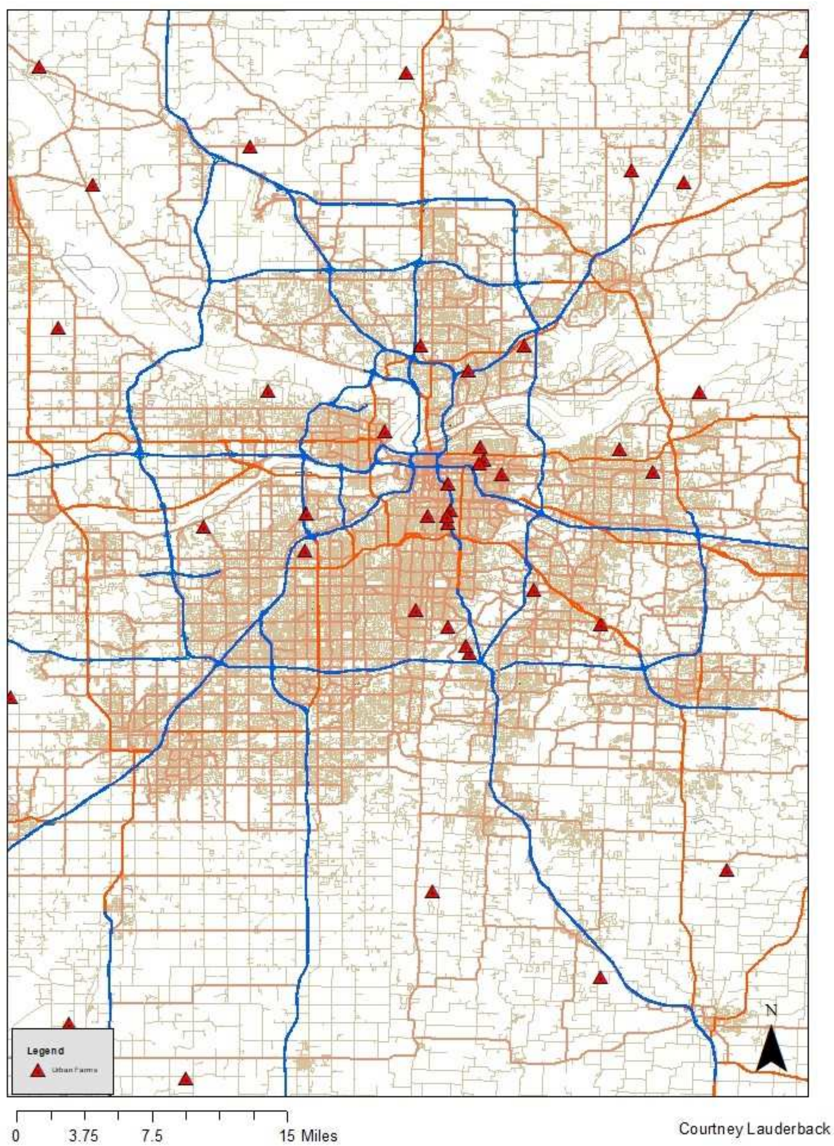


Figure 4.3: Map of Urban Farms in Kansas City

Once the farms were visualized, it was important to understand where these farms are located in Kansas City in reference to the food desert areas.

