FOOD ACCESSIBILITY: THE PROXIMITY OF FOOD SOURCES TO NEIGHBORHOODS IN THE TRIPLE CITIES OF BROOME COUNTY, NEW YORK.

BY

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Abstract

Issues of food accessibility and food insecurity receive high attention in the United States, due to evidence of disparities in the location and level of accessibility to nutritious food sources amongst neighborhoods of different economic classifications identified in several studies. However, most studies focus on grocery stores or convenience stores without considering other options available for food insecure residents. This research examined the different economic classes of neighborhoods in the Triple Cities of Broome County, New York and their proximity to grocery stores, food pantries and convenience stores, to establish the level of accessibility to food sources for residents of these different neighborhoods using ESRI ArcGIS for spatial analysis and Chi-Square for statistical analysis. The Findings reveal a positive relationship between the location and density of grocery stores, convenience stores and food pantries to low-income populations. Moreover, high-income neighborhoods are more disadvantaged in terms of physical access to food stores by distance. However, there exists an over-concentration of convenience stores in low-income neighborhoods compared to grocery stores and can have a negative impact on their diet choices and expenses on food.

Dedication

I dedicate this thesis to my family, friends, and advisors for their support in my studies. Special dedications go to my biological father, Alhaji Umar Abubakar, Tamale, Ghana, my Mother, Amina Tanko, Salaga Ghana, my godfather, Alhaji Abdul Rahman Ali, Atlanta GA United States and Professor Leo Wilton, Binghamton University, United States. You have given me an unflinching support from the start to the end of my master program, and I am highly appreciative of you.

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Chapter One

Food Accessibility, Insecurity and Assistance Programs in 21st Century United States

Concerns around the issue of food availability and accessibility, underlined by the problem of food insecurity, food deserts, poverty, health outcomes, and social justice, among others, have appeared in several studies in the United States of America. Individual and neighborhood socio-economic characteristics such as income, and race, as well as characteristics of the residential environment such as availability of food stores, determines individual's ability to access healthy food. Definitions of a food desert, food accessibility, and food security appear below and remain used throughout the thesis.

Food desert refers to an area with poor access to food stores that provide good quality food choices (Hubley 2011 and Shannon 2014; USDA 2009, Parece et al. 2017). Generally, food deserts depict regions located spatially distant from food stores and characterized by a high concentration of low-income populations. (USDA 2009, Farber, et al. 2014). The term food desert derives from the term desert, implying a region with the absence of nutritious food for occupants (Farber et al. 2014).

Food accessibility reflects the availability of nutritious food within a reasonable travel distance, estimated at half a mile (Apparicio, and Cloutier 2007, in Hubley 2011). Food access denotes the ability to have physical and economic contact with food (Jones

et al. 2013). Therefore, food access depicts a combination of both geographical availability (accessibility) and ability to acquire food financially.

Food security means access at all times to enough food for an active, healthy life (USDA 2009). Food insecurity depicts the unavailability of nutritionally adequate and safe foods, or the limited or uncertain capability to obtain acceptable foods via socially acceptable means (Harris, et al. 2014).

A relationship between poverty and an increase in rates of health-related concerns, such as obesity, remains established in the United States for many reasons, including people's inability to access food and services for healthy lifestyles (American Planning Association 2007, in Eckert and Shetty 2007 and Shannon 2014). As indicated in Figure 1, there is a fluctuation in the percentage of people living under the poverty line in the United States, corresponding to the national economic changes over a period.

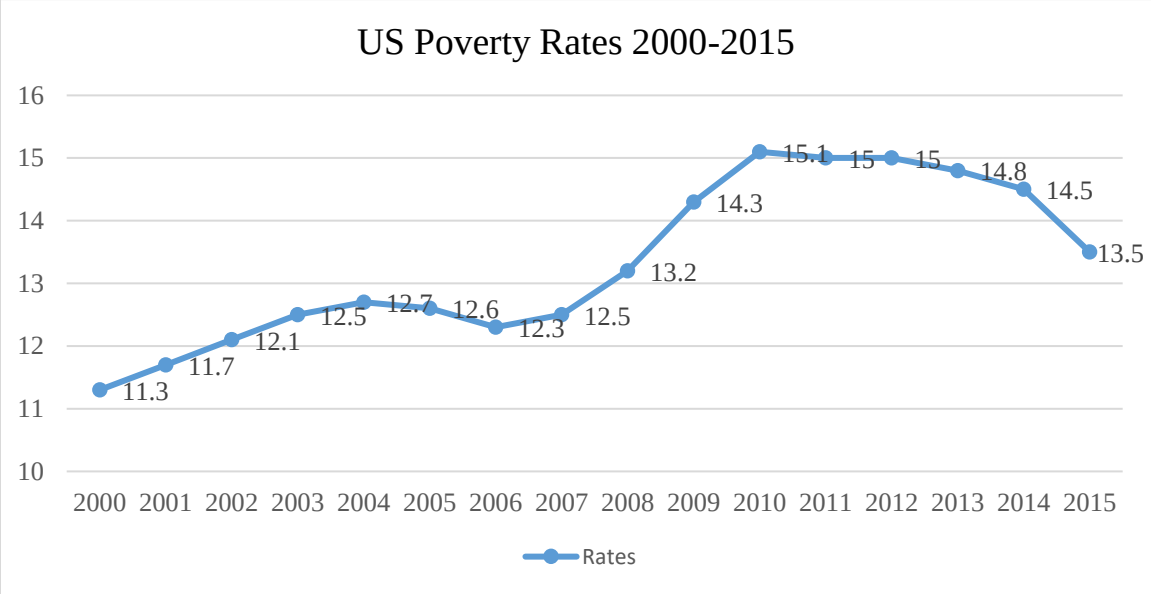

Figure 1: Line Graph, United States Poverty Rates, 2000-2015

The US poverty levels fluctuate with economic changes. For example, in 2010, 15.1 percent of all US residents fell below the poverty line (from 11,770 dollars for an individual to 24,000 for a family or 4), up from 11.3 percent in 2000. Moreover, the great recession from 2007 to 2011 reflects the poverty rates for the same period as the rates increased continuously from 12.3 in 2007 to 15.1 in 2011. Although a lower percentage of people lived below the poverty line in 2015, poverty-stricken Americans, per the Current Population Survey (CPS) Annual Social and Economic (ASEC) Supplement, comprise 13.5 percent of the population in 2015 and 14.5 percent in 2014. There exist several food assistance programs to support the poor population in the United States to acquire food as noted in many studies (Bonanno and Li 2015, Shannon 2014)

Food Assistance Programs: The Supplemental Nutrition Assistance Program (SNAP), formerly the Food Stamp Program, exists to support the low-income population in purchasing food (Bonanno and Li 2015, Shannon 2014, and Gundersen, et al. 2014). About 45 million Americans and 22 million households benefitted from SNAP in 2015, and as of 2016, about 43 million Americans, or about 21.3 million households, participated in the SNAP program (USDA 2017). To supplement SNAP, food insecure households may seek support through foodbank networks across the country (Gundersen et al. 2014).

A **foodbank** refers to a non-profit body that "solicits, receives, inventories and distributes donated food and grocery products based on industry and appropriate regulatory standards, directly to clients through various programs" (Feeding America 2014 pg. 1). With 200-member foodbanks in Feeding America, a national web of foodbanks across the country, the foodbank program provides food assistance to an

estimated 46.5 million people annually, with about 12 million children and 7 million seniors (Feeding America 2014).

Despite the support in the food purchasing power through the SNAP and access to meals and groceries through the foodbank program, several people still suffer from food insecurity (inability to access food at all times for healthy living) at some time in the year (Guo 2010). About 14.0 percent, or 17.4 million of households, experienced food insecurity during the year 2014. On average, 1 in 7 persons in the United States battle with hunger (USDA, Feeding America 2015) though an improvement compared to 2010, where 1 out of 10 persons faced food insecurity sometime in the year (Guo, 2010). The level of accessibility to food sources (stores, food pantries, food banks, soup kitchens, and state and federal programs), and the ability of foodbank locations to distribute adequate food supplies to the population determine food security for low-income populations. It is, therefore, necessary to measure the level of food accessibility and food insecurity at the local level and to contribute to the understanding and surmounting the challenges of hunger needs.

1.2 A County Level Investigation: Purpose and Significance

This research examines the disparities in food source accessibility for neighborhoods in the Triple Cities of Broome County, NY, namely the City of Binghamton, the Village of Johnson City and the Village of Endicott, the main initial urban core of the Binghamton metropolitan area. Grocery stores, compared to other food stores, such as convenience stores in neighborhoods, supply greater amounts of fresh fruits and vegetables for healthy nutrition. The study will examine the different economic classes (low-poverty and high-poverty) of neighborhoods in the Triple Cities of Broome

County and their proximity to grocery stores, and convenience to establish the number of food stores available for residents of these different neighborhoods. In addition, it examines the location of food pantries and their proximity to low-income populations in the county, because travel distance can affect the ability of food insecure households to access food pantries.

To achieve the research objective, specific questions the research answers include:

- ✓ Where are grocery stores located in the Triple Cities of Broome County New York?
- ✓ What is the travel distance to grocery stores for high-poverty and low-poverty neighborhoods in the Triple Cities of Broome County New York?
- ✓ How many grocery stores, convenience stores, and food pantries are available within walkable distance to low-poverty and high-poverty neighborhoods in Broome County New York?

The study stands relevant because it does not only add to the literature on food accessibility but also provides information on the nature of food distribution and accessibility in the Broome County area. Most of the studies reviewed focused on either grocery stores or convenience stores but this study provides a combination of both cases and an additional source of food, which is the food pantry. Additionally, limited literature exists on the nature of food accessibility within small cities such as the Triple Cities of Broome County, NY in the United States, as most previous research works focused on larger major cities in the country.

In the remaining parts of the thesis, we present eight different sections classified as chapters. Chapter Two details the reviewed literature on food accessibility, and food insecurity. Topics detailed in this section include methods in measuring food accessibility and food insecurity, disparities in food accessibility among individuals, the issue of food insecurity and food assistance programs and the social or health consequence of poor access to nutritious food.

Chapter Three presents the conceptual framework of the geographic dimensions of food accessibility and food insecurity. It derives from the literature review, the key concepts and variables examined in measuring food accessibility and food insecurity and shows the linkages between the variables and outcomes in understanding food accessibility and food insecurity.

Drawing from the conceptualization and literature review, the hypotheses appear under Chapter Four. The hypotheses examine accessibility to grocery stores and convenience stores by residents of neighborhoods of different economic classes, and the spatial locations and distribution of food pantries.

Following the hypotheses, Chapter Five provides details on the methods employed in the study, specifically, details on the data and its sources, measurements of distances, poverty, neighborhood classification, and methods of testing each of the hypotheses identified in Chapter Four.

Chapter six contains the description of the study area, the Triple Cities, namely Binghamton, Endicott and Vestal of Broome County, New York. Specifically, it

discusses the locational, physical, demographic or population characteristics, socio-economic characteristics and the available food sources of the study area.

Chapter Seven encompasses the analysis used in the study; It shows the detailed processes used to test the various hypotheses indicated in Chapter Five and shows the data and the results of the study.

Chapter Eight summarizes the main points of the thesis, discusses the findings and conclusions drawn from the study.

Chapter Two

Key Issues on Neighborhood Food Accessibility and Insecurity

Researchers cite several issues associated with neighborhood levels of food accessibility and food insecurity, including the social and economic characteristics of populations who reside in food deserts, food insecurity and the available programs to remedy the immediate problem of lack of adequate nutritious food. They indicate that individual and neighborhood socio-economic characteristics can affect individual levels of accessibility to nutritious food sources (Hilmers et al. 2012). Key issues expounded in reviewed studies include methods in measuring food accessibility and food insecurity and disparity in grocery store proximity to a residence or food deserts due to economic disparities. Also, included is the relationship between food accessibility and nutrition or health; food insecurity issues and assistance programs in the United States and their role in alleviating the challenges of access to quality food.

2.1 Measurements of Food Accessibility and Food Insecurity.

Food Accessibility: Several researchers have measured food accessibility with a variety of methods using Geographic Information Systems. The socio-economic characteristic of individuals, such as income, vehicle, and homeownership, and their relationship with household distance to food stores appear used in measuring food

accessibility in many studies (Rose and Richards, 2004; McKenzie 2013, Parece et al. 2017). However, place-based is perhaps the most commonly used method for measuring food accessibility (McKenzie 2013).

A place-based method often focuses on features of neighborhoods that influence individual abilities to access food (Algert and Agrawal, 2006; Bader et al., 2010; Grengs 2001 in McKenzie 2013**)**. Variables used in place-based measurements may include distance to food stores, transportation (walkability, public transportation, and mobility), neighborhood socio-economic characteristics such as poverty level, and race that determines the classification of neighborhoods (McKenzie 2013).

In measuring the distance from one point to the other, the commonly used method is the Euclidean method as it presents advantages such as simplicity and replicability, though it may not accurately account for curved distances within the built environment since it takes straight line measurements. Also in wide use is a survey of household travel time between one place to the other (McKenzie 2013).

A typical example of place-based study is Morland et al. (2001) study, on "Neighborhood Characteristics Associated with the Location of Food Stores and Food Service Place." They measured food store distribution in relation to neighborhood segregation by wealth and race. Specifically, they geocoded addresses of food stores in Mississippi, North Carolina, Minnesota, and Maryland, and estimated the wealth of neighborhoods using median housing values, and establishing the relationship between some food stores and neighborhoods. A Study by Caspi et al. (2012) "The Relationship between Diet and Perceived and Objective Access to Supermarkets among Low-Income Housing Residents" also used the place-based method, by measuring the distance to

supermarkets and taking perceived distance survey of households after classifying by low and high-income levels.

Food Insecurity: Gundersen et al. (2014) and Gundersen, in feeding America (2016) explain the processes of arriving at the meal gap or food insecurity at the local level. With Craig Gunderson as the lead expert, the food insecurity measure per Gunderson et al. (2014) draws from responses to eighteen questions on household food insecurity they administered. Such questions include "did you or the other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?"; "were you ever hungry, but did not eat because you couldn't afford enough food?"; and "did a child in the household ever not eat for a full day because you couldn't afford enough food?" They employed a model where they used variables such as Unemployment Rates, Poverty Rates, Median Income, the Percentage of Hispanics, Blacks and Home Ownership. They also included an error term, a weighted state and year fixed effects to minimize errors. These variables have been proven to have an influence on the level of food insecurity among households by several studies; food insecurity is higher among poor populations, (Gundersen et al. 2014), Blacks, Hispanic, below poverty level (Coleman-Jensen et al. 2016).

The socio-economic issues mentioned in the formula in measuring food insecurity and the methods of measuring distance and food accessibility are featured in the following sections to establish the disparities that exist among people in accessibility to healthy foods.

2.2 Food Deserts and Differentials in Neighborhood Accessibility to Healthy Food Sources

Food retail stores in the United States vary in size, variety, and quality. The three main types of food stores include supermarkets, grocery stores, and convenience stores (USDA 2015). A supermarket depicts a large service store offering a wide variety of food and household merchandises and groceries. A grocery store retails food including fruits and vegetables. A convenience store refers to a small store located for ease of access with a limited line of food services and merchandise and often charge higher prices compared to grocery stores (Morland et al. 2006, USDA 2015).

The identified food stores play relevant roles in providing food for American residents. However, grocery stores remain the main sources of healthy food such as fruits and vegetables (Hubley, 2011, Rose and Richards 2004, Auchincloss 2011, Morland 2001 and Steven et al. 2014). For instance, of 77 stores, 26 percent supermarket/grocery stores and 74 percent convenience stores identified in Orangeburg County, South Carolina, 75 percent to 100 percent of the grocery stores had healthy food such as fresh fruits and vegetables against 4 to 29 percent in convenience stores. Hence healthy food is substantially sold more in grocery stores compared to convenience stores (Liese et al. 2007)

There exists disparity in diet due to differential incomes and the segregation of wealthy households and healthy food stores from poor households and food stores with poor food quality in the United States, even if both parties share a preference for healthy food (Auchincloss 2011). Some researchers also argue that low-income residents spend more in grocery and other retail shopping due to the additional cost of transport to grocery shops compared to high-income residents who have them closer by, (Meltzer1

and Schuetz, 2012). Morland et al., (2001) in investigating "Neighborhood Characteristics Associated with the Location of Food Stores and Food Service Place" found that low-income neighborhoods in Mississippi, North Carolina, Maryland and Minnesota have fewer available grocery stores compared to medium or high-income neighborhoods. Also, there exist four times more supermarkets in predominantly White neighborhoods than Minority neighborhoods and three more times convenience stores in low-income neighborhoods than high-income neighborhoods in those states **(**Morland et al. 2001). Eckert and Shetty (2011), also found in their study titled "Food systems, planning and quantifying access: Using GIS to plan for food retail" that although food deserts do not exist in Toledo, Ohio, accessibility appear higher and more spread in areas with smaller grocery shops, but dotted within bigger service chains in the area. Also, neighborhoods in urban cores have less accessibility and low levels of income compared to dispersed suburban areas and that many residential areas within central Toledo, which exhibit both low-income and low food access characteristics, are mainly occupied by minority groups.

