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## Identifying Arkansas Food Desert Blocks Suitable for a Peer-to-Peer Modeled Food Redistribution Program

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Identifying Arkansas Food Desert Blocks Suitable for a Peer-to-Peer Modeled Food  
Redistribution Program

An Undergraduate Honors Thesis  
in the  
Department of Agricultural Economics and Agribusiness

Submitted in partial fulfillment of the requirements for the  
University of Arkansas  
Dale Bumpers College of Agricultural, Food and Life Sciences  
Honors Program

By  
Emily King  
March 2019

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## **Abstract**

Nearly 10% of Americans reside in low-income urban food deserts which are low-income areas that lack access to affordable and nutritious foods. Food deserts in Arkansas contribute to a food insecurity rate above the national average, making it one of the most food insecure states in the country. Efforts to alleviate food deserts have included working with supermarkets to construct stores in underserved areas, encouraging the growth of farmers' markets, and passing the Healthy Food Financing Initiative (HFFI). The inability of these programs to provide food desert residents with a variety of accessible and affordable food items year-round indicates a new program may be necessary. Increased internet usage and consumer interest in sharing based companies contribute to the idea of a sharing, or peer-to-peer (P2P) style food redistribution program. The objective of this study is to identify which of the 186,211 census blocks in the state of Arkansas are food deserts and best suited for and in the most need, based on an identified set of criteria, of a P2P food redistribution program. To complete the objective a multi-criteria decision analysis was conducted using population, internet access, vulnerable communities, and vehicle availability as criteria. Based on the results of this study, it is recommended that Pulaski County is amongst the first to be targeted for a P2P food redistribution pilot program. This recommendation is based upon the close proximity of priority areas, transportation access, ethnic/racial diversity, and the number of possible collection locations in Pulaski County. This study may be used to serve as a baseline to a future study that examines the location of P2P food redistribution collection points and the number of consumers they could reach.

## **Introduction**

Nearly 10% of Americans reside in low-income areas with a supermarket more than one mile away (Ver Ploeg et al. 2012). These areas contribute to 5.7% of U.S. households that suffer from food insecurities as a result of food deserts (Hunger and Food Insecurity, 2011). Food deserts in Arkansas contributed to a food insecurity rate above the national average from 2015 to 2017, making it one the most food insecure states in the country (Food Security in the U.S, 2017). According to the United States Department of Agriculture, food deserts are regions of the country that “often feature large proportions of households with low incomes, inadequate access to transportation, and a limited number of food retailers providing fresh produce and healthy groceries for affordable prices” (Food Access Research Atlas, 2017). Food choices within food deserts can be influenced by more than proximity, but also the cost to travel and food prices (Fitzpatrick et al., 2015). Limited food choices can increase the likelihood of developing obesity and chronic, diet-related diseases in children and adults (Schafft et al., 2009; Whitacre et al., 2009, Alviola et al., 2013, Bodor et al., 2006).

Government officials and interest groups have developed a growing number of policies to reduce the number of communities with limited food access because of related health concerns (Fitzpatrick et. al., 2015). Alleviation efforts have included working with supermarkets to construct stores in underserved areas, encouraging the growth of farmers’ markets, and passing the Healthy Food Financing Initiative (HFFI) (Fact Sheet: Food Deserts, 2017). Typically stores built in underserved communities, which include those constructed under the HFFI, have higher operating cost that they pass onto consumers, creating an affordability issue (Anderson, 2007). Farmers markets located in food desert communities do provide consumers with a source of fresh produce at reasonable prices, but they usually are not permanent establishments and have strict

seasonal schedules (Becker, 2006). The inability of these programs to provide food desert residents with a variety of accessible and affordable food items year-round indicates there is a need for a new program model. Increased internet usage and consumer interest in sharing based companies such as ThreadUp and Airbnb contribute to the idea of a sharing, or peer-to-peer (P2P) style food redistribution program (NTIA.doc.gov, 2018).