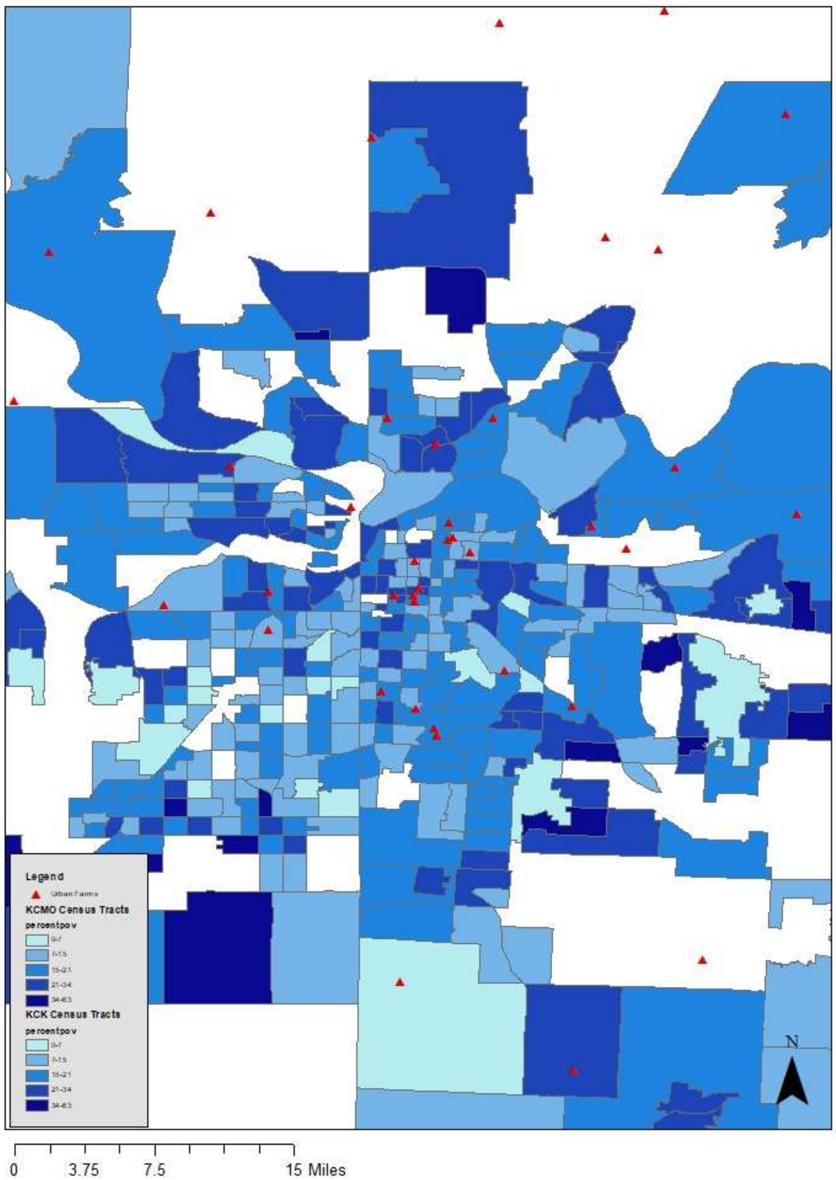


Figure 4.4: Map of Urban Farms in Kansas City with Percent Poverty Layer

After creating these maps and visualizations for the landscape of the urban farms in Kansas City, it was necessary to run descriptive statistics on the dataset to look for whether the data are clustered or dispersed, or perhaps random. First, the Global Moran's I was run resulting in the following:

| Global Moran's I Summary | |
|---|---|
| Moran's Index: | 0.114238 |
| Expected Index: | -0.013889 |
| Variance: | 0.002423 |
| z-score: | 2.602965 |
| p-value: | 0.009242 |

Table 4: Statistics of Global Moran's I of the Urban Farms in Kansas City

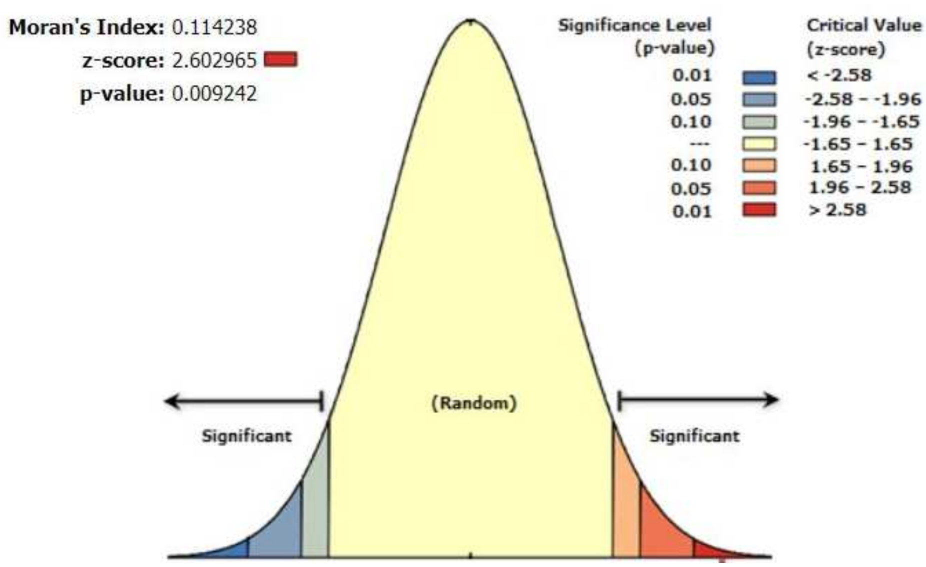


Figure 4.5: Global Moran's I of the Urban Farms in Kansas City

Given the z-score of 2.6, there is a less than 1% likelihood that this clustered pattern could be the result of random chance. The results of the analysis are always interpreted within the context of its null hypothesis. For the Global Moran's I statistic, the null hypothesis states that the attribute being analyzed is randomly distributed among the features in your study area. Based on the results from the Global Moran’s I, the null hypothesis is rejected, showing that the spatial distribution of the urban farms in Kansas City is spatially clustered. Next, the Average Nearest Neighbor Analysis was run on the dataset (See Table 6).

**Average Nearest Neighbor Summary**

| | |
|---|---|
| **Observed Mean Distance:** | 10685.6073 Meters |
| **Expected Mean Distance:** | 13284.4502 Meters |
| **Nearest Neighbor Ratio:** | 0.804370 |
| **z-score:** | -3.197634 |
| **p-value:** | 0.001386 |

Table 5: Statistics of Average Nearest Neighbor of the Urban Farms in Kansas City