In Philadelphia, areas with higher concentration of public-assistance recipients, lower levels of adult education, and higher percentages of Black people also have fewer supermarkets compared to other areas, (Cannuscio et al., 2013). Moreover, areas with higher socio-economic status in Melbourne, Florida had better proximity to supermarkets, and lower socio-economic areas had more access to fast foods (Burns and Inglis 2007). Similarly, deprived neighborhoods in the Appalachia region of Kentucky have a lesser association with supermarkets compared to low-quality food stores like corner stores (Gustafson et al. 2012). Although poor residents in Cincinnati, Ohio have access to transit

transport services to travel for food, 40 percent of them have less access to a supermarket within 20 minutes of travel time than their wealthier counterparts; access is very poor for residents with the lowest rate of automobile ownership (Farber et al. 2014). After assessing the food environment of food deserts in Roanoke, Virginia, Parece et al. (2017), identified that none of the city's supermarkets was in the food desert area and that the city lacked healthy food options with only one out of its eight restaurants serving salad. Further analysis of the economic characteristics of the residents of the area revealed that most "poverty census tracts" in the city "have limited access to retail outlets selling fresh and nutritious food" (pg. 53).

Additionally, a study of census tracts in Forsyth County, NC, Baltimore. MD, Manhattan, NY and the Bronx, NY found that the types of food stores differ from one neighborhood to the other and that the location of food stores in the study areas relates to neighborhood's socio-economic composition. Predominantly high-income and white neighborhoods have more supermarkets than predominantly low-income and minority areas. Also, even though poor areas have several smaller grocery stores, generally, they have fewer fruits and vegetable markets, yet have several liquor stores than the wealthier neighborhoods. (Moore and Roux, 2006.)

On the other side of the argument, there exists good access to quality food stores spatially based on the limited food desert definition, "reasonable access" for residents within a neighborhood to grocery stores or supermarkets in Maine (Hubley, 2011). Furthermore, a study of access to supermarkets among poorer neighborhoods in Portland, Oregon by McKenzie (2014) revealed that both low and high-income residents of suburbs travel longer distances to access quality food stores compared to residents of the inner

city. The poor neighborhoods in the inner cities have the shortest travel time and distance to accessing grocery stores compared to equally poor neighborhoods and high-income neighborhoods in the suburbs because of a "concentration of transit and pedestrian friendly infrastructure in the central city" (pg. 146). He indicated that Portland's inner city low-income populations and the outer city low-income populations have a travel distance of 1,220meters and 1,410meters respectively. The low and higher-income populations in the suburbs have a travel time of 29.4 minutes and 35.3 minutes, respectively, compared to 24.4 minutes for the inner city low-income residents, thus indicate a relative advantage for the low-income inner city residents.

An assessment of disparities in access to food stores using a sample of over 7,588 census block groups across the country by Richardson et al. (2012), revealed that although disparity in availability of food resource exists, it does not apply to all low-income or minority neighborhoods as suggested by other research findings. Instead, race and income disparity in access to food store remain definite in low density, and low-income/minority concentrated urban cores, but less pronounced in high density, low-income/ minority concentrated urban cores. However, the low density, and low-income/minority concentrated urban cores have more available fast food services compared to other areas (Richardson AS et al. 2012). Due to poverty and the existence of people with inadequate access to food, programs exist under the USDA to support people to acquire food (Guo 2011).

2.3 Food Insecurity and Support Systems and Accessibility for low-income Residents

The Supplemental Nutrition Assistance Program (SNAP), supports households with inadequate resources to purchase food **(**McKenzie 2014, Guo 2011). However, a substantial number of poor people still face the problem of food insecurity and has a strong association with asset ownership (possession of property such as a home by a person or people) and not just income (Guo 2011). About 45.6 million United States residents experienced food insecurity somewhere in the year 2014, with a one in five of households with children experiencing it (USDA 2015, Parece et al. 2017). In 2015, an estimated 12 percent of United States households experienced food insecurity with about 5 percent suffering from very low food security, which implies that their food intake within the households was disrupted due to lack of money to access food (Coleman-Jensen et al. 2016).

Several other researchers have studied the prevalence of food insecurity among several populations and have revealed a socio-economic disparity in the prevalence of food insecurity among people. For instance, food insecurity appeared high among low-income populations in Los Angeles County, California, as revealed by a survey conducted by Furness et al. (2004). In the study, they found out that food insecurity prevalence decreased when the incomes of respondents increased, and it was higher among people living below the federal poverty line, among African Americans, Latinos and households with children, but less among Whites and Asians. Furness' findings appear confirmed in a recent report from USDA authored by Coleman-Jensen et al. (2016). They indicated that food insecurity is higher among households near or below the

federal poverty level, households with a single parent as head, and among homes headed by Hispanics and Blacks. Also at state levels, unemployment and poverty have a strong influence on levels of food insecurity. An increment of unemployment by 1 percent increases food insecurity by about 0.24 percent and an increment in poverty by 1 percent increase food insecurity by 0.20 percent. (Gundersen et al. 2014).

Also, Harris et al. (2014) posited that food insecurity has a negative impact on people's health and that residing in a household with food insecurity increases the chances of an infant of age 36 months or less to have a poor health condition and prone to hospitalization "some time since birth by nearly one-third" (pg. 97). Additionally, residing in a household with extreme challenges with food security increase the risk of adult diabetes because they are obliged to eat cheaper and non-healthful foods (Harris et al. 2014)

While the existence of SNAP has enhanced the ability of poor people to acquire food, physical accessibility affects some beneficiaries across the country (Rose and Richards, 2004). Participants in a study conducted by Christaldi and Castellanos (2014), in Lackawanna County, Pennsylvania indicated that proximity to food stores affect their level of food security. The participants in 10 separate focus group discussions of low-income, unemployed and also SNAP beneficiaries of the area cited the cost of transport services, restrictions on the number of food bags carried or additional fees for grocery bags, service hours of buses and the availability of grocery stores within a convenient distance as factors that affect their ability to have enough food. Furthermore, for those who rely on food pantries, working hours of food pantries and the locations of pantries

affect people's ability to have enough food, therefore, increasing their chances of being food insecure in certain periods.

At the national level, although the effects of different types of food stores are not known, Bonanno and Li (2015) found that the existence of food stores mitigates the level of food insecurity within a region. For instance, in households with children, they found that an 18 percent increase in the number of food stores has about the same level of reduction in adult food insecurity that could be caused by 20 percent increment in the distance to stores. In other words, an increase in one supermarket/grocery store for about 90,000 residents in United States metropolitan areas has the same food insecurity reduction impact as an addition of a small grocery store for 22,000 persons. Hence, increasing the access of people to the larger grocery stores impacts positively on their ability to be food secure.

2.4 Quality Food, Nutrition, and Health.

Studies on food deserts and low-income populations in the United States indicate a link between supermarket accessibility and fruits and vegetable consumption and healthy dieting in general **(**Inagami et al. 2006, Eckert and Shetty 2011**).** Also, a link has been established between the proximity of grocery stores and health complications like obesity, hence, the significance of grocery stores or supermarkets in promoting healthy lifestyles for United States residents. (Caspi et al. 2012)

In the United States, low-income residents often appear clustered in deteriorated areas of inner cities and at higher risk of contracting food related diseases compared to high-income residents (Eckert and Shetty, 2011 and Hubley 2011). Disparities in the

geographic distribution of healthy food sources likely contribute to the differences in the diet of people. Common health issues affecting people in food deserts or low-income populations include obesity and related illnesses (Auchincloss et al. 2013, Inagami et al. 2006). Obesity has been on the rise in the United States of America and relates to poor accessibility to quality food, among others. Hence, not a coincidence that it remains high in African-Americans, Latinos, low-income neighborhoods irrespective of race (Inagami et al. 2006), or single adult headed households and Hispanic head households (Rutten et al. 2012). For example, residents of Los Angeles County's disadvantaged areas have a higher Body Mass Index (BMI) than those in advantaged areas (Hutchinson, et al. 2012).

Neighborhoods with people who travel far distances to access grocery stores have higher BMI compared to those with people who travel shorter distances. For example, individuals with height 5'5ft and travel a distance more than 1.75miles have higher BMI than those who travel 1.75 or fewer miles to access grocery stores (Inagami et al. 2006). After using a sample of 307 stores and 1,243 population samples in urban southeastern Louisiana, and running a multivariate statistical analysis on available grocery stores and level of obesity in neighborhoods; Boder et al. (2012) found that living in a good quality food environment reduces the risk of being obese and overweight. Hence a relationship between the level of access to good quality food and obesity in the study area.

There exists a link between the level of access to supermarkets and the use of fruits among households, (Rose and Richards, 2004). For instance, in the United States, 76 percent of households have easy access to food stores, with those living within distance of a mile of a food store consuming more fruits and vegetables (285 grams a day) than those living within a distance greater than five miles of a food store (220 grams

a day). Considering a round trip travel time, people with shorter travel time also consume more fruits and vegetables than those with longer travel times; quantities stood at 269 grams per day and 244 grams per day respectively (Rose and Richards, 2004). In a city like Boston, the majority of the poor residents do not consume enough fruit and vegetables, and people who live more than a mile from a supermarket consume fewer fruits and vegetables than those within a mile of a supermarket (Caspi et al. 2012). The predominantly low-income residents in Mississippi, North Carolina, Maryland, and Minnesota have few available supermarkets. However, there exist more alcohol retail services in low-income areas than others, hence, a likelihood of the poor consuming more alcoholic beverages than healthy foods (Morland 2001). Results of a regression by Sharkey et al. (2013) showed that spatial access to food stores dictates the amount of quality food consumed by residents of Colonia, along the Texas – Mexico border. Specifically, it was revealed that a better proximity of residence to a convenience store, remains associated with a reduction in total energy, saturated fat, etc. among residence.

In conclusion, the literature reviewed shows a relation between income levels and the level of proximity to food stores, as most studies found disparities between the distance traveled by low and high-income residents to access grocery stores. We also see a relationship between the availability of grocery stores and the use of fruits and vegetables and the consequence of the lack of nutritious food on individual nutrition and health. Although results vary from place to place, many people live in food deserts, and some lack the financial capacity to purchase food though near retail shops. Although SNAP and foodbanks support a lot of people, some of the beneficiaries have to travel longer distances to access food stores or pantries. Thus the issue of distance is not

surmounted. The studies reviewed have great relevance to the study as they provide a detailed understanding of the issue of food accessibility in the United States as a background in investigating food accessibility for low-income populations in Broome County, New York.

Chapter Three

Conceptualization on Food Accessibility and Food insecurity

Based on the literature reviewed and the research purpose, the conceptual framework as shown in Figure 2 below, indicates the linkages between variables identified and their outcomes in food accessibility and food insecurity. The main variables include neighborhood socio-economic characteristics such as income and racial or ethnic composition and individual socio-economic characteristics such as employment status, income, race or ethnicity, assets ownership and availability of means of transportation such as public buses or private vehicles.

The conceptual framework illustrates an interplay of four main broader factors including spatial features, socio-demographic characteristics, food support systems and food insecurity and their linkage to food accessibility and consequence on individual wellbeing. On the spatial aspect, variables such as location and type of settlements such as rural and urban determine the food retail environment, travel distance to food sources and the type of transportation network available for public use.

In this context, the main food sources considered include grocery stores, convenience stores, and food pantries. As cited in the literature, urban areas have a higher concentration of food retail outlets over rural areas, they also provide residents with a variety of transportation services such a public bus and rail transport systems,

hence easier to travel to access food store locations in such settlements. Residents of rural settlements have lower densities of food stores hence travel longer distances to access food, because their locations, generally do not provide them enough public transportation options compared to the urban dwellers.

Furthermore, the conceptual framework indicates that individuals' neighborhoods socio-economic characteristics, such as income level and characteristics of the physical environment (food environment and available transportation) of where people reside, can affect their level of access to food. Also, the dynamics of the social environment, such as race and neighborhood income class of where people live, affect household proximity to various kinds of stores because entrepreneurs choose settings that enable them to maximize profit. The different kind of food stores such as grocery stores and convenience stores vary in sizes, locations, and quality in the food supplied.

Individual's socio-economic characteristics such as income or poverty level, employment status, home ownership, race or ethnicity, contribute to determining their level of food insecurity. People with low levels of income or people who live below the poverty line do not have enough money to access food resources; they may also have to depend on public transportation to access food stores if they do not have shopping options within a walkable distance, hence at a higher risk of being food insecure.

Moreover, the composition of household sizes of individuals affects their level of food insecurity. For instance, households with aged members who do not work, children and people with disability are likely to have inadequate financial capacity to purchase food since household members generally do not have flowing income. And even in the

case of aged and the disabled, the ability to use available means of transportation affects their mobility, hence increasing their chance of being food insecure.

In the United States, individuals facing food insecurity receive support through food assistance programs from the private and public sector. The public food assistance programs that support such low-income populations to acquire food include the Supplementary National Food Assistance Program (SNAP), the School Lunch Program and Women, Infants, and Children (WIC) food nutrition support service among others. In the private sector, the Foodbank program together with soup kitchens, and other religious and philanthropist organizations support poor individuals and families with food supplies. Despite these support services, the literature indicates that the proximity of individuals with low-income, high-poverty, and unemployment, etc. to food pantries or grocery stores, convenience stores and fast foods can also affect the availability of quality food to them.

Furthermore, individuals' choices of food affected by their level of access to nutritious food sources and or ability to acquire food have consequences on their wellbeing. According to the literature reviewed, poor people have poor health conditions such as obesity and diabetes compared to richer people because of over concentration of fast foods and convenience stores in their neighborhoods, therefore, proximity and availability of food remain crucial for individual well-being.

For the purposes of this study, the key variable from this conceptual framework used is the poverty level of neighborhoods and its relationship with the density of grocery stores, convenience stores, and food pantries. The poverty level of neighborhoods is

useful in classifying neighborhoods and determining the food retail environment of such neighborhoods. These linkages form the basis for the hypotheses established in the following Chapter Four.

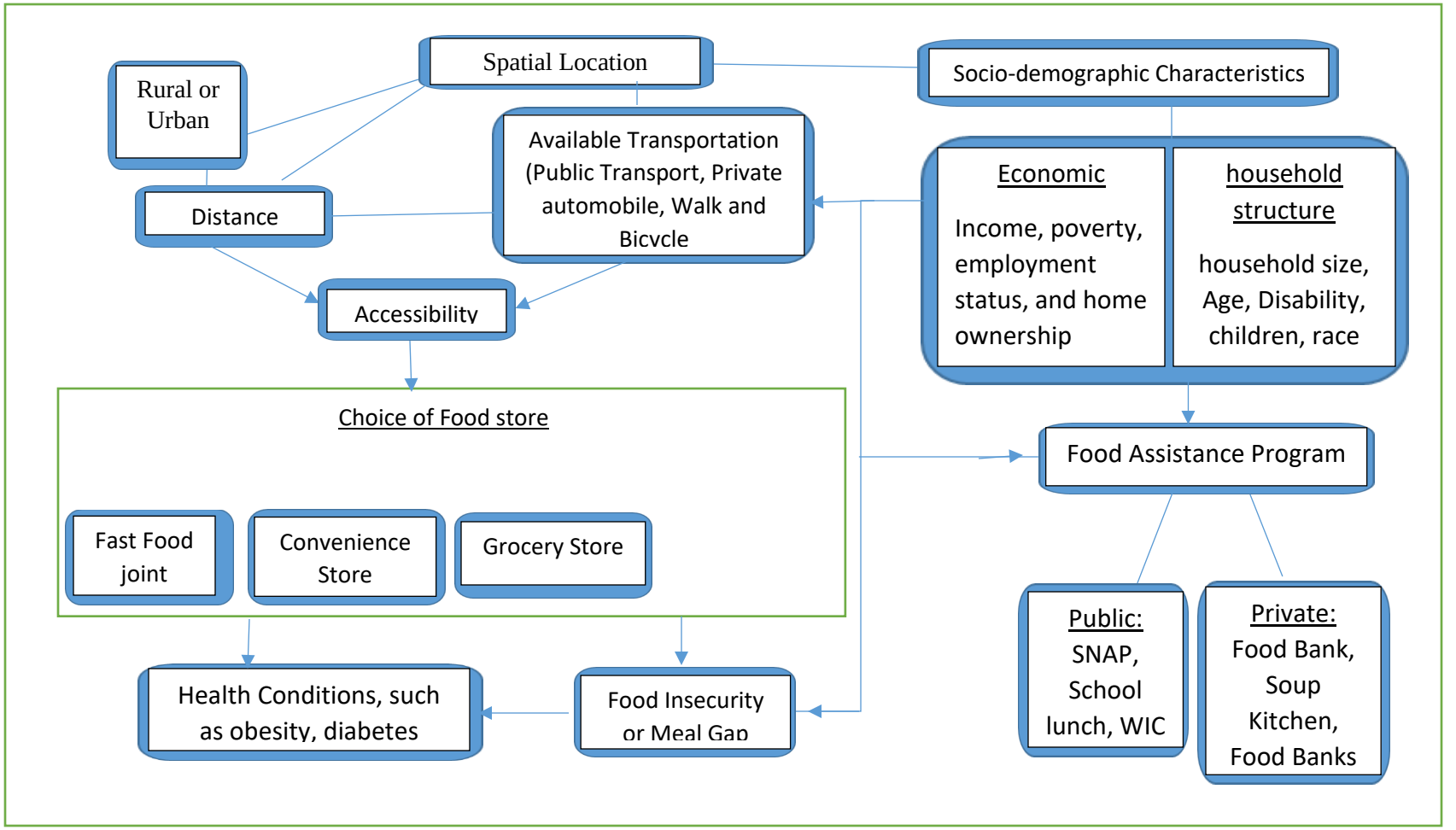

Figure 2: Geographic Dimensions of Food Accessibility and Food Insecurity

Chapter Four

Hypotheses: Grocery Store Location, Socio-Economic Characteristics, and Food Insecurity

Based on the literature on food accessibility in Chapter Two and the conceptualization in relation to the location of food stores, Convenience stores, and food pantries, and socio – economic characteristics in Chapter Three, the following hypotheses pertaining to economic variables, locational variables for grocery stores, convenience stores, and food pantries were formulated.