A P2P economic model could serve as a possible solution to the problem of urban food deserts which make up 75% of total food deserts (Hunger and Food Insecurity, 2011). The P2P economy model falls within a category of economies known as sharing economies which allow for the using and sharing of goods and services among others (Puschmann and Alt, 2015). A P2P economy specifically is a model where individuals interact to buy or sell goods and services directly to one another, without an intermediary or company. Airbnb and Uber are examples of successful P2P organizations. The term “collaborative consumption” is another term for P2P economies that reflects the ability of individuals to move between the roles of consumers and producers. P2P economies have been emerging in agriculture and food systems in subtle forms like community gardens and food swapping (Miralles et al., 2017). Food sharing has become common in cities through emergency food relief (i.e. food banks and soup kitchens) and Apps that connect people who want to engage in new food cultures (Gaspard, 2018). At the core of many of these new food sharing initiatives is the redistribution of surplus food (Gaspard, 2018). Redistributing surplus food through a P2P system can positively impact food deserts and reduce the big problem of food waste. The objective of this study is to identify food desert census blocks in the state of Arkansas that are best suited for and in the most need, based on an identified set of criteria, of a P2P food redistribution program.

## **Background and Literature Review**

### ***Food Deserts***

Increasing rates of obesity and related chronic diseases in the United States have generated a major public health concern. This concern led Congress to conduct a food access study and define the term *food desert* in the 2008 Food, Conservation, and Energy Act, also known as the Farm Bill (Access to Affordable and Nutritious Food, 2009). The 2008 Farm Bill defines a food desert as an “area in the United States with limited access to affordable and nutritious food, particularly such an area composed of predominantly lower income neighborhoods and communities” (Title VI, Sec. 7527). The United States Department of Agriculture expanded upon this definition to include geographic markers such that food deserts are categorized as regions further than one mile from a supermarket in urban or suburban areas, and further than ten miles in rural areas (Food Access Research Atlas, 2017; Frndak, 2014). Using these guidelines the USDA’s Food Desert Locator has identified 10% of the roughly 73,000 census tracts as food deserts (Ver Ploeg et al., 2012). When determining where food deserts are located and the extent to which they exist it is important to understand two ideas: what are nutritious and affordable foods and what does it mean to have limited access to them (Access to Affordable and Nutritious Food, 2009).

### ***Nutritious Foods & Affordability***

There are many scientific methods used to determine whether foods are more or less nutritious relative to other food options. One study with the objective of conducting a cost comparison between more and less nutritious foods used the Nutrition Detectives school-based nutrition education program. In the study for an item to be more nutritious, it did not have excessive marketing-related claims; have an unhealthy ingredient listed first; contain high-

fructose corn syrup or partially hydrogenated oils, or have a long ingredient list compared to other items in the same category (Katz et al., 2010). Whole-wheat bread, oatmeal, multigrain crackers, natural fruit juices, and vegetables are examples of the more nutritious foods used in the study. Even small food retailers provide foods like those listed that have nutritional merits, but it is unlikely that they will offer enough options to fulfill all recommendations for a healthy diet (Access to Affordable and Nutritious Food, 2009; Wright et al., 2016). Many of the small retailers in and around food deserts are fast food restaurants and convenience stores. A study conducted in 2013 found that rural food desert blocks tend to have higher 10-mile densities of convenience stores and higher densities of fast-food restaurants while urban food deserts have higher 2-mile densities of fast-food restaurants (Alviola et al., 2013).

While food deserts do not often offer nutritious foods they do provide consumers affordability. The affordability of food is impacted by the budget constraints of consumers who must consider relative price differences between alternative food options (Access to Affordable and Nutritious Food, 2009; Katz et al., 2010). As stated in the Farm Bill and defined by the USDA, food deserts are predominately low-income communities meaning there is a poverty rate of 20% or greater or a median family income at or below 80% of the area median family income (Title VI, Sec. 7527; Food Access Research Atlas, 2017). With less expendable income consumers may find it difficult to justify spending a larger proportion of income on healthy food items. The higher cost of healthier foods which, on average is \$1.48 more per day, drives poor people to purchase foods that are more energy dense and also filled with higher amounts of sugar and fat (Rao et al., 2013; Wright et al., 2016). In addition, when supermarkets and grocery stores are far away residents of food deserts must consider the cost of travel (Access to Affordable and Nutritious Food, 2009).