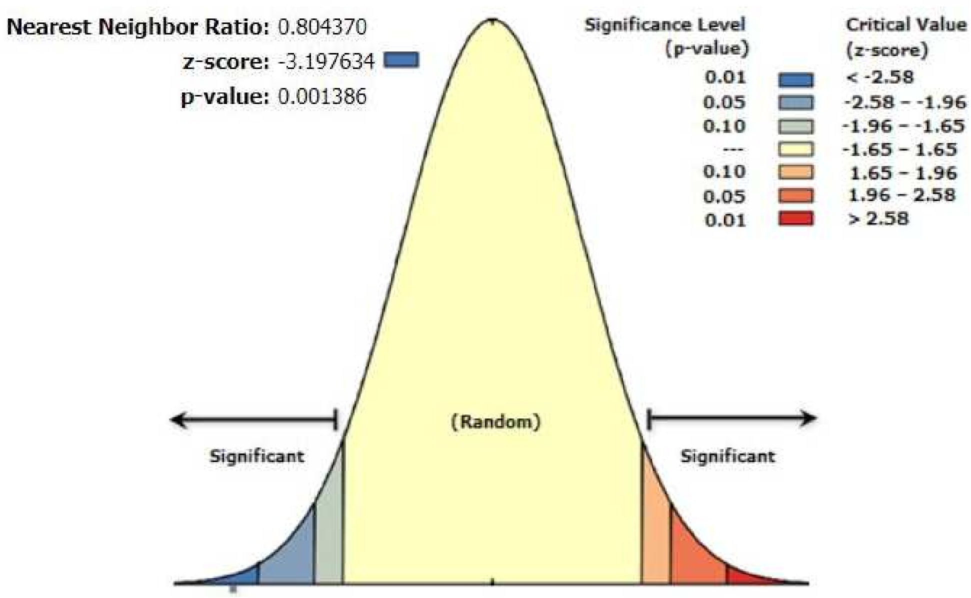


Figure 4.6: Average Nearest Neighbor of the Urban Farms in Kansas City

Given the z-score of -3.2, there is a less than 1% likelihood that this clustered pattern could be the result of random chance. The Average Nearest Neighbor analysis calculates a nearest neighbor index based on the average distance from each feature to its nearest neighboring feature. For this statistic, if the average nearest neighbor ratio is less than 1, the pattern exhibits clustering. If the index is greater than 1, the trend is toward dispersion. As we can see, the ratio is -3.2, therefore there is significant clustering in the dataset, corroborating the result from the Global Moran's I. I then ran the same descriptive statistics for the percent poverty data to show if there is clustering in the dispersion of those living in poverty (and consequently food deserts) in Kansas City.

| Global Moran's I Summary | |
|---|---|
| Moran's Index: | 0.060906 |
| Expected Index: | -0.006098 |
| Variance: | 0.000386 |
| z-score: | 3.409240 |
| p-value: | 0.000651 |

Table 6: Statistics of Global Moran's I of Percent Poverty Rates in Kansas City

| Average Nearest Neighbor Summary | |
|---|---|
| Observed Mean Distance: | 2246.6078 Meters |
| Expected Mean Distance: | 2581.3103 Meters |
| Nearest Neighbor Ratio: | 0.870336 |
| z-score: | -3.794526 |
| p-value: | 0.000148 |

Table 7: Statistics of Average Nearest Neighbor of Percent Poverty Rates in Kansas City

As was shown with the distribution of the urban farms in Kansas City, there is also significant clustering of the people living in poverty and food deserts in Kansas City. It is important to run these statistics because just looking at the map from Figure 4.5, one would not be able to determine whether there is clustering by simply looking at the map. The Global Moran's I on the percent poverty rate resulted in a z-score of 3.4, which shows that there is a less than 1% likelihood that this clustered pattern could be the result of random chance. The Average Nearest Neighbor on the percent poverty rate resulted in a z-score of 3.4, which also shows that there is a less than 1% likelihood that this clustered pattern could be the result of random chance (See Table 7 and Table 8). Using ArcGIS, I was able to map the results of the Local Moran's I.