Hypothesis 1: Poverty and location of Grocery Stores

Based on the conceptual framework provided above, this hypothesis will test the relationship between neighborhood poverty level and distance to grocery store locations. As noted in Chapter Two, other findings indicate a relationship between the density of grocery stores and income, and that low-income populations have fewer available grocery stores compared to high-income residents.

Null Hypothesis (H_{01}): No relationship exists between the density of grocery stores and poverty level of a neighborhood.

Alternative Hypothesis (H_{A1}): A relationship exists between the density of grocery stores and poverty level of a neighborhood. Specifically, neighborhoods with

higher levels of poverty will have fewer available grocery stores compared to neighborhoods will lower levels of poverty.

Hypothesis 2: Poverty and Convenience Stores

As discussed in the reviewed literature and conceptual framework, low-income or poor neighborhoods have a higher density of convenience stores compared to high-income neighborhoods. Therefore, this hypothesis examines the relationship between income and convenience store location.

Null Hypothesis (H_{O2}): There exists no relationship between the density of convenience stores and neighborhood poverty level.

Alternative Hypothesis (H_{A2}): There exists a relationship between the density of Convenience stores and neighborhood poverty level.

Hypothesis 3: Poverty and Accessibility to Food Pantries

As low-income residents are the main targets for foodbanks, hypothesis three examines the relationship between the location of food pantries and the income level of residents close to them. Low-income residents who might also lack access to an automobile will find food pantries more accessible if they have them in close proximity. Below is the specific hypothesis.

Null Hypothesis ($H0_3$): There exists no relationship between the density of Food Pantries and the poverty level of neighborhoods.

Alternative Hypothesis (HA_3): There exist a relationship between the density of Food Pantries and the poverty level of neighborhoods. Specifically, there will be more food pantries in high poverty neighborhoods because food pantries will be located close to their service populations. Food pantries serve as a source of food for some low-income residents experiencing food insecurity.

In the next chapter, the methodology provides the details of data and analysis methods to test the hypotheses identified in this chapter. Specifically, Chapter Five explains the variables used, the source of data and the geographical and statistical analysis used in the research.

Chapter Five

Methodology

Drawing from literature on food accessibility and food insecurity, this thesis employs a place-based method of studying food accessibility, and uses both statistical test and Geographic Information Systems (GIS) to analyze the distance of grocery stores and food pantries for residents of low-income and high-income neighborhoods in the Triple Cities of Broome County of New York.

5.1 Data and Variables

The data used for this study include American Community Survey (ACS) 2015 200 percent of the federal poverty level at the census tract level, addresses of grocery stores, food pantries and convenience stores. The specific data and sources for the various hypothesis are as follows.

For hypothesis one, we used ACS 2015 poverty data, specifically, census tract-level data on 200 percent of the federal poverty level. To identify the location of grocery stores, we compiled a list of grocery stores and their addresses sourced from the Agricultural Business Organization list on food stores and businesses in Binghamton, Johnson City, and Endicott, in Broome County, New York and validated through a field survey and Google search.

The variables for testing this hypothesis include the 200 percent poverty levels and density of grocery stores, 200 percent of the poverty level provides larger numbers and minimizes the chance of measuring the lesser number of people who might be facing financial challenges. Moreover, all public health institutions in the United States have adopted the 200 percent at the poverty level for measurement of poverty in health analysis. The ACS data have some margin of errors, however, the ACS 2015 estimates remain the best available data for analysis.

In addition to the census tract level ACS 2015 poverty data as in the case of hypothesis one above, a list of convenience stores was used to examine hypothesis two. Convenience store addresses list was compiled from the Agricultural Business Organization list of food stores and businesses in the Triple Cities (Binghamton, Johnson City, and Endicott), Broome County, New York and corroborated through a Google search and field survey. The level of poverty of neighborhoods and the density of convenience stores are the variables used in testing this hypothesis.

Similar to hypotheses one and two, the census tract level ACS 2015 poverty data was used in examining hypothesis three. Also, a list of food pantries from the Foodbank of the Southern Tier in Broome County, New York is used in this analysis. The variables for testing the hypotheses are the 200 percent poverty level and density of food pantries geocoded.

5.2 Measurements and Specifications

Measurement of Poverty: Based on the American Community Survey 2015 data on the percentage of households below the poverty level by census tract, we designated census tracts with at least 25 percent of households at 200 percent of the federal poverty level as high-poverty census tracts and those with less than 25% as low-poverty census tracts for this study.

Measurement of Distance: The addresses of grocery stores and food pantries were geocoded, and distances to neighborhood census tracts were measured using the spatial join feature of ESRI ArcGIS. Neighborhoods for this study are classified as low and high-income, census tracts classified as high-poverty census tracts form the low-income neighborhoods while those that fall under the low-poverty census tracts form the high-income neighborhoods. The spatial join feature allows the selection of features (grocery stores, convenience stores or food pantries) that are within a certain proximity to a census tract. This method of measurements falls under the Euclidean method as it measures straight distances from census tract centroids to food sources. Areas that have lesser number of grocery stores, convenience stores, and food pantries, within a half-mile radius from a food source shall be considered to have low access. A half-mile was chosen because the USDA and researchers cited in the literature identify half a mile as the reasonably walkable distance to access a food store. The Buffer function in ArcMap was used to show the census tracts that fall within a half-mile to the grocery stores, convenience stores, and food pantries.

Statistical Analysis: After the spatial analysis was completed using the ESRI ARG GIS software (ARCMAP), the results for the categories (low-poverty and high-poverty tracts) were subjected to the Pearson's chi-squared and goodness of fit statistical test using the R-Studio software. The Chi-Square (X^2) test is a statistical method used to test the relationship between two discrete categorical variables from the same population. It tests the probability that observed differences from given categories have a statistical significance and gives a P- value that forms the basis for conclusions. A P-value if less than 0.05 level shows an insignificant deviation from the observed values, hence null hypothesis stand rejected, and a P-value over the 0.05 level indicates a significant deviation between the expected value and observed values. Hence the alternative hypothesis upheld. Table 1 below contains the summary of methods employed in the study.

The next chapter (Chapter 6) will provide a detailed description of the study area before the analysis, which will be captured in Chapter Seven to show how the methods and data were used in the study.

Hypothesis	Data Acquisition + Preparation			Data Portrayal + Analysis	
	Source	**Structure**	**Manipulation**	**Method of Portrayal**	**Method of Analysis**
H_{O1} No relationship exists between the density of grocery stores and poverty level of a neighborhood	ACS Census Tract Data on poverty (American Fact Finder and Tiger Shapefiles Food Store list, from New York State Agriculture business organization	Spatial/ Nominal	Original data Creation of categories	Maps and Graphs	Geocoding of Addresses, Calculation of distance using attribute joins, identifying low-income neighborhoods. Undertaking the Chi-Square Test
H_{O2} There exists no relationship between the density of convenience stores and neighborhood poverty level	ACS Census Tract Data on poverty (American Fact Finder and Tiger Shapefiles, list of Convenience store from New York State Agricultural Business Organization	Spatial/ Nominal	Original data, creation of categories	Maps and Graphs	Geocoding of Addresses, Calculation of distance using attribute joins, identifying low-income neighborhoods. Chi Square test analysis
H_{O3} There exists no relationship between the density of Food Pantries and neighborhood poverty level	ACS Census Tract on poverty, (American Fact Finder and Tiger Shapefiles. List of Food Pantries from the Southern Tier Food Program	Spatial/ Nominal	Creation of categories	Maps and Graphs	Geocoding of Addresses, Calculation of distance using attribute joins, identifying low poverty and high-poverty neighborhoods, Chi-Square test analysis.

Table 1: Summary of Methods

Chapter Six

Description of the Broome County NY, Study Area

This chapter describes the locational, physical and socio-economic characteristics, and the current food environment of the study area. Data were collected from United States Census Bureau, Broome County Department of Planning and Economic Development and the Agricultural Business Organization of New York.

6.1 Location and Organizational Characteristics

The study area, the Triple Cities is in the Southwest of Broome County, Southern Tier of New York and comprises of the City of Binghamton, the Village of Endicott and the Village of Johnson City. Broome County covers a land area of 705.77 square miles (Census 2010). As indicated in Figure 3 (Map of the study area), Broome County is bounded on the north by Chenango County, Delaware County to the east, Tioga County and Cortland County to the west and northwest respectively, and it shares boundaries with the state of Pennsylvania to the south. Broome County comprises several small settlements, a single city (Binghamton), seven villages and sixteen towns. The notable population centers of Broome County, are Binghamton, the seat of county and largest city, located at the confluence of Chenango and Susquehanna rivers and its interconnected relative towns of Endicott and Johnson City form the "Triple Cities" and are the focus areas of this research.

As shown in Figure 3 below, Broome County has several rivers, ponds, and lakes connected to the Susquehanna and Delaware River basins, Susquehanna River,

.

Whitney Point Lake. Broome County has a transportation network that enhances vehicular access and commercial activities between the Triple Cities and other settlements. The county has two major interstate highways (Interstate 81 and Interstate 88), NYS Route 7 and seven major highways.

Considering land uses, Broome County is predominantly rural with 64% or 293,204 acres of its land zoned as agricultural or rural residential and the remaining divided among other land uses, namely residential (15%), business or commercial (2%), Industrial (2%), and recreation or open space (2%). 15 percent of the total land has no defined zoning, some communities without zoning regulations include the town and village of Lisle, Triangle, and Nanticoke.

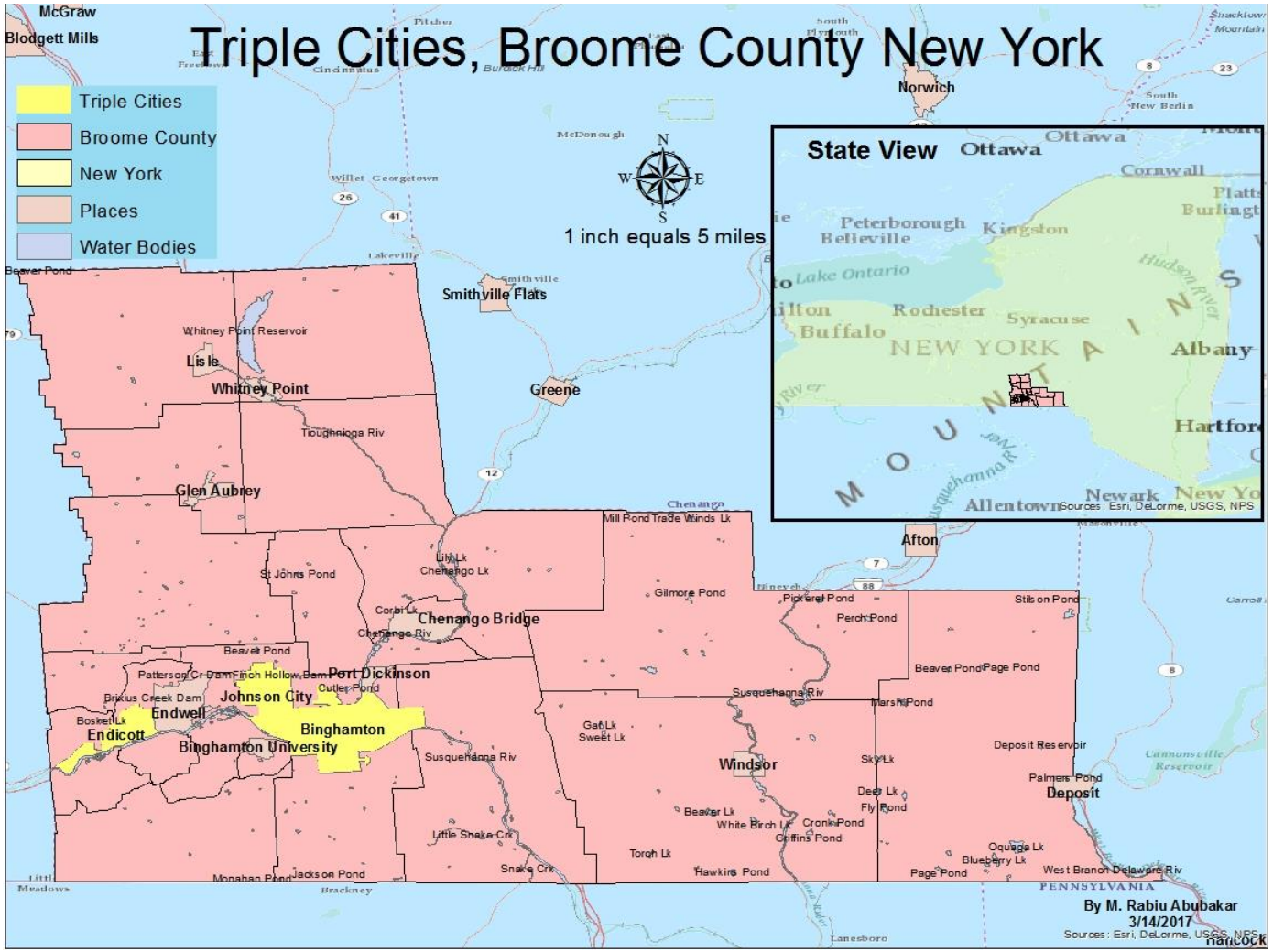

Figure 3: Map: Triple Cities, Broome County New York

6.2 Demographic Characteristics

The American Community Survey 2015 estimates the total population of Broome County at 198,093, with women in the majority with approximately 100,631 or 50.8 percent, and the male population comprising 49.2 percent or 97,462 of the total population. It has a population density of 284.2 Population per square mile. A review of previous census data in Table 2 and Figure 4 shows that Broome County has been experiencing a population decline over the years, and projections indicate a further decline in future years. While Broome County population declined over the years, that of New York State's population has continued to grow. The population of Broome County declined at a rate of -5.5 between 1990 to 2000 and continued to from a modest growth of 0.03 between 2000 to 2010 to -1.2 between 2010 to 2015, projections expect a further decline of about -0.4 between 2015 and 2020. New York State witnesses the opposite of the case in Broome County as its population increases, though at a slower rate. New York State's population change was at a rate of 1.5 between 2010 and 2015 and projected to slightly increase by 1.6. Moreover, just like the population of Broome County, the Triple Cities is slowly declining in population over the years. Apart from the village of Johnson City, which has a quite stable population after declining in 2010, the City of Binghamton population trend. The village of Johnson City moved from a population 15,496 in 2000 to 14837 and 14,903 in 2010 and 2015, respectively. For the same period, the population of the City of Binghamton reduced from 47,391 to 47,376 and then to 46,495, whereas that of Endicott increased from to 13,059 in 2000 to 13,392 in 2010 and 13,143 2015.

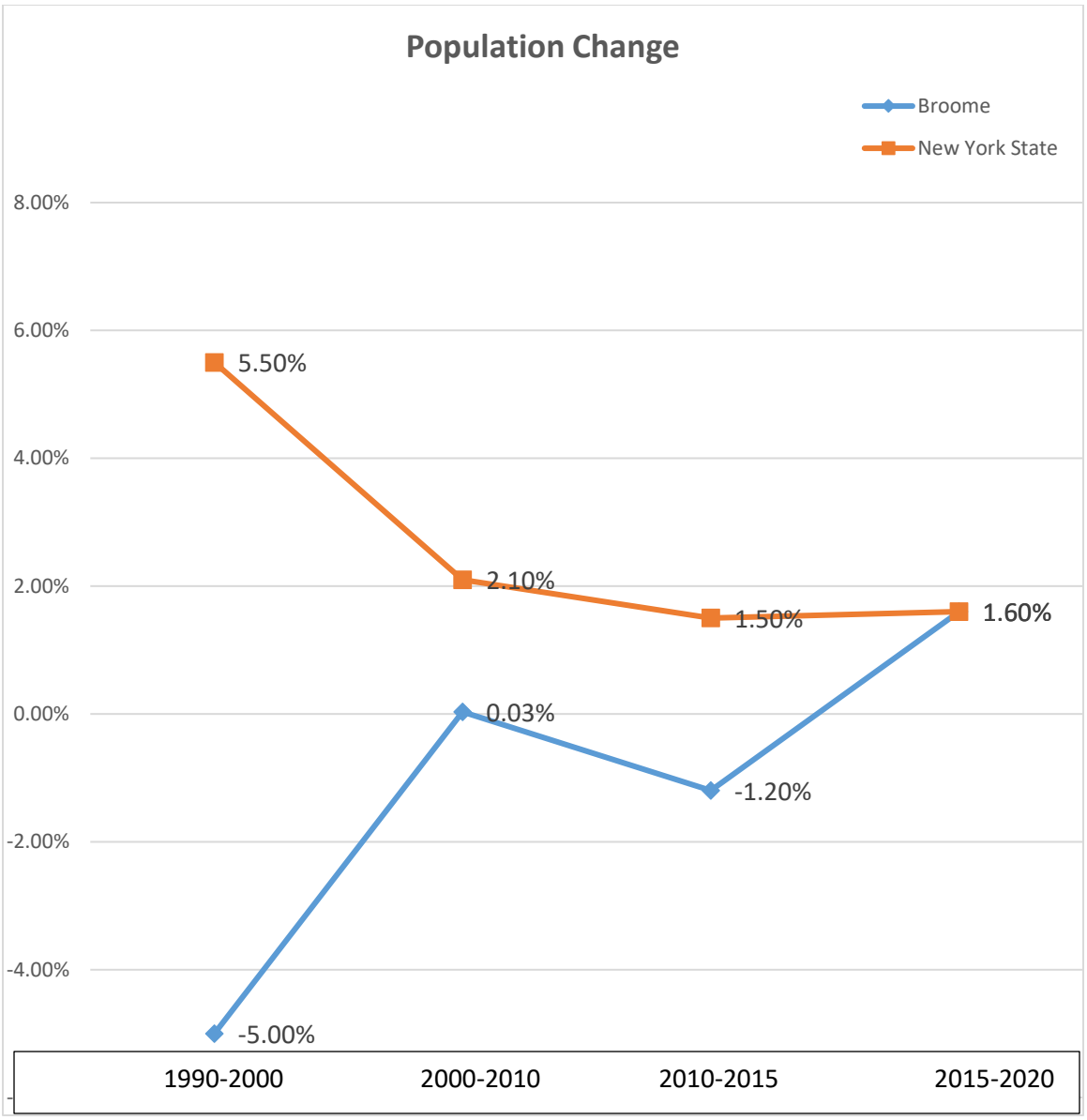

Figure 4: Population Change, Broome County and New York State, 2000-2020

Location		Population and Population Change (2000 to 2020)				
	2000	2010	% Change 2000-2010	2015	2020 (Projected)	%Change 2010-2020
Binghamton	47,391	47,376	-1.24	46,495	-	-
Johnson City	15,496	14837	-0.87	14,903	-	-
Endicott	13,059	13,392	-0.37	13,143	-	-
Broome County	200,536	200,600	0.03	198093	199,743	-0.4
Southern Tier	657,297	657,909	0.1	-	643,719	-2.2
New York State	18,976,457	19,378,457	2.1	19,673,174	19,697,021	1.6
United States	281,421,906	308,745,538	6.2	316,515,021	333,896,000	8.1