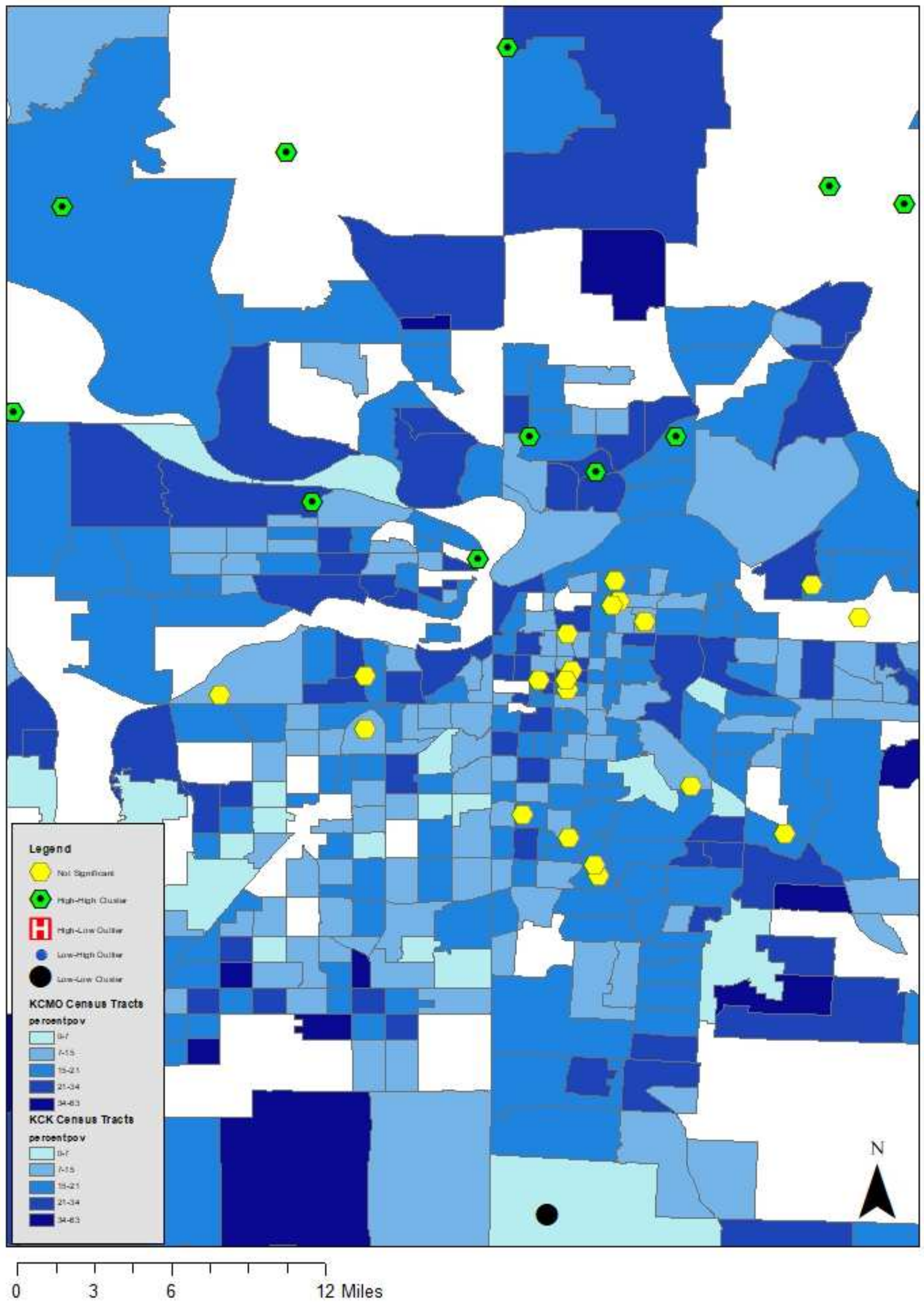


Figure 4.7: Local Moran's I of Urban Farms in Kansas City

The Local Moran statistic was suggested in Anselin (1995) as a way to identify local clusters and local spatial outliers. By studying the map in Figure 4.7, you can see the result of the Local Moran's I. The map shows that significant clustering takes place with the farms that are signified by the green hexagon, which are all located in the northern area of the Kansas City metropolitan area. The farms located toward the city center (signified by the yellow hexagon) all show no statistical significance. As well, there are no significant outliers that exist in this sample. Local Moran and Global Moran are used for different purposes and it depends on the assumptions you are using on your research. Global Moran implies that one single statistic can account for all of your data. Local Moran will return local clusters that may or may not be correlated. With the results from the both the Global Moran's I, we learned that significant clustering does exist within the sample. Then, with the result from the Local Moran's I, we learned that the clustering exists between eleven farms labeled "High-High Cluster" in the legend (green hexagon). This significance is showing that neighborhoods with higher numbers of farms are surrounded by neighborhoods with higher number of farms. This is a positive outcome considering what is being studied, and somewhat expected with the landscape of the Kansas City Metropolitan area. The geography of the area shows that as you move north of the river, the population begins to spread out some and there is more land available for things like farming. This landscape doesn't exist to that extent in the urban core of the city where we see there to be no significance when running the Local Moran's I. This is why we did, however, see the clustering using the Global Moran's I statistic, which showed there to be significant clustering of farms in that area, which was not significant by the Local Moran's I. Being in the more urban center of a metropolitan area, there is less land availability for something like farming, therefore, it is understandable that farms would cluster in areas with land availability and ability to grow in the soil.

Knowing that there is significant clustering of these farms, a buffer was added to the farms in ArcGIS to show where gaps might exist. Figure 4.8 shows the farms with a 1-mile buffer around them. 1 mile was chosen as the buffer as this is a defined standard by the USDA for walking distance, outside of what is designated a food desert. With that, it is clear that these farms alone do not meet a standard that could equitably increase access to healthy foods for a significant amount of the community struggling with food access.