Table 2: Population Change 2000 to 2020. Broome County and New York

A further look at the population of Broome County in comparison to the Southern Tier in Table 2 shows that the Southern Tier experiences a similar change in population. It has an expected decline rate of -2.2 for the period of 2010 to 2020, after a modest growth of 0.1 between 2000 and 2010

Location	Population Age Structure, Broome County and New York State, 2015				
Broome County	Cohort	Below 5 years	19 years and below	Between 20 to 64	65 years and above
	Number	10115	47784	116110	34199
	Percentage	5.1	24.1	58.6	17.2
	Age Dependency Ratio		1:1 or 41 percent		
New York State	Cohort	Below 5 years	19 years and below	Between 20 to 64	65 years and above
	Number	1,176,432	4800192	12052544	2,820,435
	Percentage	6.0%	24.4	61.3	14.3
	Age Dependency Ratio		1:1 (0.63) or 38.7 percent		

Table 3: Population Age Structure, Broome County, and New York State: 2015

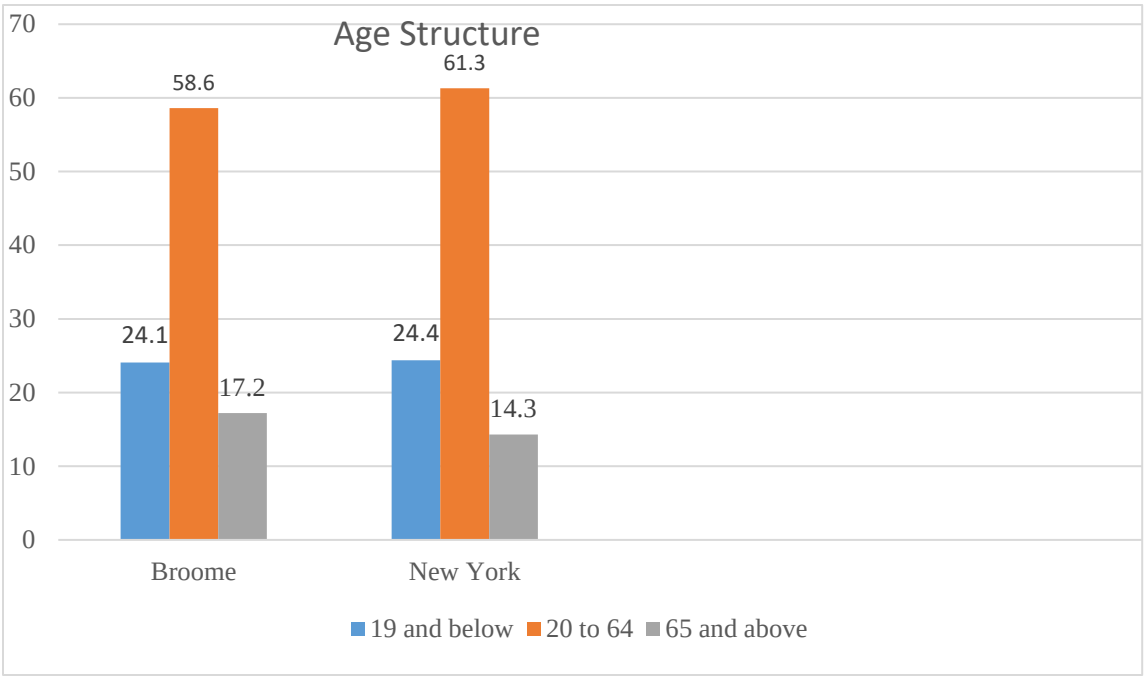

Figure 5: Age Structure, Broome County and New York State, 2015

Although with small differences, the population age structure of Broome County is quite similar to New York State's. The county has about 58.6 percent of residents between the ages of 20 to 64, about 3 percent lower than New York State's 62.3 as indicated in Figure 5 above. Furthermore, it has a relatively higher percentage of the older population with 17.2 percent compared to the State's 14.3 percent. The age dependency ratio that is the estimated number of dependence per working age person is 1:1, hence a good standing similar to the State's 1: 0.63. The percentage of children below 5 years conforms to the State's percentage though with a slight difference as Broome County has 24.1 percent and the state has 24.4 percent of its population below 5 years of age.

As shown in Table 4, Whites form an overwhelming majority of Broome County's residents with 172145, representing 86.9 percent of the total population,

followed by the number of Blacks at 10764 or 5.4 percent, and Asians with 8101 representing 4.1 percent. A total of 7,459 representing 3.8 percent of the population is Latinos with the remaining accounting for other minor race and ethnic groups in the County.

Racial and Ethnic Composition, Broome County 2015					
Race/Ethnicity	White	Black	Asian	Hispanic	others
Population	172145	10764	8101	7459	7,083
Percentage	86.9	5.4	4.1	3.8	3.6

Table 4: Racial and Ethnic Composition, Broome County 2015

Figure 6 below shows the racial and ethnic composition of Broome County by Census Tracts for four main categories namely, Whites, Black, Asians and Hispanic or Latinos with the color representing higher concentration to lower concentration. It shows that most parts of the county are predominantly white and minority populations are somewhat concentrated in the west central part and population centers of the County, mainly the triple cities Binghamton, Endicott and Johnson City. Although there is also several white populations in those population centers, the population of minorities decline as you move out to the hinterlands, and less dense population centers such as Chenango Bridge, Windsor, Deposit and Whitney Point among others.

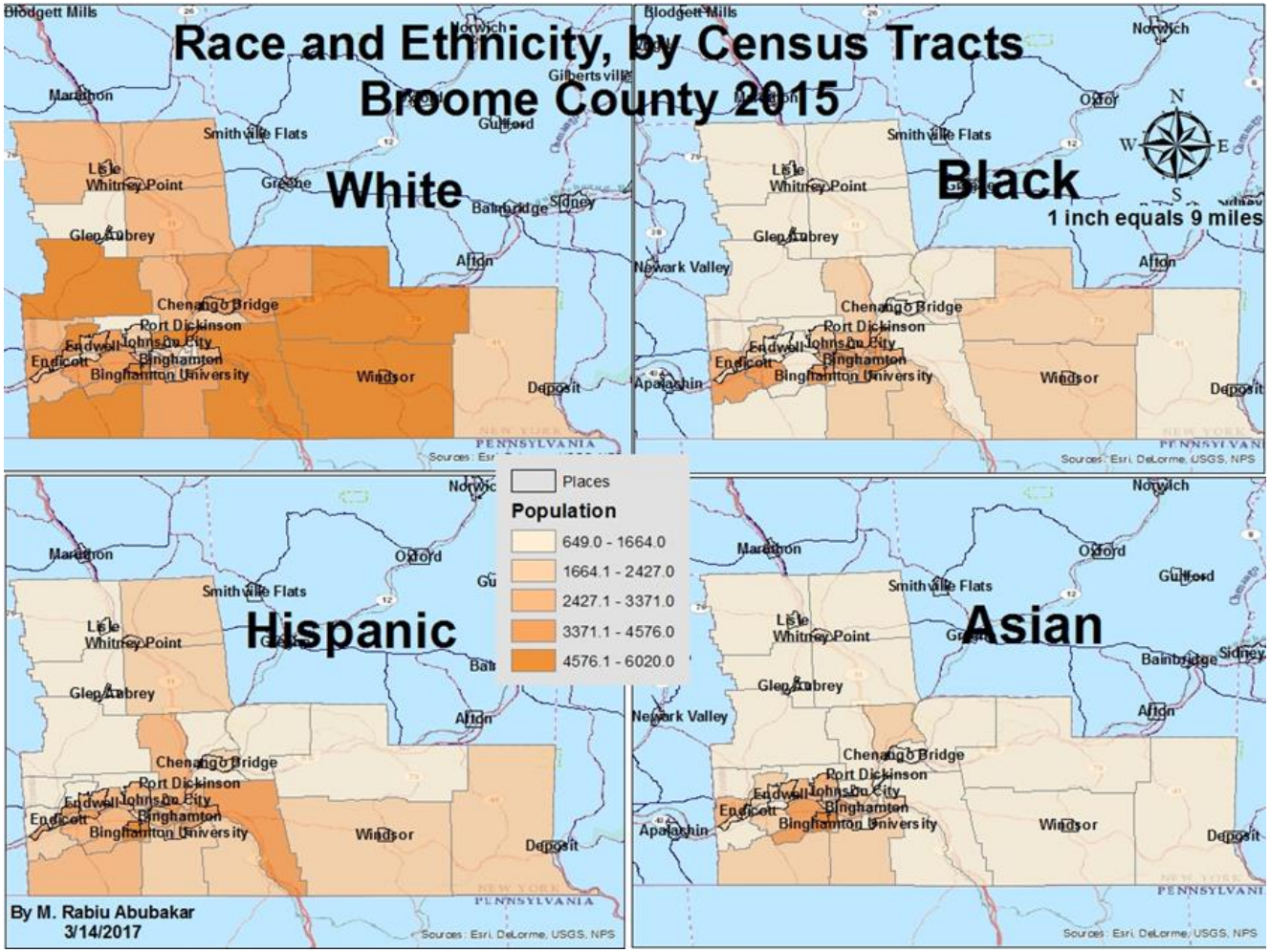

Figure 6: Racial and Ethnic Composition, Broome County 2015

6.3 Socio – Economic Characteristics

Per data from American Community Survey, the 2015 median income in Broome County was $46,261, lower than New York State's $59,269. As displayed in Figure 7, on household median income by census tracts in the county, the majority of the county's census tract have a median income below 30,000 except for areas around the southwest area of the county and Binghamton University that have a median income above 50,000. Census tracts in the City of Binghamton, Village of Johnson City, Endicott (the Triple Cities) and census tracts along the Central West of the county have the least median income, ranging from 13,500 dollars to 23,578. It is worth noting that these same areas show higher densities of diversity in ethnicity and race and have higher populations as shown in Figure 6 above.

Apart from having lower median income compared to the state, per 2015 American Community Survey estimates, Broom County also have a relatively higher percentage of individuals below the federal poverty level, 17.9%, compared to New York State's 15.4%. We can deduce from Figure 8, Map of the population of the County below the federal poverty level that the poor residents of the county appear spread across the County but mostly in Binghamton, Johnson City and Endicott (Triple Cities) and even some census tracts classified as higher median income in Figure 7. However, it is noticeable that, the census tract around the Chenango Bridge in the Central North corner of the county, and areas west of Binghamton University, areas on the edges of Binghamton towards Vestal, have lower numbers of people below the poverty line but higher median income compared to the Triple Cities area.

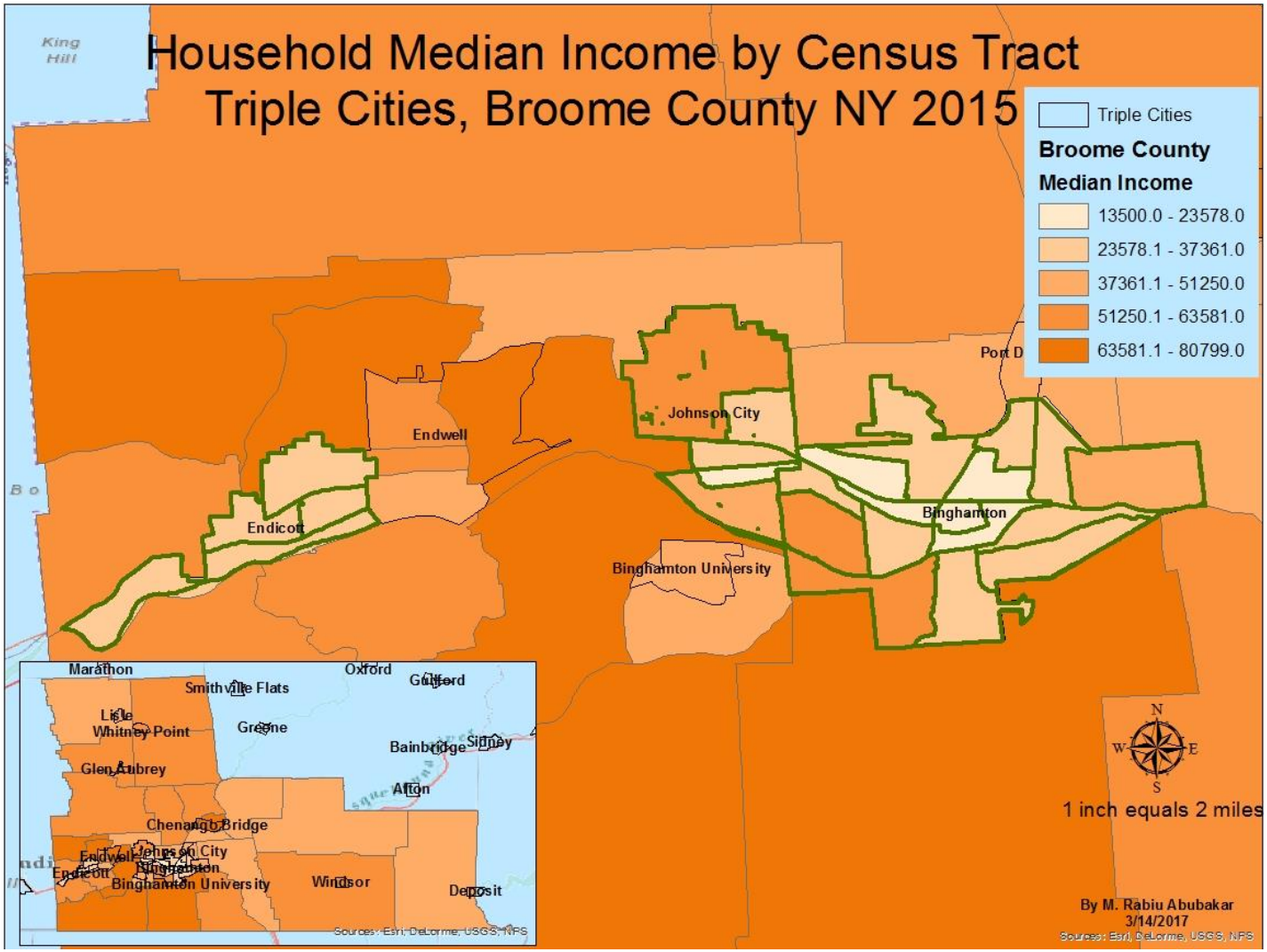

Figure 7: Map: Household Median Income, Triple Cities, Broome County NY 2015

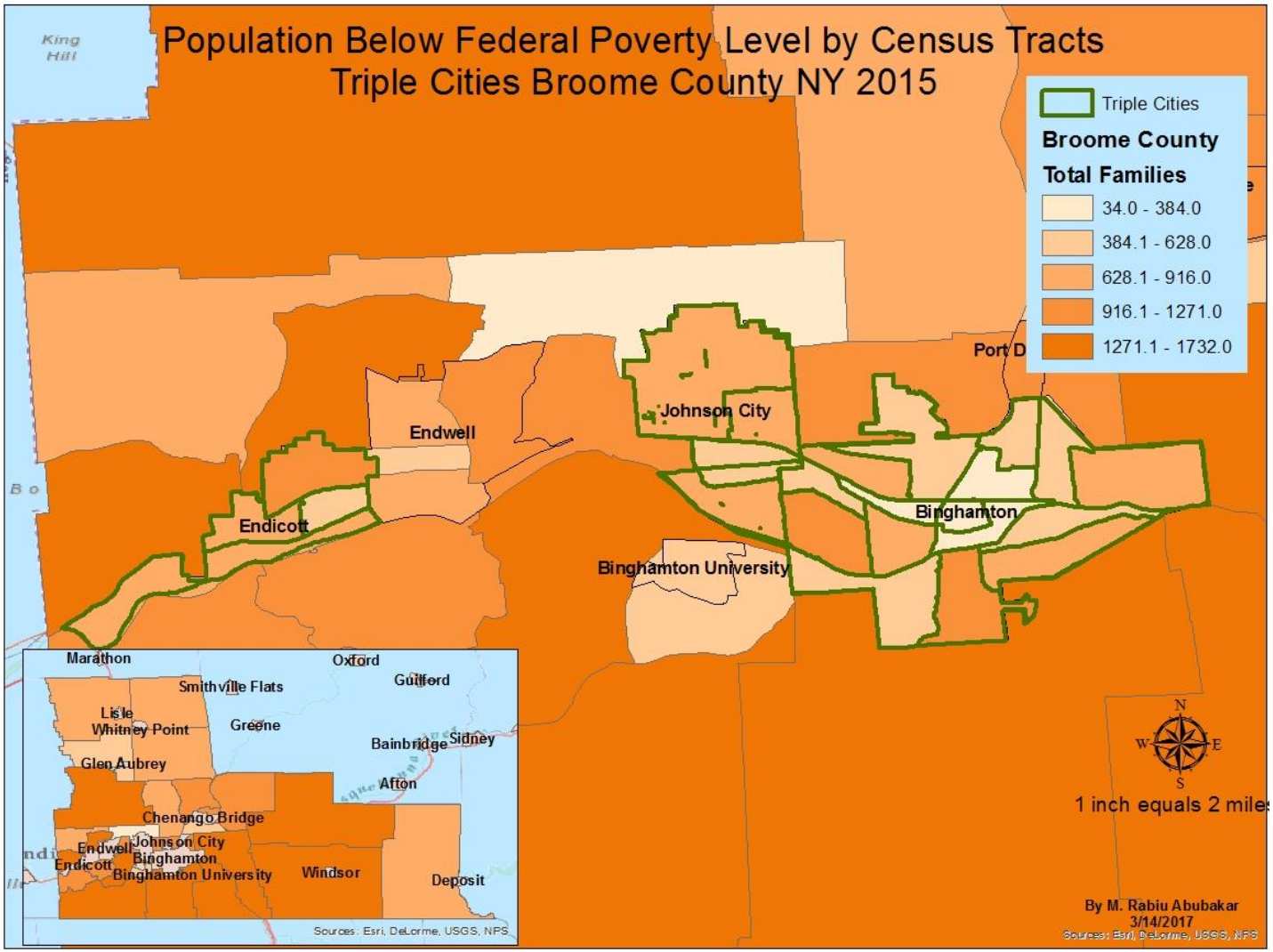

Figure 8: Map, Population Below Federal Poverty Level, Triple Cities, Broome County 2015

The Department of Labor Employment Statistics data shows that the 2015 average unemployment rate of the county is 6.0 percent, higher than 5.3 percent for the State. Its average annual unemployment rate ranged between 6 to 9 percent from 2009 to 2015, and constantly close but slightly higher than the state's range of 5 to 8 percent for the same period. Figure 9 shows the distribution of the employed and unemployed labor force in the Broome County with the employed represented with a circle and the triangle for the unemployed. We see a concentration of unemployed labor force in the population centers, the City of Binghamton mainly, Johnson City, Endicott, and then a dotted spread across the county, indicating a relatively dispersed unemployed labor force. The same observation is made for the employed labor force except that most parts of the suburbs do not have significant numbers of the unemployed labor force compared to Triple Cities.

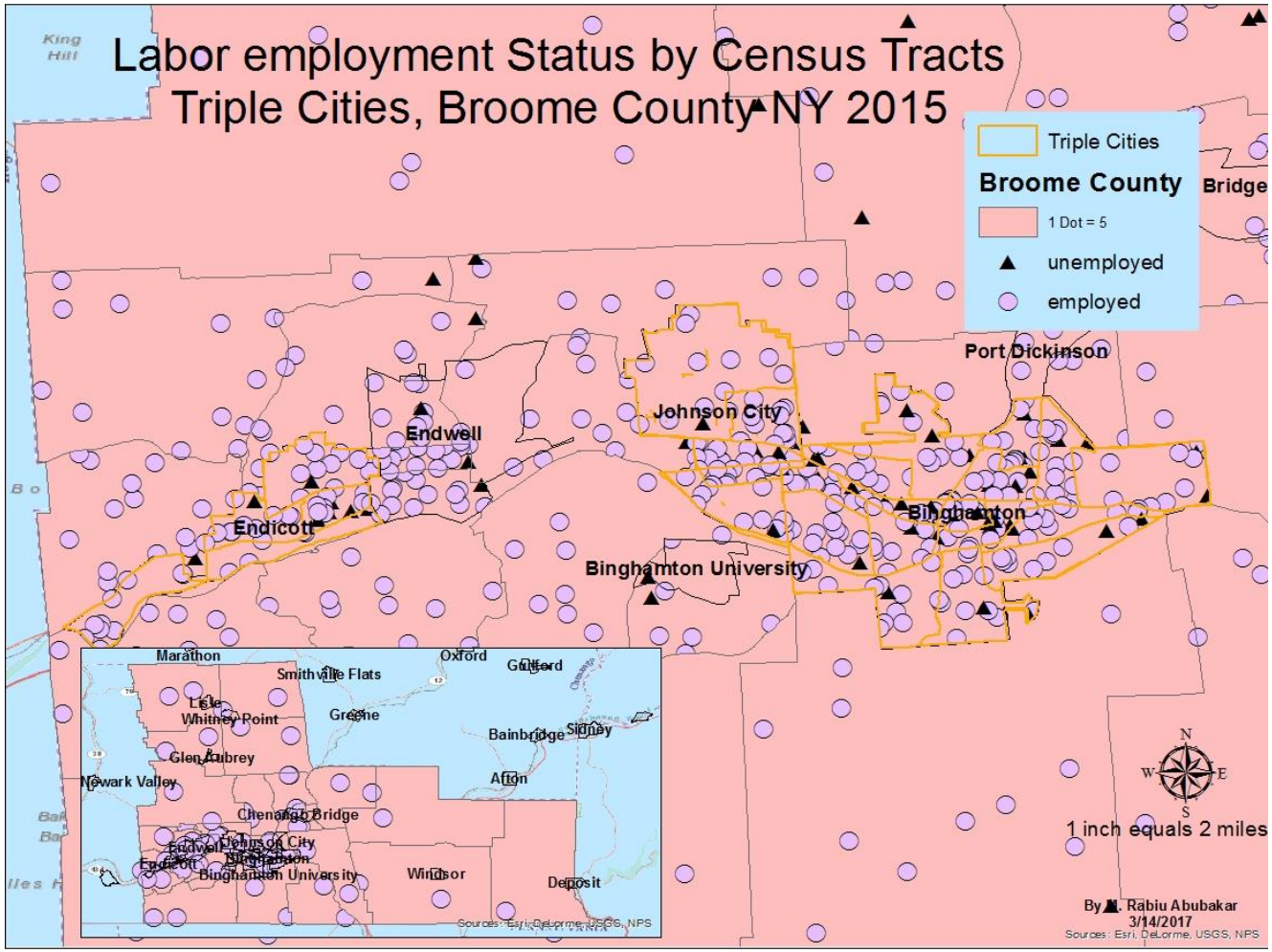

Figure 9: Labor Employment Status, Triple Cities, Broome County NY 2015

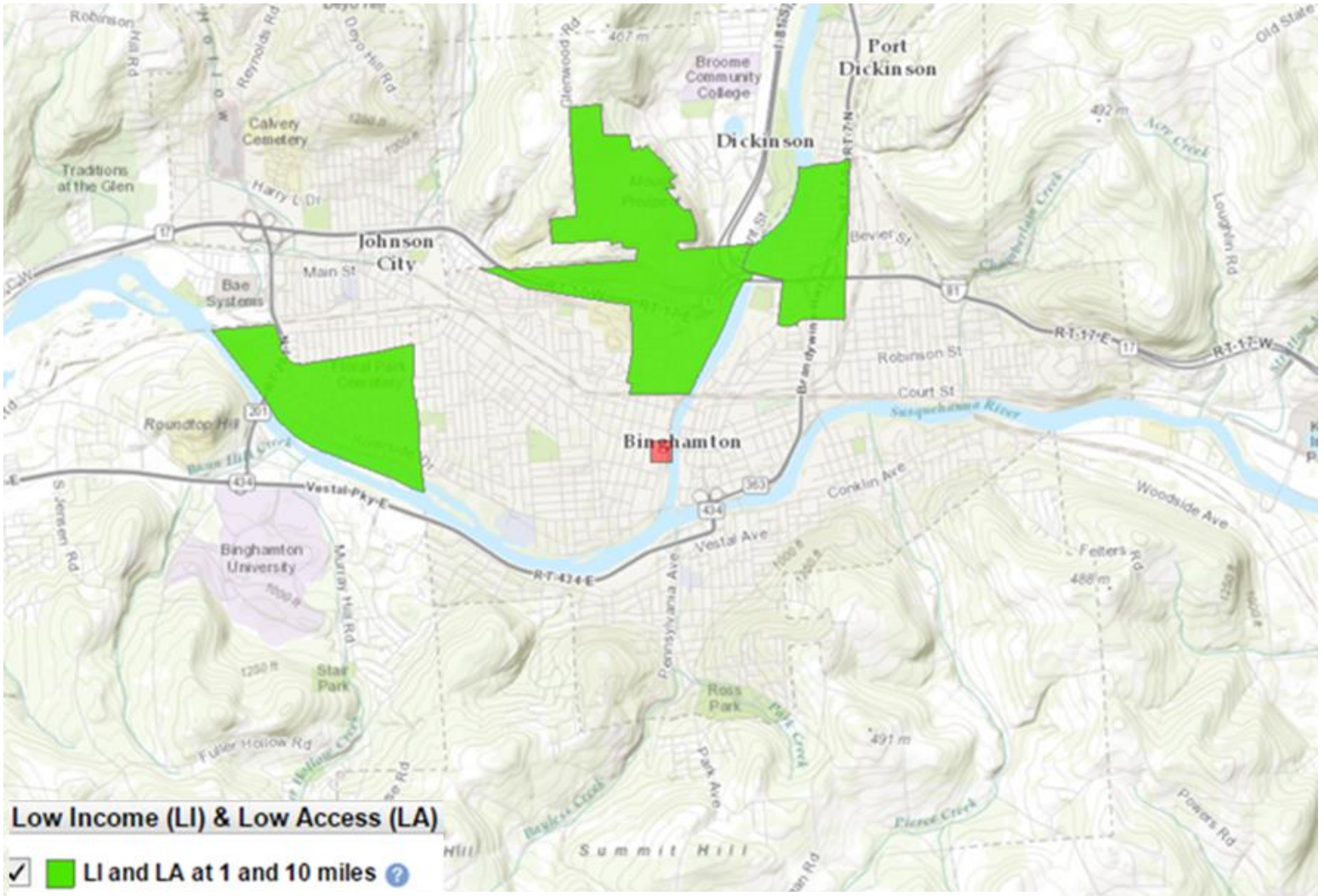

Figure 10: Map, USDA Identified Food Deserts, Broome County, 2015.

6.4 Food Stores and Food Deserts in Broome County New York

Although Broome County has about 200 food stores (Agriculture Business Organization 2016), and a public transportation system, some portions of Broome County fall under food deserts. All the identified food deserts are in the Triple Cities area. According to the USDA's Food Environment Atlas, Binghamton's North Side and a portion of the downtown of the city are designated food deserts. Other areas around Broome County classified as food deserts include the south of Floral Avenue, along the Susquehanna River or riverside drive in Johnson City, Endicott, south of Main Street. The Map (Figure 10) below indicates the identified food deserts in the county by the USDA.

Figure 11 shows the various food sources available for residents of Broome County New York, namely foodbanks, grocery stores and convenience stores. The list of convenience stores and grocery stores was compiled from the United States Department of Agriculture list of food retail stores (3/23/16) and verified via Google searches and New York State government open data website and food pantries from the Food Bank Organization of the Southern Tier. Out of a total of 212 food stores, convenience stores form the majority (177) compared to grocery stores (35). Spatially, as shown in Figure 11, we see a concentration of convenience stores and grocery stores in the Triple Cities area, around the central west of the county with the suburbs having a dispersed pattern. The food pantries (44 total) shown in yellow points also assume the same trend but more importantly non-existent in the most part of the suburbs and even Vestal area. The next chapter provides detailed analysis on the nature and density or distribution of food sources and food insecurity in the study area (Broome County)

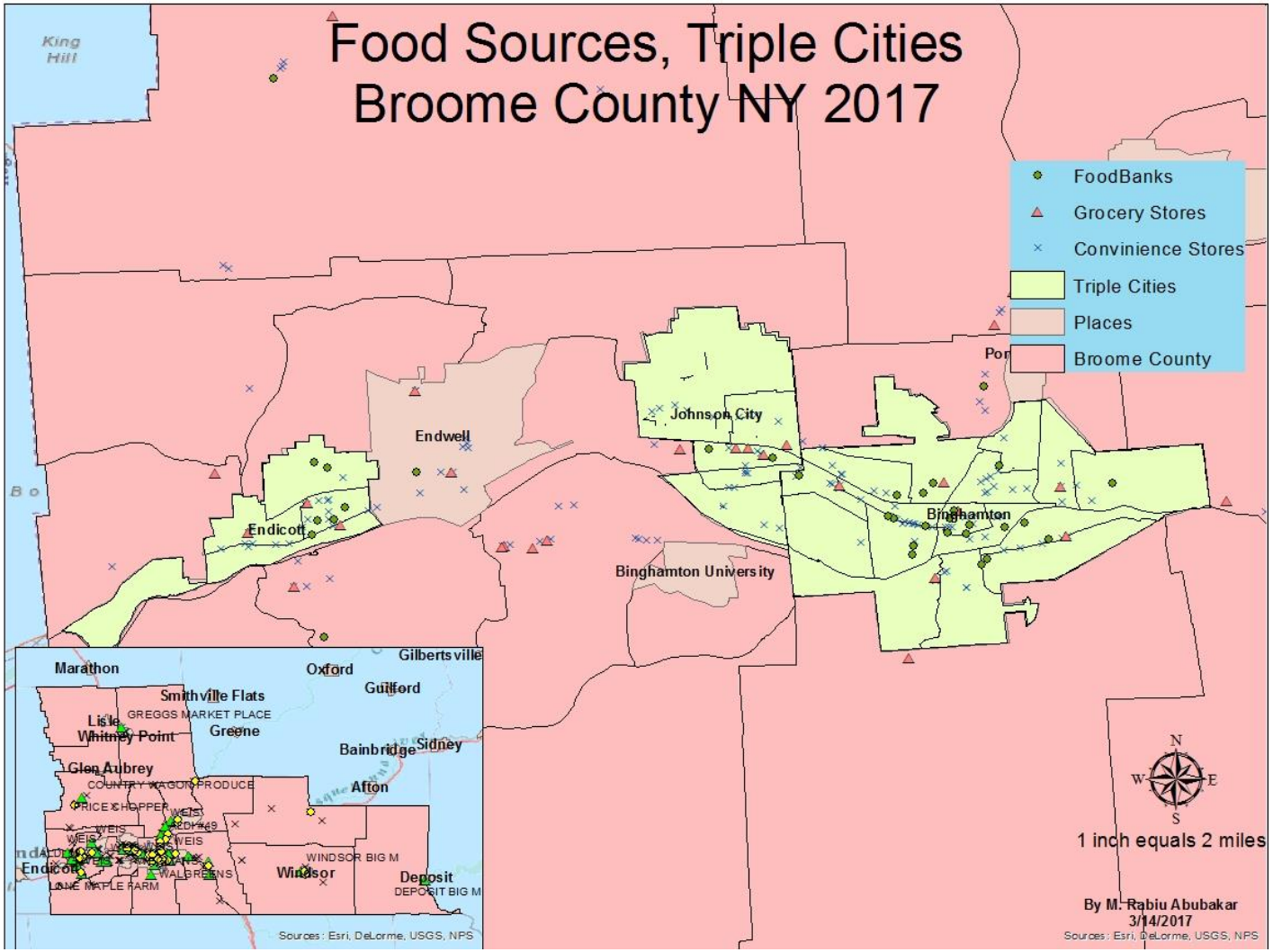

Figure 11: Food Sources, Triple Cities, Broome County NY 2015

Chapter Seven

Relationship between Poverty and Density of Food Sources in the Triple Cities of Broom County NY.

In this chapter, we analyze the data and present the results of the study. This chapter is structured into three sections that show the relationship between density of grocery stores, convenience stores, food pantries and neighborhood poverty level within a given distance.

7.1 Density and location of Grocery Stores, Distance, and Poverty.

To test the first hypothesis, which is on the relationship between density of grocery stores and poverty levels of neighborhoods, census tracts were grouped into two categories, low-poverty (high-income neighborhoods) and high-poverty (low-income neighborhoods). Low-poverty census tracts include census tracts with less than 30 percent of households at 200 percent of the federal poverty level while those at 30 percent or above at 200 percent of the federal poverty level formed the high-poverty census tracts.

As indicated in Table 5 below, a total of 15 census tracts formed the low-poverty census tracts and the remaining 22 of the 37 census tracts in the three Cities of Binghamton, Johnson City and Endicott forming the high-poverty census tracts. Spatially, as displayed in Figure 12 below, we can see a concentration of poverty

in the city of Binghamton, and some parts of Johnson City and Endicott, which also happens to host most of the minority groups and serves as the population center of the County. A preliminary look at the spatial distribution of the grocery stores buffer at 0.5-miles in Figure 12 suggests a concentration of grocery stores in the major population centers.

Grocery Store, Distance, and Poverty			
Distance	Poverty Category		Total
	Low-Poverty	High-Poverty	
Within 0.5-Mile	8 (10.5)	13 (10.5)	25
Above 0.5-Mile	5 (2.5)	0 (2.5)	5
Totals	13	13	26
Number of Census Tracts	15	22	37
X-squared = 3.9619, df = 1, p-value = 0.04654			

Table 5: Grocery Stores, Distance, and Poverty

The results of the ArcGIS analysis of the number of grocery stores within low and high-poverty census tracts shown in Table 5 indicates that residents of low-poverty census tracts have access to 8 out of the 13 identified grocery stores within a half-mile distance, and high-poverty census tracts have access to all the 13 grocery stores identified. Residents of the low-poverty census tracts can access the remaining 5 grocery stores in over a half-mile distance.