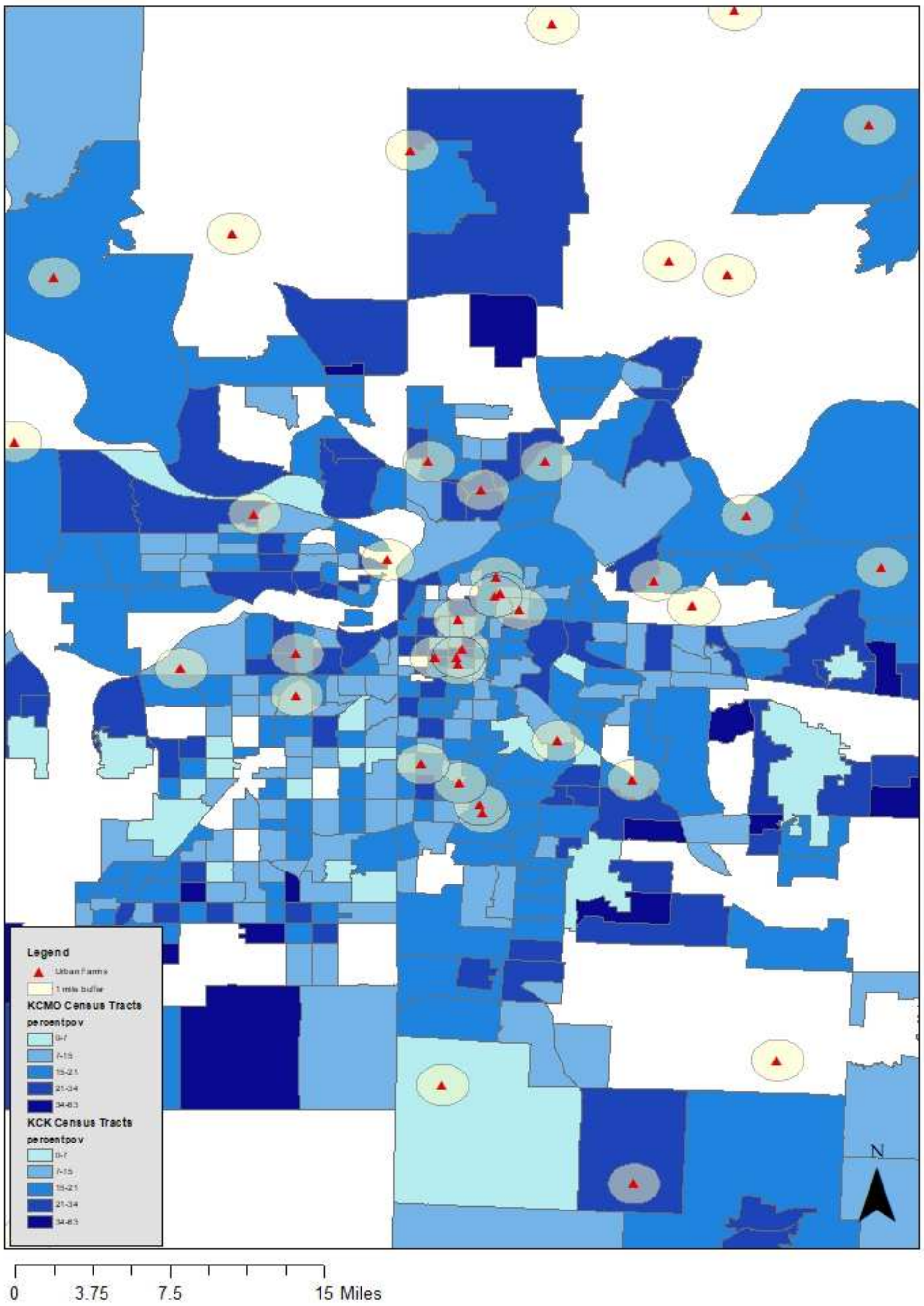


Figure 4.8: Map of Urban Farms in Kansas City with Percent Poverty Layer and 1 Mile Buffer

However, with the inclusion of the study “A Case Study if Micro-Transportation Food Delivery in Jackson County, Missouri” done by Joseph Reneker, Carlos Sun, Yaw Adu-

Gyamfi as a part of the Smart Food Oases project, the buffers around the farms were increased to 3 miles. As you can see in Figures 4.8 and 4.9, the change in buffer size made a significant increase in the area each farm could serve in Kansas City, therefore increasing access.

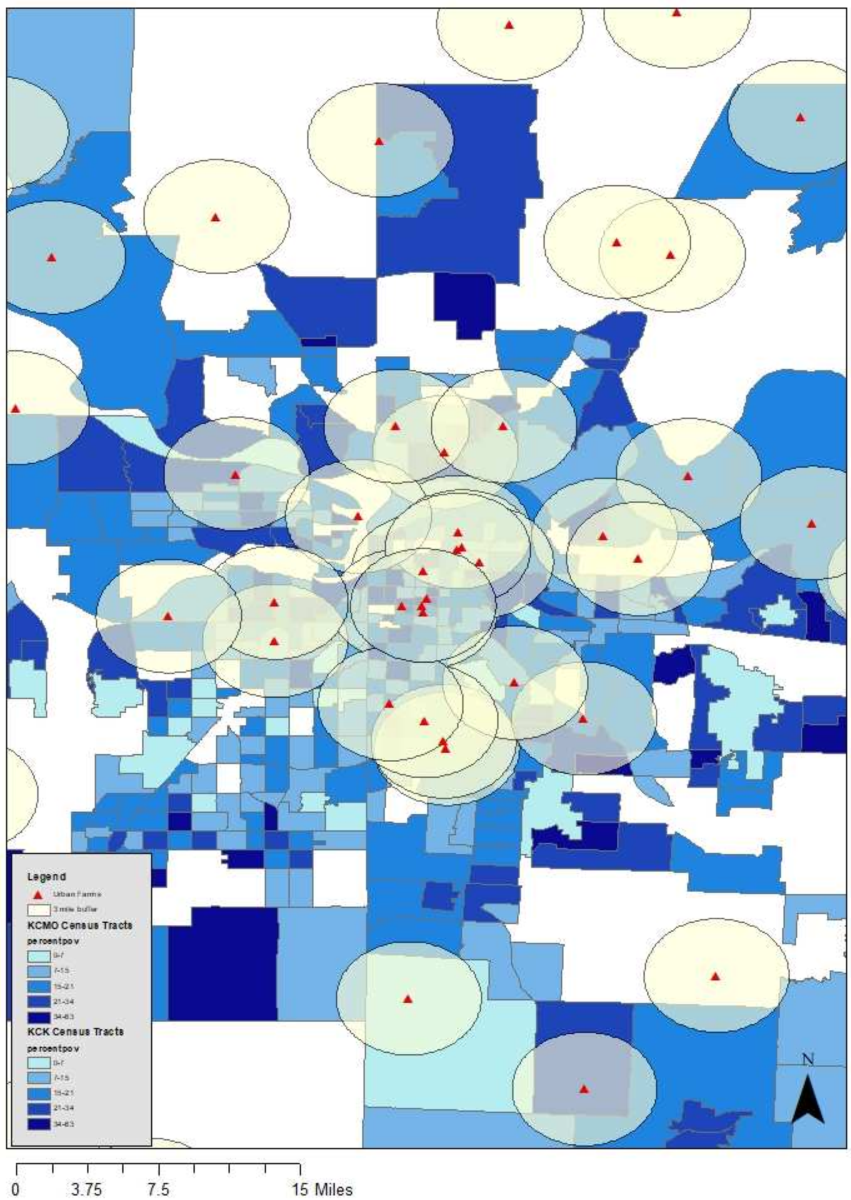


Figure 4.9: Map of Urban Farms in Kansas City with Percent Poverty Layer and 3 Mile Buffer