Furthermore, the chi-square analysis reveals a relationship between the density of grocery stores and neighborhood income levels as its p-value is less than 0.05. As indicated in Table 5, the number of grocery stores within the high-poverty census tracts in a 0.5mile radius, 13 exceeds the expected number of 10.5, meanwhile the number of grocery stores within the low-poverty census tracts, 8 is lesser than the expected number of grocery stores. At above 0.5 miles, the number of grocery stores within the low-

poverty census tracts still exceed the expected figure of 2.5 with 5 grocery stores, while the high-poverty census tracts have nothing at that level, hence more grocery stores within high-poverty census tracts.

The results of the chi-square analysis are $X^2 = 3.96.1$, df = 1, p-value = 0.04654, which is below 0.05. Hence we reject the null hypothesis "No relationship exists between the density of grocery stores and poverty level of a neighborhood" and accept the alternative hypothesis, which states that there is a relationship between the density of grocery stores and poverty level of a neighborhood. In the following paragraphs, we will see results of the second hypothesis on locations of convenience stores and poverty classes in the Triple Cities of Broome County NY.

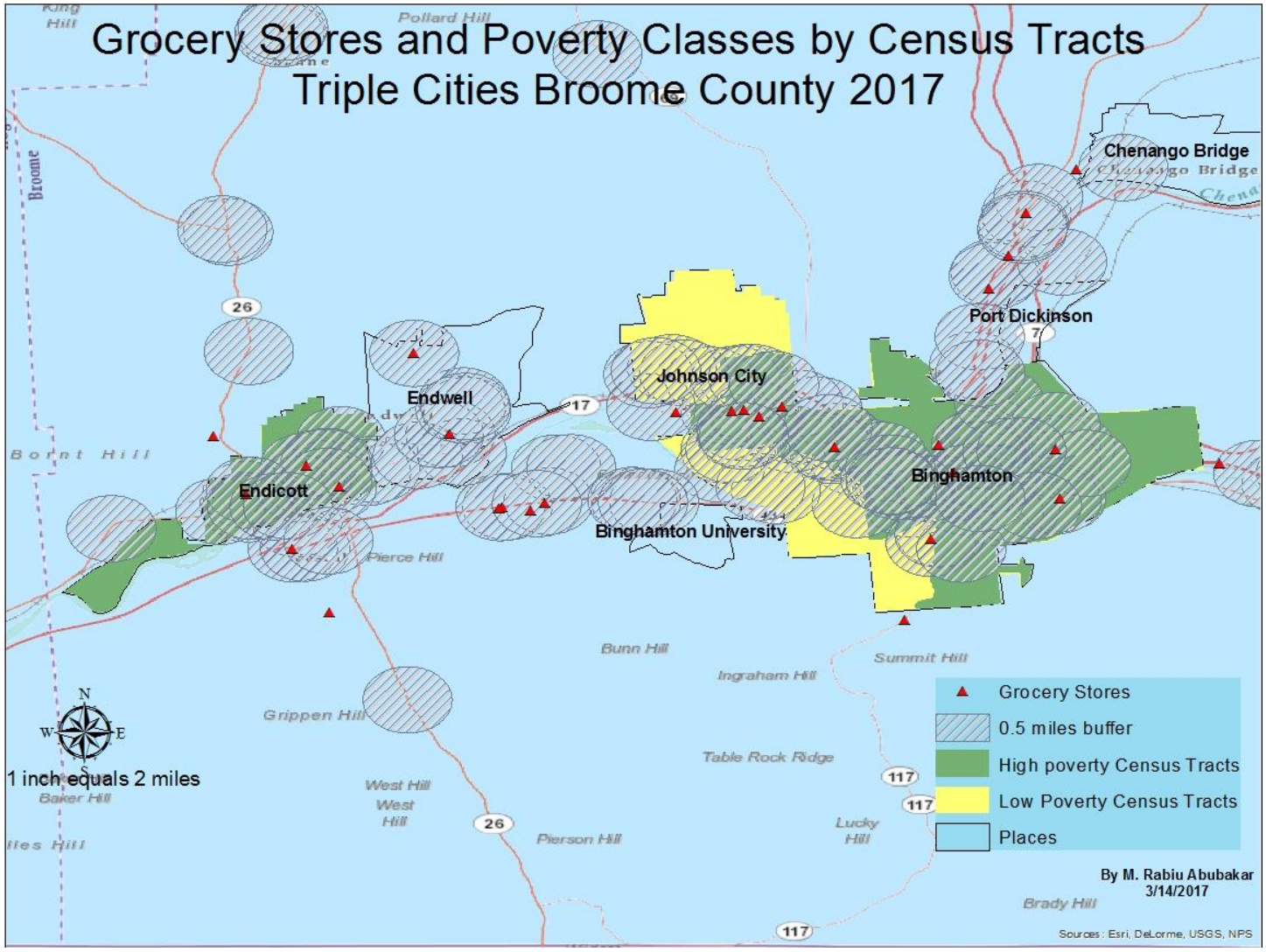

Figure 12: Grocery Stores and Poverty, Triple Cities, Broome County NY 2017

7.2 Convenience Store, Distance, and Poverty

The second hypothesis seeks to test the relationship between the density of convenience stores and neighborhood poverty levels. The same classifications of census tracts in hypothesis one, low-poverty (high-income neighborhoods) and high-poverty (low-income neighborhoods) were employed in testing the second hypothesis. Low-poverty included census tracts with less than or equal to 30 percent of households at 200 percent of the federal poverty level, while those above 30 percent of 200 percent of the federal poverty level formed the high-poverty census tracts

Table 6 below shows that the number of convenience stores located in high-poverty census tracts in the study area, (Binghamton, Johnson City, and Endicott), is substantially higher than the number of convenience stores in the low-poverty census tracts. The low-poverty census tracts have available 45 convenience stores within a half-mile distance, while the high-poverty census tracts have 83 convenience stores within the same distance, which is almost all the identified convenience stores (86) and about twice the number available for the low-poverty census tracts (45). There exist only 3 convenience stores at greater than a half-mile from high-poverty census tracts, while the low-poverty census tracts have 41, showing a clear concentration of convenience stores in poor neighborhoods.

Moreover, Figure 13, shows the spatial distribution of convenience stores in the Triple Cities area at a buffer of 0.5 miles. We can see a concentration of convenience stores in the high-poverty census tracts in the city of Binghamton, and some parts of Johnson City and Endicott, whiles the low-poverty census tracts have a dispersed distribution of convenience stores.

Convenience Store, Distance, and Poverty			
Distance	Poverty Category		Total
	Low-Poverty	High-Poverty	
Within 0.5-Mile	45 (64)	83 (64)	128
Above 0.5-Mile	41 (22)	3 (22)	44
Totals	86	86	172
Number of Census Tracts	15	22	37
X-squared = 41.809, df = 1, p-value = 0.0001			

Table 6: Convenience Stores, Distance, and Poverty

In addition, the chi-square analysis results as indicated in Table 6 shows a significant relationship between density of convenience stores and poverty levels of neighborhoods. Considering the calculated expected values, we see the high-poverty census tracts exceeding the expected value of 64, with 83 convenience stores within a 0.5-mile radius, while the low-poverty census tracts have 45 grocery stores at the 0.5-mile radius. Also, the number of convenience stores in high-poverty census tracts 3, is significantly lower than the expected value or 22 convenience stores at above 0.5-mile radius.

The p-value is significantly lower than 0.05, the results as indicated in Table 6 is Chi-square of 41.809, with one degree of freedom, and a p-value of 0.0001. This shows a significant relationship between the density of convenience stores and neighborhood poverty level as a p-value below 0.05 indicates a higher likelihood of the alternative hypothesis occurring. Therefore, we reject the null hypothesis that "there exists no relationship between the density of convenience stores and neighborhood poverty level." We accept the alternative hypothesis that "there exist a relationship between the density of convenience stores and neighborhood poverty level" because the P- value of 0.0001 is less than 0.05.

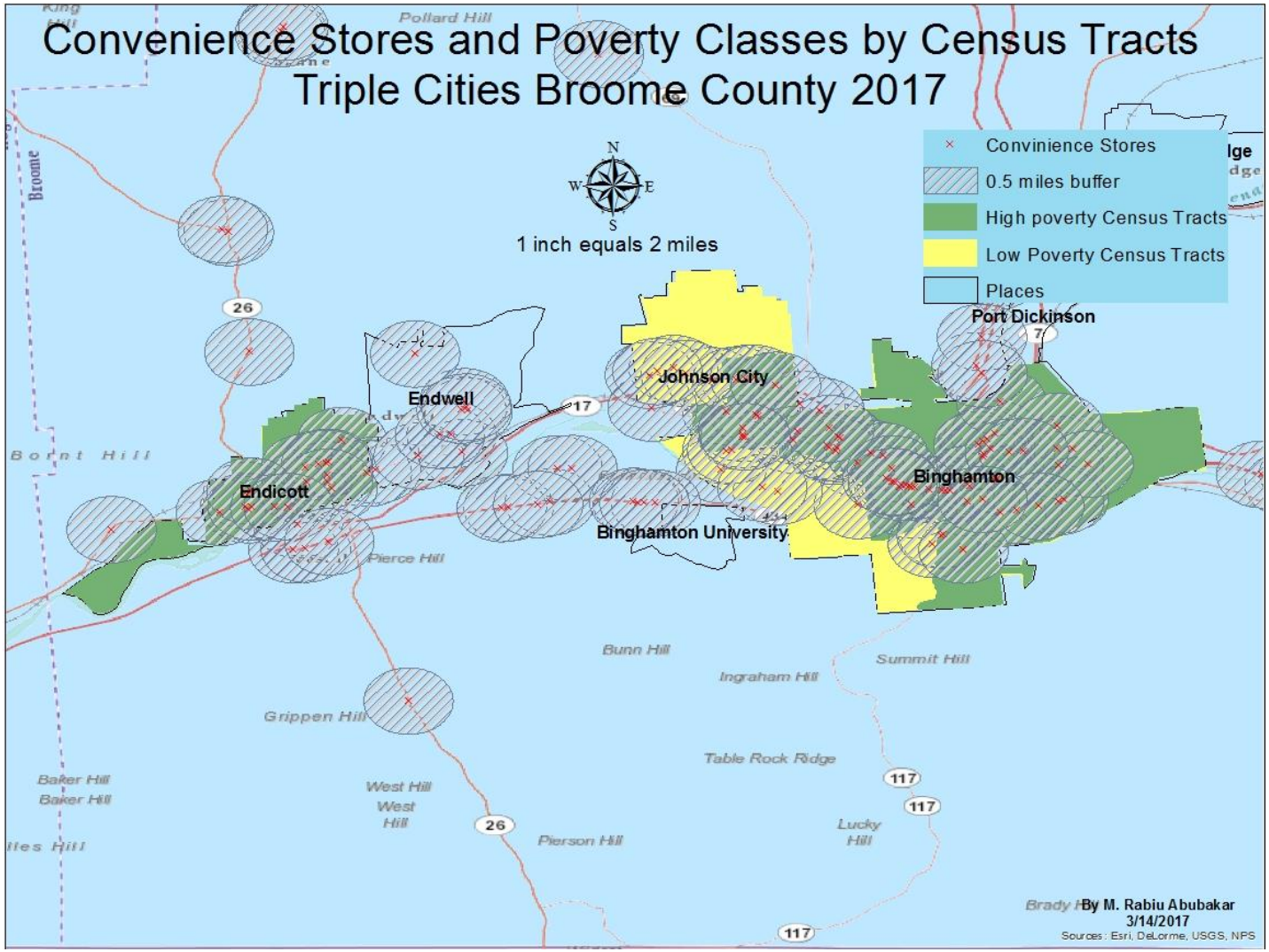

Figure 13: Convenience Stores and Poverty Classes, Triple Cities Broome County 2017

7.3 Food Pantries, Distance, and Poverty.

Turning to hypothesis three, we examine the relationship between the density of food pantries and neighborhood poverty level in the Triple Cities of Broome County NY. We used the same categories used in hypothesis one and two, low-poverty (high-income neighborhoods) and high-poverty (low-income neighborhoods) and measured the number of food pantries available within a 0.5 miles to the census tracts.

Figure 14 shows the spatial distribution of food pantries at a buffer of 0.5 miles served by the Foodbank of the Southern tier in Broome County, New York. It reveals a concentration of the food pantries in the Triple Cities and the census tracts identified as high-poverty census tracts compared to the low-poverty census tracts. The ArcGIS spatial analysis on the densities of food pantries and poverty levels shown in Table 7 indicate that high-poverty census tracts have more food pantries compared to the low-poverty census tracts in the study area. All the 29 food pantries are within 0.5-mile travel distance of high-poverty census tracts, while the low-poverty census tracts have available 13 food pantries within 0.5 miles, and 16 food pantries available at above 0.5 mile respectively.

For the expected values in the Chi-square analysis, we see that the high-poverty census tracts have more food panties than the expected value at the 0.5-mile radius and lesser at above the 0.5-mile radius, showing a relative location of food panties in low-income neighborhoods in the Triple Cities area. At a 0.5-mile radius, 13 food pantries are within the low-poverty census tracts compared to 29 within the high-poverty census tracts, which exceeds the 21 expected value for both categories. There exists no food pantry at above 0.5-mile radius to high-poverty census tracts compared to 16 at above

0.5-mile radius for the low-poverty census tracts, which exceeds the 8 expected food pantries at the 0.5-mile distance for both categories.

The null hypothesis that " There exists no relationship between the density of food pantries and the poverty level of neighborhoods" is rejected because the P-value in the chi-square analysis results indicated in Table 7 is 0.0049, which is below the 0.05 significant level. The Chi-square analysis results are $X^2 = 19.42$ and a p-value of 0.0049, the p-value is below the 0.05 level. Hence we accept the alternative hypothesis since there is a relationship between the number of food pantries and poverty level of a neighborhoods. The Chi-Square analysis results are consistent with the ARG – GIS spatial analysis findings that indicate a higher concentration of food pantries in high-poverty census tracts.

Food Pantry, Distance, and Poverty			
Distance	Poverty Category		Total
	Low-Poverty	High-Poverty	
Within 0.5-Mile	13 (21)	29 (21)	42
Above 0.5-Mile	16 (8)	0 (8)	16
Totals	29	29	58
Number of Census Tracts	15	22	37
X-squared = 19.42, df = 1, p-value = 0.00049			

Table 7: Food Pantry, Density and Poverty, Triple Cities, Broome County NY 2015

In the next chapter, a summary of findings of this study, including an overview of the literature and the results of the analysis are presented.

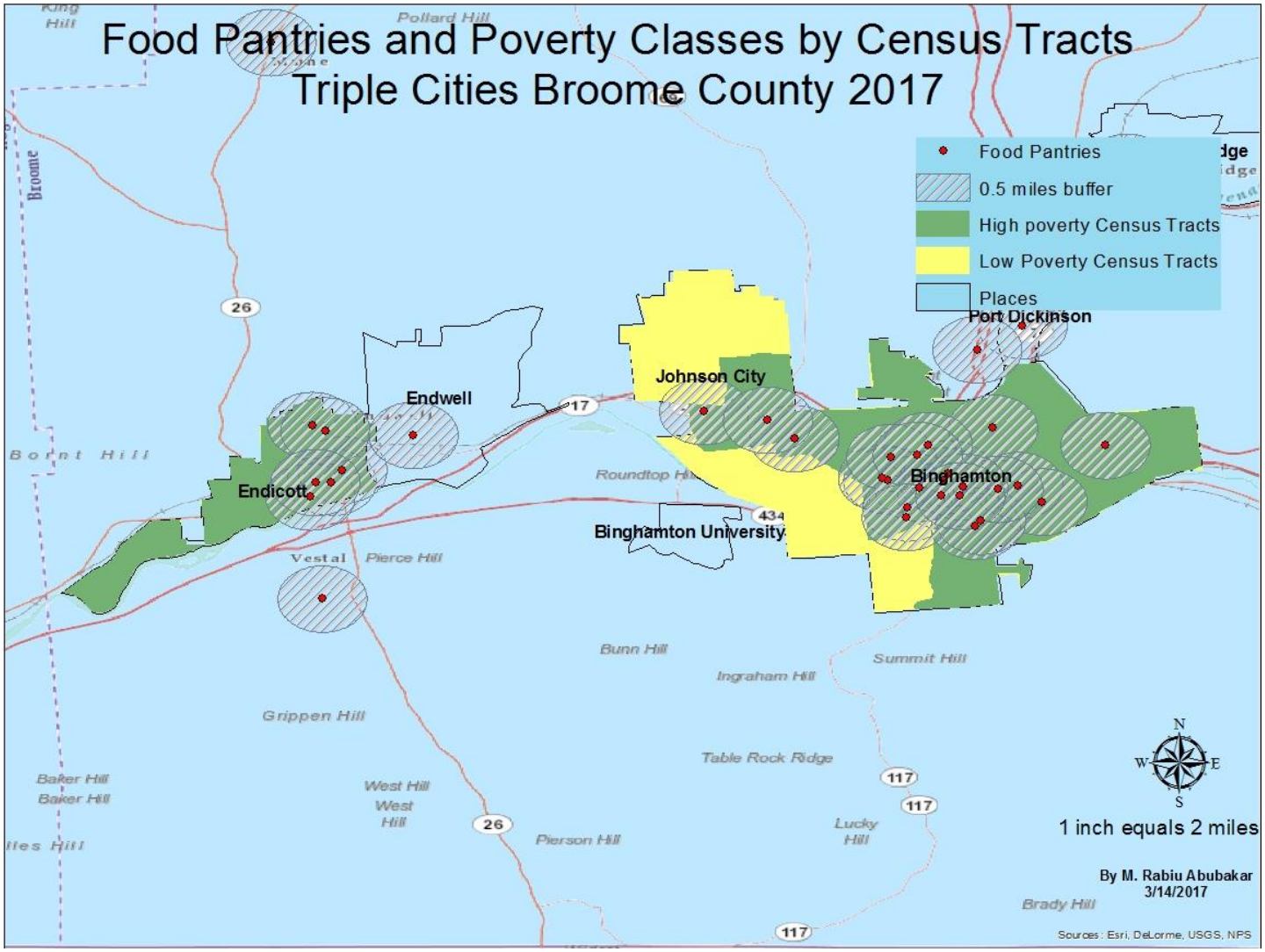

Figure 14: Map, Food Pantry and Poverty Classes, Triple Cities 2015

Chapter 8

Summary of Research Findings and Conclusion

This chapter provides an overview of the entire thesis by summarizing and connecting the various chapters discussed earlier in the thesis. It elaborates the key points of the literature and conceptual framework, methodology and states the results of the analysis and the verdict for the various hypotheses examined.