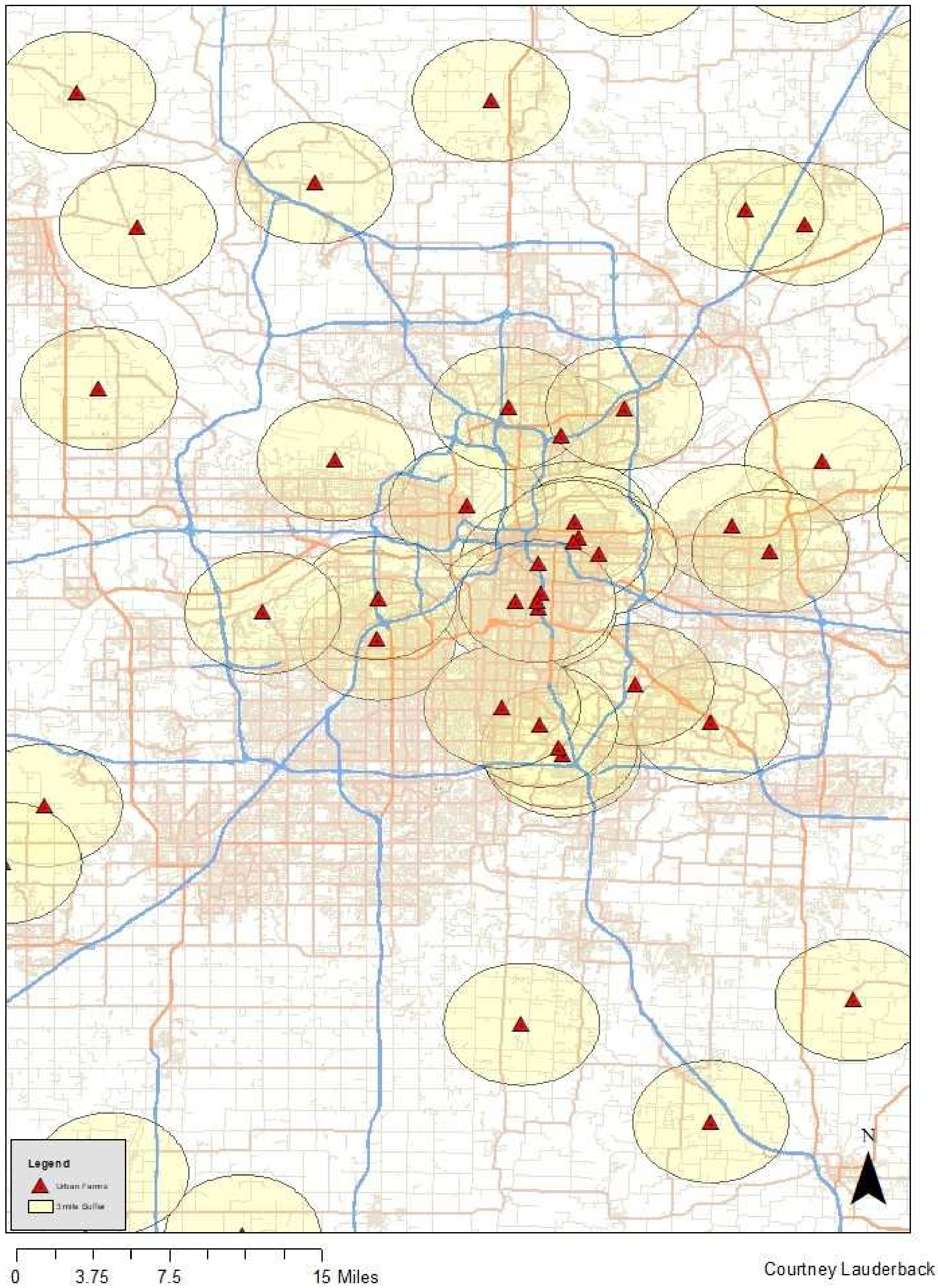


Figure 4.10: Street Map of Urban Farms in Kansas City with 3 Mile Buffer

The choice of 3 miles as a buffer was an arbitrary distance chosen for the Reneker case study. It was chosen because, in this scope, 3 miles would be too far to consider walking as the mode of transport, but short enough that the use of a car need not be assumed. The Reneker case study used ArcGIS to plot service areas for grocery stores in Jackson County, MO, and used census block data to evaluate how many households are deliverable by e-bike and car. The census blocks were mapped based on the delivery mode that is most feasible per block. The mode of delivery that is best suited for each census block, however, may depend on a variety of factors (time of day, weather, road conditions, etc.), availability of the vehicle type in the area, and/or personal preferences of the customer. For this analysis, if a location is deliverable by an e-bike, an e-bike was chosen. A car (or none) will be chosen otherwise. See Figure 4.11 for a display of the census blocks deliverable by e-bike and car.

The results of this case study show that there is a large potential for food deliveries via micromobility in Jackson County, Missouri. Most of the census blocks in the county may be deliverable by an e-bike. This case study evaluated whether a census block is deliverable by each mode, not which mode is most optimal. For this analysis, it was assumed that an e-bike is limited by the distance it may feasibly travel, which is 5 km in this study. The methodology also treats 5 km as an easy travel distance for a vehicle. Assuming the vehicle travels faster, delivery via car might always be seen as more optimal. However, by incorporating travel time measurements (e.g. urban congestion, availability of short-term parking, etc.) a new analysis may show that micromobility is better than a car in some short-distance deliveries. This case study found whether people living within a census block are close enough to any grocery store and may be served by food delivery. This case study did not include the urban farming and community agriculture delivery resources because this case study used readily available grocery information. It must be noted for the purpose of this study that access to grocery stores differ drastically between daytime and nighttime hours (Widener et. al., 2017). Many stores close, decreasing the availability of healthy food from where shift-workers are stationed. Public transportation also makes fewer and less frequent stops during nighttime hours.

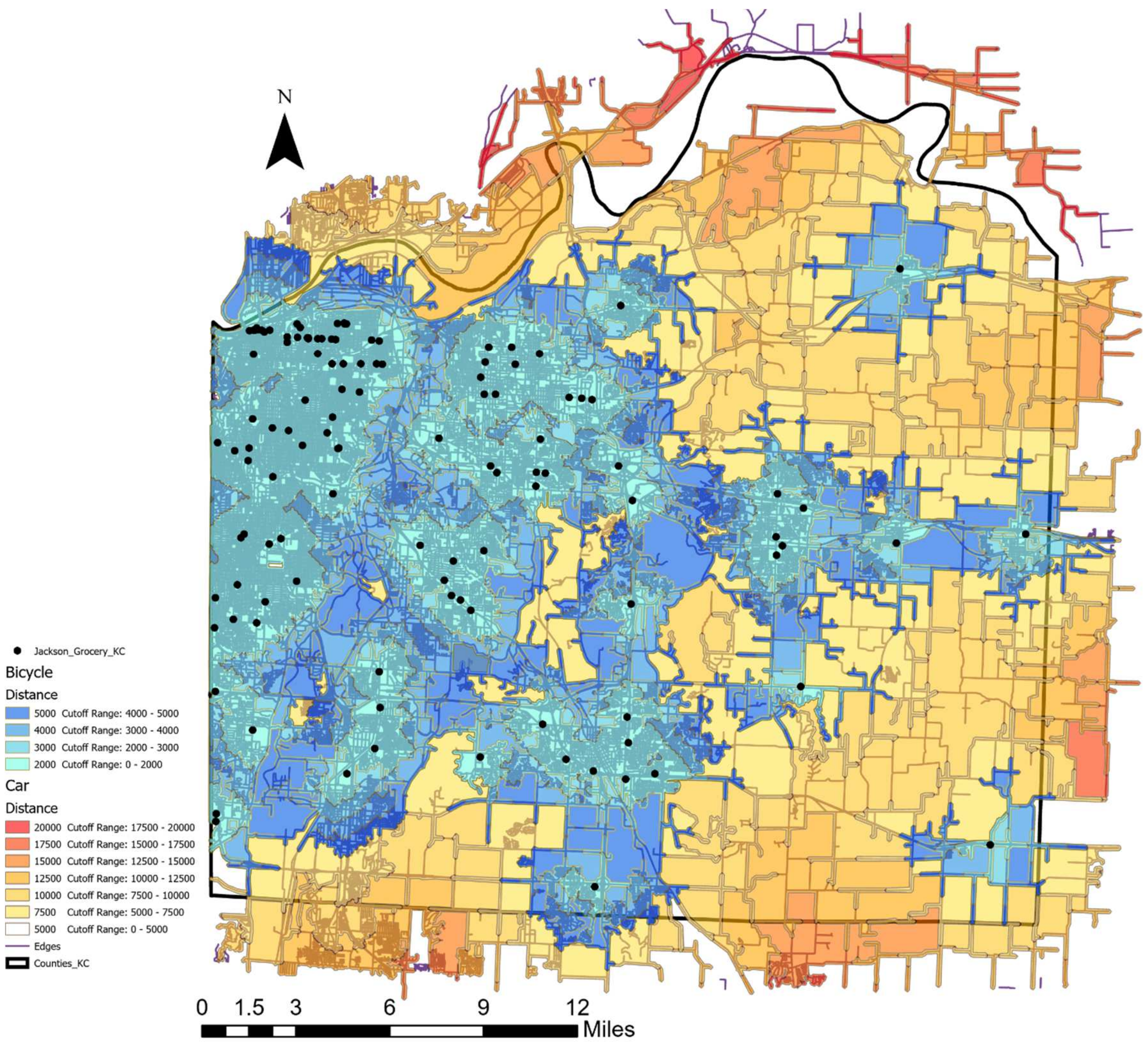

Figure 4.11: A map showing service areas plots for both delivery modes

Most of the census blocks in Jackson County may be deliverable by e-bikes (94.1% of population and 94.7% of housing units). 5.8% of the population and 4.9% of housing units are deliverable by a car. A small number of census blocks are not deliverable by either method. With the added value from this study, the addition of microtransportation as a food delivery method to the Urban Farming Network could be cause for a significant increase in healthy sustainable food access for those living in food desert areas in Kansas City.

In addition to the results demonstrating the potential for increased access, this data and analysis could also be used at the municipal level. The city of Kansas City could make a valuable impact on their food deserts by taking this information and seeing where the gaps are in access to healthy foods for their community residents. Knowing exactly where the food is being grown currently could push the city to do land studies on where else farms could be started in the city based on where they are currently lacking. As well, the city could invest in different types of infrastructure to support an equitable delivery system for these locally grown foods. This could be an investment in a fleet of e-bicycles to support the micro-transportation of locally grown foods to the consumer. This could also look like the city investing in neighborhood markets that are supplies by the local farms and functions as a physical pickup spot for food, but this would exist within each and every neighborhood to secure access to these foods for every person in the community, especially those living in food desert areas.

# CHAPTER 5
# CONCLUSION

Access to healthy food is sadly not something everyone has in the United States. Over 39 million people within the United States live in food deserts (AEFD, 2021). The most common groups affected by this are low-income communities and communities of people of color. Researchers consider a variety of factors when identifying food deserts, including access to food, as measured by distance to a store or by the number of stores in an area; household resources, including family income or vehicle availability; neighborhood resources, such as the average income of the neighborhood and the availability of public transportation. There has been an extensive amount of research into the subject over the years, however this problem continues to bare its weight on the most vulnerable communities that exist in the United States.

The present study focused on the local food system as a possible solution to the problem. This study specifically focused on the role of the local urban growers as being a potential solution to this very persistent problem. This study consisted of two sections of analysis, a socioeconomic analysis and a spatial analysis. The socioeconomic evaluation consisted of focus groups and surveys given to local residents as well as an analysis of the census data to get a better understanding to those living in food desert areas in the Kanas City Area.

Figure 1.1 shows where the USDA has designated a food desert within the Kansas City Metropolitan area. With this information and further data collection, I was able to compile a database of all of the urban farms that exist in Kansas City (See Figure 4.3).

With the Urban Farm database and local census data, I ran descriptive statistics (Global Moran's I, Local Moran's I, and Average Nearest Neighbor) to find there to be significant clustering of both the urban farms and the poverty rate that exists in Kansas City, with the Local Moran's I showing the clustering to be favorable to the northern region of the Kansas City metropolitan area (see Figure 4.7). With this information, I added different size buffers to the farms in Kansas City to show where gaps exist. These gaps showed that with the implementation of a micro-transportation network, a majority of the area that is included in the food deserts in Kansas City could be supplied healthy foods from the farms in Kansas City itself. This analysis also showed that this information can be used to show where the addition of a new farm could help the local communities and food desert areas and bridge the gap in acquiring access to healthy foods in the urban environment. Mapping the local urban farms and employing the microtransportation concept from the Reneker case study shows there to be significant coverage of food accessibility in the Kansas City metropolitan area. As well, this spatial analysis shows where the gaps in coverage exist, as in where the addition of more urban farms could fill the holes where a food supplier does not currently exist.

This study could potentially be extremely useful to the Kansas City area and could function as the blueprint in providing equitable access to food to every person in the community. This type of study can be replicated by other urban areas as well to show their gaps in the local food system and where improvements could be made. The integration of the Urban Farming Network (UFN) increases the equitable access to nutritious foods for vulnerable communities. The addition of the UFN could potentially influence the policy of the municipality and gain support and access government assistance programs to be used in the UFN. The success of the Urban Farming Network would be a defining factor in decreasing the size of the food desert being studied. There are a multitude of positive health impacts on a community that result from increased access to healthy foods. Due to the local focus of an Urban Farming Network, there is a potential decrease in supply chain interruptions due to the UFN existing within the community that the goods are distributed to. There is also a positive environmental impact of growing and consuming food grown locally, from soil health and green space use to the decrease in the need for food to be shipped from far distances. Every single person deserves access to healthy food no matter what age, race, income level, or anything else. Starting at the community level could be the start to putting an end to this problem. Addressing food insecurity at the local level brings the community together and helps every person and their neighbor and in this case, a healthier life for the community also becomes a healthier life for the environment.

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