8.1 Research Purpose, Analysis, and Findings

This thesis began with an introduction to food accessibility and food insecurity issues in the United States. We provided definitions of major concepts related to the research including, food desert, accessibility, food insecurity and food assistance programs in the United States that support food insecure households. With an intent to examine food accessibility, we measured the relationship between the density of grocery stores, convenience stores and food pantries and neighborhood poverty classifications in the Triple Cities of Broome County, NY, namely the City of Binghamton, the Village of Johnson City and the Village of Endicott.

The reviewed literature provided insight into issues pertaining to food accessibility and food insecurity, specifically, it shows the relationship between food accessibility and poverty, race or ethnicity, health, and nutrition. The literature also identified methods for measuring food accessibility and discussed food

assistance programs that support low-income residents to acquire food. The literature indicates that grocery stores, compared to other food stores, such as convenience stores in neighborhoods, supply greater amounts of fresh fruits and vegetables for healthy nutrition and food pantries play an important role in alleviating food insecurity in households with poverty. The literature reviewed and conceptual framework on the geographic dimensions of food accessibility and insecurity showed a relationship between individual and neighborhood socio-economic characteristics and locations of grocery stores and convenience stores.

Based on the literature reviewed and conceptual framework, we formulated three hypotheses, which informed the focus of this research. The hypotheses tested the relationship between density of grocery stores and neighborhood poverty levels, the relationship between convenience store and neighborhood poverty levels and the relationship between food pantries and neighborhood poverty levels in the Triple Cities of Broome County New York.

To test the hypothesis formulated, we used ESRI ArcMap for spatial analysis and Pearson's Chi-Square and goodness fit test for statistical analysis. The ArcMap was used to classify the census tracts into two categories, namely low-poverty and high-poverty census tracts, where the high-poverty included census tracts with more than 30 percent of households at the 200 percent of the federal poverty level and the low-poverty included census tracts with less than 30 percent of the households at the 200 percent of the federal poverty level. The locations of food sources such as grocery stores, convenience stores, and food pantries were geocoded. For further analysis, we selected the number of food sources available for the various census tracts categories and found out that there exist a

difference in the number of grocery stores, convenience stores and food pantries accessible for low-income neighborhoods and high-income neighborhoods within a certain distance in the Triple City areas of Broome County NY.

For the first null hypothesis, the low-income neighborhoods have more grocery stores than the high-income neighborhoods. For instance, while 8 grocery stores appear accessible for the high-income neighborhoods within a distance of 0.5 miles, the low-income neighborhoods have accessibility to all the 13 grocery stores at a distance of a half a mile. The Chi-Square analysis also supports a relationship between grocery store densities and poverty level with a p-value of 0.0465. Although the p-value is close to 0.05, we failed to accept the null hypothesis that "No relationship exists between the density of grocery stores and poverty level of a neighborhood." and accept the alternative that "there exist a relationship between the density of grocery stores and poverty level of a neighborhood", because the prior ArcGIS based spatial analysis shows a higher concentration of grocery stores in the low-income neighborhoods in Binghamton, Johnson City, and Endicott compared to the high-income neighborhoods in the same areas.

For the second hypothesis, based on the results of the ArcGIS-based spatial analysis and the results of the Chi-Square statistical analysis, we reject the null hypothesis that **"**There exists no relationship between the density of convenience stores and neighborhood poverty level." The ArcGIS based spatial analysis revealed a greater concentration of convenience stores in the high-poverty neighborhoods compared to the low-poverty neighborhoods. Out of a total of 86 convenience stores within the Triple Cities area of Binghamton, Johnson City, and Endicott, the high-poverty census tracts

have almost double the number of convenience stores in the low-poverty census tracts. A total of 83 convenience stores is within 0.5 miles of the high-poverty census tracts (low-income neighborhoods) compared to 45 for the low-poverty census tracts (high-income neighborhoods). Beyond 0.5 miles, the low-poverty census tracts have access to the remaining 41 Convenience stores and 3 for the high-poverty census tracts. The p-value (0.0001) of the chi-square analysis is significantly lower than 0.05, hence the alternative hypothesis "there exist a relation between the location of Convenience Stores and economic class of neighborhoods" stands true and accepted.

For the third hypothesis, we reject the null hypothesis that "there exists a relationship between the density of Convenience stores and neighborhood poverty level", because the outcomes of the analysis on the location of food pantries and poverty levels in Chapter Seven shows that there exist more food pantries within reasonable distances to high-poverty neighborhoods compared to low-poverty neighborhoods. For instance, the number of food pantries available within a 0.5-mile distance of high-poverty census tracts (29) is more than twice the number of food pantries available for the low-poverty census tracts (13) within the same distance. In fact 29 is the total number of food pantries in the study area, hence full access for the low-income residents. The chi-square analysis results also showed a p-value significantly less than 0.05 (P= 0.0049). Therefore, we accept the alternative hypothesis that "there exist a relationship between the density of food pantries and neighborhood poverty level" in the Triple Cities of Broome County, New York. In the next section, we provide conclusions and implications of the research findings.

8.2 Discussion and Conclusion

Urban food deserts and disparities in physical accessibility to nutritious food sources exist in several urban communities and has affected individuals of different socio-economic status or locations differently in the United States. Therefore, this thesis examined the distribution of food sources, namely grocery stores, convenience stores and food pantries and the relationship between their location and neighborhoods of different economic classes based on distance in the Triple Cities of Broome County, NY.

Unlike findings in other areas that indicate a positive relationship between the location and density of grocery store to high-income populations, this research reveals a positive relationship between the location and density of grocery stores to low-income populations. Both the ESRI ArcGIS based spatial analysis and the Chi-Square statistical analysis revealed that low-income neighborhoods have a higher density of grocery stores compared to the high-income neighborhoods in the Triple Cities of Broome County, New York.

Furthermore, the study's finding on the location amd density of convenience stores is consistent with several other research findings cited in the literature that indicate a concentration of convenience stores in low-income neighborhoods compared to higher-income neighborhoods in the United States. The analysis indicates that low-income neighborhoods have accessibility to more than twice the number of convenience stores within a 0.5-mile distance compared to high-income neighborhoods in the Triple Cities of Broome County and the residents of high-income neighborhood have to travel over half a mile to access about half of the convenience stores located in the area.

Food pantries that support low-income populations with food remain in close proximity to the neighborhoods with higher numbers of families in poverty. The study shows a relationship between the location of food pantries and the poverty level of neighborhoods in the Triple Cities of Binghamton, Johnson City, and Endicott. The spatial analysis reveals a high concentration of these food pantries in the high-poverty census tracts and the statistical analysis shows that the result of the spatial analysis stays true as it indicates a positive relationship between the location of food pantries and low-income neighborhoods in the area.

In a nutshell, although residents of low-income neighborhoods compared to high-income neighborhoods in the Triple Cities area have better access to grocery stores that are classified as the best source for nutritious foodstuff such as fresh fruits and vegetables, the over-concentration of convenience stores may have a negative impact on the diet choices of residents. Per the literature reviewed, convenience stores do not supply enough nutritious foods such as fruits and vegetables and have a relationship to individual negative health outcomes. The existence of food pantries in walkable distance of a half mile to low-income residents shows a good case for food insecure populations, as they can easily access food when available.

The questions left unanswered in this research include the issue of transportation at the household level and personal diet decisions in the face of several options within the Triple Cities area. Moreover, the Triple Cities area is connected to several settlements such as Vestal and smaller suburban communities in the County, and results may be

different if the entire county is considered. Also, the errors in the data from American Community Survey may affect the findings but remains the only reliable and most recent socio-economic data in the United States of America.

Future research will examine household level transportation options in order to establish the level of ability of individuals to access food sources and to investigate the adequacy of food support systems in mitigating the level of food insecurity because physical access does not completely indicate the ability to utilize resources. We will also look at the entire county and see the differences that exist between these triple cities and the rural parts of the county and will pay closer attention to the available food sources and the quantity of nutritious food available to provide an informed verdict on the general food environment of Broome County NY.

Appendix A, List of Grocery and Convenience Stores

List of Grocery and Convenience stores						
	Type	Name	Address	City	State	ZipCode
1	Convenience	5 BELOW	420 HARRY L DR	JOHNSON CITY	NY	13790
2	Convenience	5 BELOW	2505 VESTAL PKWY E SUITE 34	VESTAL	NY	13850
3	Convenience	5 STAR DELI	60 OAK ST	BINGHAMTON	NY	13905
4	Convenience	A-1 HALAL	59 MAIN ST	BINGHAMTON	NY	13905
5	Grocery	ACQUISTO	608 UPPER COURT ST	BINGHAMTON	NY	13904
6	Restaurant	AFC SUSHI	33 CHENANGO BRIDGE RD	BINGHAMTON	NY	13901
7	Restaurant	AFC SUSHI	650 HARRY L DR	JOHNSON CITY	NY	13790
8	Convenience	ALASKA QUICK MART	254 CHENANGO ST	BINGHAMTON	NY	13901
9	Grocery	ALDI #49	1149 UPPER FRONT ST	BINGHAMTON	NY	13905
10	Grocery	ALDI 50	134 VESTAL PKWY W	VESTAL	NY	13850
11	Grocery	ALDI 71	619 MAIN ST	JOHNSON CITY	NY	13790
12	Convenience	ALEX QUICK MART	144 COURT ST	BINGHAMTON	NY	13901
13	Convenience	ALIS HALAL	208-210 GRAND AVE	JOHNSON CITY	NY	13790
14	Convenience	APPLE FOOD	306 CONKLIN AVE	BINGHAMTON	NY	13903
15	Convenience	APPLE FOOD	522 HOOPER RD	ENDWELL	NY	13760
16	Convenience	APPLE FOOD	100 N MCKINLEY AVE	ENDICOTT	NY	13760
17	Restaurant	APPLE HILLS	131 BROOKS RD	BINGHAMTON	NY	13905
18	Convenience	ASIA FOOD STORE	200 MAIN ST	BINGHAMTON	NY	13905
19	Restaurant	BELDEN HILL CAMPGROUND	1843 NYS RT 7	HARPURSVILLE	NY	13787
20	Restaurant	BREAD N BUTTER CNTRY ST	3518 NYS RT 79	HARPURSVILLE	NY	13787
21	Convenience	CAVANAUGHS DELI	LEROY ST	BINGHAMTON	NY	13905
22	Convenience	CHENANGO BRDG RED&WHITE	RIVER RD	CHENANGO BRIDGE	NY	13745
23	Grocery	CIDER MILL THE	6-feb S NANTICOKE	ENDICOTT	NY	13760

			AVE			
24	Convenience	CLINTON ST XPRESS MART	338-344 CLINTON ST	BINGHAMTON	NY	13905
25	Convenience	CONKLIN DELI	293 CONKLIN AVE	BINGHAMTON	NY	13903
26	Convenience	CONKLIN MART	1552 CONKLIN RD	CONKLIN	NY	13748
27	Grocery	CONKLIN RELIABLE MARKET	1109 CONKLIN RD	CONKLIN	NY	13748
28	Convenience	CORDISCOS CORNER	308 CHENANGO ST	BINGHAMTON	NY	13901
29	grocery	COUNTRY WAGON PRODUCE	2859 NYS RT 26	GLEN AUBREY	NY	13777
30	Convenience	COURT ST BEER DEPOT	218 COURT ST	BINGHAMTON	NY	13905
31	convenience	COURT STREET FUEL STOP	208-210 COURT ST	BINGHAMTON	NY	13901
32	convenience	CVS	800 HOOPER RD SUITE 500	ENDWELL	NY	13760
33	convenience	CVS	9 OAKDALE RDOAKDALE MALL	JOHNSON CITY	NY	13790
34	convenience	CVS	50 PENNSYLVANIA AVE	BINGHAMTON	NY	13903
35	convenience	CVS	34-38 COURT ST	BINGHAMTON	NY	13901
36	convenience	CVS	345 MAIN ST	JOHNSON CITY	NY	13790
37	convenience	CVS	138 VESTAL PKWY WEST	VESTAL	NY	13850
38	convenience	CVS	34 W STATE ST	BINGHAMTON	NY	13901
39	convenience	CVS	68-70 MAIN ST	BINGHAMTON	NY	13905
40	convenience	CVS	249 MAIN ST	BINGHAMTON	NY	13905
41	convenience	CVS	1010 UNION CENTER HWY	ENDICOTT	NY	13760
42	convenience	CVS	37 RIVERSIDE DR	JOHNSON CITY	NY	13790
43	convenience	CVS	1276 UPER FRONT ST	BINGHAMTON	NY	13901
44	convenience	CVS	1103 NORTH ST	ENDICOTT	NY	13760
45	convenience	CVS	157-163 ROBINSON ST	BINGHAMTON	NY	13904
46	convenience	CVS	245-269 HARRY L DRIVE	JOHNSON CITY	NY	13790
47	Convenience	DANDY MINI MART	51 COMMERCIAL DR	JOHNSON CITY	NY	13790
48	Convenience	DARLINGS MEATS & PROVIS	3300 NY RTE 79	HARPURSVILLE	NY	13787
49	Grocery	DEPOSIT BIG M	156 FRONT ST	DEPOSIT	NY	13754

50	Convenience	DOLLAR GENERAL	3226 WATSON BLVD	ENDWELL	NY	13760
51	Convenience	DOLLAR GENERAL	2658 ST RT 26	MAINE	NY	13802
52	Convenience	DOLLAR GENERAL	225 HARRISON AVE	ENDICOTT	NY	13760
53	Convenience	DOLLAR GENERAL	2649 MAIN ST	WHITNEY POINT	NY	13862
54	Convenience	DOLLAR GENERAL	310 EXCHANGE AVE	ENDICOTT	NY	13760
55	Convenience	DOLLAR GENERAL	222 MAIN ST	JOHNSON CITY	NY	13790
56	Convenience	DOLLAR GENERAL	325 CLINTON ST	BINGHAMTON	NY	13905
57	Convenience	DOLLAR GENERAL	357 COURT ST	BINGHAMTON	NY	13904
58	Convenience	DOLLAR GENERAL	29 NORTH RD	WINDSOR	NY	13865
59	Convenience	DOLLAR STREE	2437 VESTAL PKWY E	VESTAL	NY	13850
60	Convenience	DOLLAR STREE	10 GLENWOOD AVE	BINGHAMTON	NY	13905
61	Convenience	DOLLAR STREE	560 HARRY L DRIVE	JOHNSON CITY	NY	13790
62	Convenience	DOLLAR STREE	800 HOOPER RD STE 12	ENDWELL	NY	13760
63	Grocery	DOWN TO EARTH	305 GRANT AVE	ENDICOTT	NY	13760
64	Convenience	E Z FOOD MART	333 PROSPECT ST	BINGHAMTON	NY	13905
65	Convenience	ENDICOTT EXPRESS MART	1550 UNION CENTER MAINE HWY	ENDICOTT	NY	13760
66	Convenience	ENDICOTT MINI MART	138 W MAIN ST	ENDICOTT	NY	13760
67	Convenience	EXPRESS MART	1015 UNION CENTER HWY	ENDICOTT	NY	13760
68	Convenience	EXPRESS MART	421 HOOPER RD	ENDWELL	NY	13760
69	Convenience	EXPRESS MART	1991 RT 26	ENDICOTT	NY	13760
70	Convenience	EXPRESS MART	719 MAIN ST	JOHNSON CITY	NY	13790
71	Convenience	EXPRESS MART	2105 E MAIN ST	ENDWELL	NY	13760
72	Convenience	EXPRESS MART 320	704 FRONT ST	BINGHAMTON	NY	13905
73	Convenience	EXPRESS MART 325	2972 RT 11	WHITNEY POINT	NY	13862
74	Convenience	EXPRESS MART 338	16 NORTH RD	WINDSOR	NY	13865
75	Convenience	EXPRESS WAY MARKET	237 MAIN ST	JOHNSON CITY	NY	13790
76	Convenience	EZ FOOD MART	333 PROSPECT ST	BINGHAMTON	NY	13905

77	Convenience	EZ FOOD MART	2000 E MAIN ST	ENDICOTT	NY	13760
78	Convenience	FAMILY DOLLAR	3605 NY ROUTE 79	HARPURSVILLE	NY	13787
79	Convenience	FAMILY DOLLAR	412 CHENANGO ST	BINGHAMTON	NY	13901
80	Convenience	FAMILY DOLLAR	1183 VESTAL AVE	BINGHAMTON	NY	13903
81	Convenience	FAMILY DOLLAR	457 UPPER COURT ST	BINGHAMTON	NY	13904
82	Convenience	FAMILY DOLLAR	1113 CONKLIN RD	CONKLIN	NY	13748
83	Convenience	FAMILY DOLLAR	60 COURT ST	BINGHAMTON	NY	13901
84	Convenience	FAMILY DOLLAR	56 MAIN ST	BINGHAMTON	NY	13905
85	Convenience	FAST MART	1304 NORTH ST	ENDICOTT	NY	13760
86	Restaurant	FASTRAC MARKET	17 CANAL ST PO BOX 225	PORT CRANE	NY	13833
87	convenience	FIVE STAR FIVE DELI	900 BROAD STREET	ENDICOTT	NY	13760
88	convenience	FLORAL AVENUE MARKET	296 FLORAL AVE	JOHNSON CITY	NY	13790
89	convenience	FRIENDS GROCERY	46 COURT ST	BINGHAMTON	NY	13901
90	convenience	FRONT STREET DELI MART	1065 FRONT ST	BINGHAMTON	NY	13905
91	convenience	GERRY TULLS STORE	18 NYS RT 38B	ENDICOTT	NY	13760
92	Grocery	GREGGS MARKET PLACE	2956 RT 11	WHITNEY POINT	NY	13862
93	convenience	HANG PHAT MARKET	278 MAIN ST	BINGHAMTON	NY	13905
94	convenience	HARASH STOP & SHOP	14 MAIN ST	JOHNSON CITY	NY	13790
95	Convenience	HARASH STOP & SHOP	109 WASHINGTON AVE	ENDICOTT	NY	13760
96	Convenience	MIRABITO	1308 E MAIN ST	ENDICOTT	NY	13760
97	Convenience	HW CONVENIENCE	56 1/2 HENRY ST	BINGHAMTON	NY	13901
98	Convenience	J&R STOP N SHOP	415 W MAIN ST	ENDICOTT	NY	13760
99	Convenience	JAV GAS 4 LESS	266 CHENANGO ST	BINGHAMTON	NY	13901
100	Convenience	JAYS ONE STOP	285 HARRY L DR	JOHNSON CITY	NY	13790
101	Convenience	JAYS ONE STOP	28 EXCHANGE ST	BINGHAMTON	NY	13901
102	Convenience	JAYS ONE STOP	429 RIVERSIDE DR	JOHNSON CITY	NY	13790
103	Convenience	K MART BIG 3521	33 W STATE ST	BINGHAMTON	NY	13901
104	Convenience	K&P STOP-N-SHOP	198 ROBINSON ST	BINGHAMTON	NY	13904
105	Convenience	KIMS ORIENTAL	3740 VESTAL PKWY E	VESTAL	NY	13850
106	Convenience	KING DELI	274 FLORAL AVE	JOHNSON CITY	NY	13790
107	Convenience	KWIK FILL	267 MAIN ST	BINGHAMTON	NY	13905

108	Convenience	KWIK FILL	1053 UPPER FRONT ST	BINGHAMTON	NY	13905
109	Convenience	KWIK FILL	8 W STATE ST	BINGHAMTON	NY	13901
110	Convenience	KWIK FILL	3408 E MAIN ST	ENDWELL	NY	13760
111	Convenience	KWIK FILL	200 HARRY L DR	JOHNSON CITY	NY	13790
112	Convenience	KWIK FILL	3231 BRIDGE ST	VESTAL	NY	13850
113	Convenience	LAO VANTHANVY ORIENTAL	154 BALDWIN ST	JOHNSON CITY	NY	13790
114	Grocery	LONE MAPLE FARM	2001 HAWLEYTON RD	BINGHAMTON	NY	13903
115	Convenience	LOVES TRAVEL STOP #403	2 INDUSTRIAL PARK DR	BINGHAMTON	NY	13904
116	Convenience	MAIN STREET MARKET	2906 EAST MAIN STREET	ENDWELL	NY	13760
117	Grocery	MAINESOURCE FOOD & PAPR	1018-1022 UPPER FRONT ST	BINGHAMTON	NY	13905
118	Convenience	MASK	2618 NY RT 12	CHENANGO FORKS	NY	13746
119	Convenience	MATIN FOOD	8 MAIN ST	BINGHAMTON	NY	13905
120	Convenience	MIRABITO	3151 VESTAL PKWY E	VESTAL	NY	13850
121	Convenience	MIRABITO	217-227 COURT ST	BINGHAMTON	NY	13901
122	Convenience	MIRABITO	3200 OLD VESTAL RD	VESTAL	NY	13850
123	Convenience	MIRABITO	120 BALDWIN ST	JOHNSON CITY	NY	13790
124	Convenience	MIRABITO	520 CHENANGO ST	BINGHAMTON	NY	13901
125	Convenience	MIRABITO	1102 CHENANGO ST	BINGHAMTON	NY	13901
126	Convenience	MIRABITO	1899 RT 12 & PORT RD	BINGHAMTON	NY	13901
127	Convenience	MIRABITO	648 OLD 17 RD	WINDSOR	NY	13865
128	Convenience	MIRABITO	98 BROAD AVE	BINGHAMTON	NY	13904
129	Convenience	MIRABITO	4005 VESTAL PKWY	VESTAL	NY	13850
130	Convenience	MIRABITO	1323 FRONT ST	BINGHAMTON	NY	13905
131	Convenience	MIRABITO	715 UPPER COURT ST	BINGHAMTON	NY	13904
132	Convenience	MIRABITO	733 HARRY L DR	JOHNSON CITY	NY	13790
133	Convenience	MIRABITO	VESTAL PKWY E	VESTAL	NY	13850
134	Convenience	MIRABITO	1161 ROUTE 17	WINDSOR	NY	13865
135	Convenience	MIRABITO	150-156 CONKLIN AVE	BINGHAMTON	NY	13903
136	Convenience	MIRABITO	2965 ROUTE 26	GLEN AUBREY	NY	13777
137	Convenience	MIRABITO	215 CLINTON ST	BINGHAMTON	NY	13905
138	Convenience	MIRABITO	3117 WATSON BLVD	ENDWELL	NY	13760
139	Convenience	MIRABITO	49-53 DOWNS AVE	BINGHAMTON	NY	13905
140	Convenience	MIRABITO	879-881 FRONT ST	BINGHAMTON	NY	13905
141	Convenience	MIRABITO	1590 MAIN ST RT 26	VESTAL	NY	13850
142	Convenience	MIRABITO	906-908 NORTH ST	ENDICOTT	NY	13760
143	Convenience	MIRABITO	1000	BINGHAMTON	NY	13903

			PENNSYLVANIA/PARK AVE			
144	Convenience	MIRABITO	409 COURT ST	BINGHAMTON	NY	13904
145	Convenience	MSB QUICK MART	3502 COUNTRY CLUB RD	ENDWELL	NY	13760
146	Convenience	NANNERYS GROCERY	184 CLINTON ST	BINGHAMTON	NY	13905
147	Convenience	NYC-ENDICOTT GRMT DELI	2 WASHINGTON AVE	ENDICOTT	NY	13760
148	Grocery	OLD BARN HOLLOW	214 STATE ST	BINGHAMTON	NY	13901
149	Grocery	ONE STOP	283-285 FRONT ST	BINGHAMTON	NY	13905
150	Grocery	PRICE CHOPPER	33 CHENANGO BRIDGE RD	BINGHAMTON	NY	13901
151	Grocery	PRICE CHOPPER	911 NORTH ST	ENDICOTT	NY	13760
152	Grocery	PRICE CHOPPER	10 GLENWOOD AVE	BINGHAMTON	NY	13905
153	Grocery	PRICE RITE 233	3124 VESTAL PKWY E	VESTAL	NY	13850
154	Convenience	PRINCE MART INC	55 ROBINSON ST	BINGHAMTON	NY	13901
155	Convenience	QUICK CHECK MINIMART	225 MAIN ST	WINDSOR	NY	13865
156	Convenience	QUICK N EASY MART	976 CONKLIN RD	CONKLIN	NY	13748
157	Convenience	QUICK STOP DELI	96 HARRY L DRIVE	JOHNSON CITY	NY	13790
158	Convenience	QUICKWAY	1232 UPPER FRONT ST	BINGHAMTON	NY	13905
159	Convenience	QUICKWAY	1231 CAMPVILLE RD	ENDICOTT	NY	13760
160	Convenience	QUICKWAY	3300 OLD VESTAL RD	VESTAL	NY	13851
161	Convenience	QUICKWAY	5 KATTELVILLE RD	CHENANGO BRIDGE	NY	13745
162	Convenience	QUICKWAY	1178 VESTAL AVE	BINGHAMTON	NY	13903
163	Convenience	QUICKWAY	1166 CASTLE CREEK RD	CASTLE CREEK	NY	13744
164	Convenience	QUICKWAY FOOD STORE #74	3622 NYS RT 79	HARPURSVILLE	NY	13787
165	Convenience	RED APPLE FD MRT M0357	23 FLORAL AVE	BINGHAMTON	NY	13902
166	Convenience	RITE AID	2642 MAIN ST PO BOX 269	WHITNEY POINT	NY	13862
167	Convenience	RITE AID	85 ROBINSON ST	BINGHAMTON	NY	13901
168	Convenience	RITE AID	511 HOOPER RD	ENDWELL	NY	13760
169	Convenience	RITE AID	100 E MAIN ST	ENDICOTT	NY	13760
170	Convenience	RITE AID	3701 VESTAL PKWY E	VESTAL	NY	13850
171	Convenience	RITE AID	1250 UPPER FRONT	BINGHAMTON	NY	13901

			ST			
172	Convenience	RITE AID	201 CONKLIN AVE	BINGHAMTON	NY	13903
173	Convenience	ROGERS MARKET	109 NORTH ST	ENDICOTT	NY	13760
174	Convenience	RUNWAY	143 RIVERSIDE DR	JOHNSON CITY	NY	13790
175	Convenience	RUNWAY	C684 ONKLIN RD	BINGHAMTON	NY	13903
176	Convenience	RUNWAY	3225 E MAIN ST	ENDWELL	NY	13762
177	Convenience	RUNWAY	429-431 E MAIN ST	ENDICOTT	NY	13760
178	Convenience	RUNWAY	3 SOVA RD	HARPURSVILLE	NY	13787
179	Convenience	RUNWAY MART	77 MAIN ST	BINGHAMTON	NY	13905
180	Grocery	S&M DELICATESSEN	3309 WATSON BLVD	ENDWELL	NY	13760
181	Grocery	SAMS CLUB 6366	2441 VESTAL PKWY E	VESTAL	NY	13850
182	Grocery	SAVE-A-LOT	200 MAIN ST	JOHNSON CITY	NY	13790
183	Grocery	SCHNEIDERS MARKET	5 MILE PT PLAZA	KIRKWOOD	NY	13795
184	Convenience	SK MINI MART	110 MAIN ST	BINGHAMTON	NY	13905
185	Convenience	SMILEY FOOD MART	2650 NYS ROUTE 26	MAINE	NY	13802
186	Convenience	SPEEDWAY	709 HARRY L DR	JOHNSON CITY	NY	13790
187	Convenience	SPEEDWAY	1243 UPPER FRONT ST	BINGHAMTON	NY	13905
188	Convenience	SPEEDWAY	503 E MAIN ST	ENDICOTT	NY	13760
189	Convenience	SPEEDWAY	63 MAIN ST	BINGHAMTON	NY	13905
190	Convenience	SPEEDWAY	1454 UPPER FRONT ST	BINGHAMTON	NY	13905
191	Convenience	SPEEDWAY	781 ST RT 7	PORT CRANE	NY	13833
192	Convenience	SPEEDWAY	61 GLENWOOD AVE	BINGHAMTON	NY	13905
193	Convenience	SPEEDWAY	3808 VESTAL PKWY E	VESTAL	NY	13850
194	Convenience	SPEEDWAY	2818 NY RT 11	WHITNEY POINT	NY	13862
195	Convenience	SPEEDWAY	236 CONKLIN AVE	BINGHAMTON	NY	13903
196	Convenience	STOP N GAS	232 VESTAL PARKWAY EAST	VESTAL	NY	13850
197	Convenience	SUNRISE GAS & GROCERY	3650 RT 26 PO BOX 362	MAINE	NY	13802
198	Convenience	TARGET	3112 VESTAL PARKWAY EAST	VESTAL	NY	13850
199	Convenience	TASHA DELI	400 BROOME ST	NEW YORK	NY	10013
200	Convenience	TOMS COFFEE	184MAIN ST	BINGHAMTON	NY	13905
201	Convenience	UNCLES ASIAN MARKET	200 GRAND AVE	JOHNSON CITY	NY	13790
202	Convenience	UNITED STATES MARKET	33 EDWARDS ST	BINGHAMTON	NY	13905

203	Grocery	WALGREENS	335 MAIN ST	JOHNSON CITY	NY	13790
204	Grocery	WALGREENS	37 PENNSYLVANIA AVE	BINGHAMTON	NY	13903
205	Grocery	WAL-MART	2 GANNETT DR	JOHNSON CITY	NY	13790
206	Grocery	WAL-MART	2450 VESTAL PKWY E	VESTAL	NY	13850
207	Grocery	WEGMANS	650HARRY L DR	JOHNSON CITY	NY	13790
208	Grocery	WEIS	307 CONKLIN AVE	BINGHAMTON	NY	13903
209	Grocery	WEIS	1290 FRONT ST	BINGHAMTON	NY	13905
210	Grocery	WEIS	1109 WEST CORNERS	ENDICOTT	NY	13760
211	Grocery	WEIS	800 HOOPER RD	ENDWELL	NY	13760
212	Grocery	WEIS	925 MAIN ST	VESTAL	NY	13850
213	Grocery	WEIS	50 PENNSYLVANIA AVE	BINGHAMTON	NY	13905
214	Grocery	WEIS	160 ROBINSON ST	BINGHAMTON	NY	13904
215	Grocery	WEIS	100 RANO BLVD	VESTAL	NY	13850
216	Convenience	WEST SIDE GULF	92 MAIN ST	BINGHAMTON	NY	13901
217	Convenience	WESTSIDE MINI MART	96 MAIN ST	BINGHAMTON	NY	13905
218	Grocery	WINDSOR BIG M	500 CHAPEL ST	WINDSOR	NY	13865
219	Convenience	YELLOW DELI	121 SUSQUEHANNA ST	BINGHAMTON	NY	13901

Appendix B, List of Food Pantries

List of Food Pantries					
	Site Name	**Address**	**City**	**State**	**Zip Code**
1	Salvation Army FP-Binghamton	127-131 Washington Street	Binghamton	NY	13901
2	Our Lady of Sorrows Church	801 Main Street	Vestal	NY	13850
3	C.C. Broome/Community Food Pantry	100 Main Street	Binghamton	NY	13905
4	C.C. Broome/ Mother Teresa's Cupboard	202 Garfield Avenue	Endicott	NY	13760
5	Loaves and Fishes Food Pantry - Binghamton	25 1/2 Mill Street	Binghamton	NY	13903
6	Catherine's Cupboard	1031 Chenango St	Binghamton	NY	13901
7	St. Anthony Food Pantry	1000 Jenkins Street	Endicott	NY	13760
8	Windsor Human Development	594 Kent Street	Windsor	NY	13865
9	Colesville Community Pantry	28 King Road	Harpursville	NY	13787
10	All Saints Episcopal	475 Main St	Johnson City	NY	13790

	Church				
11	Assembly of God CHOW Pantry	255 Washington St	Binghamton	NY	13905
12	Boulevard UMC Pantry	113 Grand Blvd	Binghamton	NY	13905
13	Centenary-Chenango Street UMC	438 Chenango St	Binghamton	NY	13901
14	Chenango Valley Food Pantry	221 Chenango Bridge Rd.	Binghamton	NY	13901
15	Christ Episcopal Church	10 Henry St	Binghamton	NY	13901
16	Community Baptist Church	743 Chenango St	Binghamton	NY	13901-1830
17	Community Wellness Center	3 Otseningo St.	Binghamton	NY	13903
18	Cornell Cooperative Extension Pantry	840 Upper Front St	Binghamton	NY	13905
19	Cornerstone Children's Outreach (Central UMC)	911 E. Main St.	Endicott	NY	13760
20	East Side Congregational Church	284 Robinson St	Binghamton	NY	13904
21	First Baptist Church (Conklin Ave) Pantry	91 Baldwin St	Binghamton	NY	13903
22	First Congregation Church	30 Main St	Binghamton	NY	13905
23	First UMC (Endicott)	53 McKinley Ave	Endicott	NY	13760
24	First UMC (Windsor)	56 Chapel St.	Windsor	NY	13865
25	God's Bread	56 Chapel St.	Windsor	NY	13865
26	Greater Faith and Deliverance Pantry	219 Oak St.	Binghamton	NY	13905
27	High Street Methodist Church	1288 High St	Binghamton	NY	13903
28	Iglesia De Dios-Mt. Sinai	5 Rutherford St	Binghamton	NY	13905
29	Landmark Church	125 Court St.	Binghamton	NY	13901
30	Main Street Baptist Church	117 Main St.	Binghamton	NY	13905
31	Maine Federated Church	2615 Main St (Rt. 26)	Maine	NY	13802
32	New Life Ministry	201 Hill Ave.	Endicott	NY	13760
33	Northminster Presbyterian Church	711 Farm-to-Market Rd	Endwell	NY	13760
34	Project Concern	23 Katteville Rd	Chenango Bridge	NY	13745-0024
35	St. Cyril's	148 Clinton St.	Binghamton	NY	13905
36	St. James Pantry	155 Main St	Johnson City	NY	13790
37	St. Mark's Pantry	728 River Rd.	Chenango Bridge	NY	13901
38	St. Mary's of Kirkwood	975 NY Rt. 11	Kirkwood	NY	13795
39	St. Patrick's Pantry	50 Oak St.	Binghamton	NY	13905
40	St. Paul's Pantry	200 Jefferson Ave.	Endicott	NY	13760

41	Sunflower Park	185 Murray St.	Binghamton	NY	13905
42	Temple Concord	9 Riverside Dr.	Binghamton	NY	13905
43	Valley Christian Reformed Church	1452 River Rd.	Chenango Forks	NY	13901
44	YWCA Pantry	80 Hawley St.	Binghamton	NY	13901

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