### ***Limited Access***

Now that nutritious and affordable foods have been defined it is important to discuss what it means to have limited access to them. The ease or difficulty of accessing food retailers that offer nutritious and affordable foods can depend on the location of the retailer in relation to the consumer, the consumer's individual characteristics such as vehicle ownership or SNAP participation, and neighborhood characteristics such as the availability of public transportation (Access to Affordable and Nutritious Food, 2009). A large part of identifying and categorizing food deserts is the distance consumers are from supermarkets and grocery stores. When quantified into time individuals in low-income areas with limited grocery store access spend 19.5 minutes traveling to shop which is significantly more than the national average of 15 minutes (Hamrick and Hopkins, 2012). A combined study conducted by New York University, Stanford University, and the University of Chicago (Allcott et al., 2017) used data from the National Household Travel Survey and found that the average American travels 5.2 miles to purchase groceries while those living in urban food deserts travel nearly 7 miles to shop. They also found that 90% of grocery shopping trips are made via car, which is why ownership or access to a vehicle is an important consumer characteristic to consider. While some food desert residents are willing to travel a long distance to purchase groceries that choice is made more difficult when access to a vehicle is removed (Allcott et al., 2017). Low-income households are about seven times more likely to not own a vehicle than other U.S. households (Vallianatos et al., 2002) Second to money, no vehicle access is the most important factor that limits access to food (Wright et al., 2016). The availability of a vehicle is a key determinant in the choice of main food stores (Wright et al., 2016). Low-income consumers in food deserts without vehicles are more likely to shop at local convenience stores.

### ***Consequences of Food Deserts***

Low-income food desert residents, especially those without access to a vehicle, are at a greater risk for poor nutrition (Frndak, 2014; Schafft et al., 2009). There are many studies that have found relationships between poor nutrition and impaired cognitive development, obesity, chronic disease and poor social skills (Nyaradi et al., 2013; Reed et al., 2012; Schafft et al., 2009; Frndak, 2014; Thomsen et al., 2015). Numerous studies have focused on the nutritional impact food deserts have on school-aged children. A study conducted in New York found that school districts with a high percentage of children living in food desert areas produced lower 4<sup>th</sup>-grade achievement in science, English, and math (Frndak, 2014). Another study conducted in Pennsylvania demonstrated school districts with a higher proportion of populations residing within food deserts have increased rates of overweight children (Schafft et al., 2009). Finally, in an interesting study conducted in the Kansas City metropolitan area a positive correlation between food desert residency and the development of pediatric food allergies was discovered (Humphrey et al., 2015). Beyond school children, food deserts have been linked to lower levels of serum carotenoids (biomarkers for fruit and vegetable consumption) and higher systolic blood pressure in adults (Suarez et al., 2015). Low-income adults living in food deserts have also been shown to have higher rates of poor glucose control, a higher burden of cardiovascular risk factors, higher arterial stiffness, and systemic inflammation (Theuri, 2015; Kelli et al., 2016).

### ***Proposed Solution(s)***

Providing nutritious and affordable foods within a reasonable distance is key to ameliorating food deserts and the severe consequences that stem from them. Researchers, community advocates, and policymakers have seen the severity of food deserts and are actively working to find solutions (Hodgson, 2012; Story et al., 2007). Wadlington (2017) found potential

solutions can be characterized into two categories: “(1) providing nutritional assistance by utilizing food assistance programs and (2) increasing access to healthy food via farmer’s markets.” (p. 30) The Supplemental Nutrition Assistance Program, or SNAP, originated under the name Food Stamp Act in 1997 and has since grown to account for roughly 71% of all federal food and nutrition programs as of 2015 (Oliveira, 2016). The objective of SNAP is to decrease the prevalence of food insecurity and poor diet and nutrition which is extremely common in food deserts (Fitzpatrick and Ver Ploeg, 2010). However, some research shows SNAP alone may not adequately address food hardship because the additional income it provides may be offset by the higher price of food in supermarkets or grocery stores and the greater travel costs (Fitzpatrick and Ver Ploeg, 2010). Distance and affordability may make using electronic benefit transfer (EBT) cards at convenience stores the simplest option for SNAP beneficiaries (Karsten and West, 2017).

To address the issue of distance the HFFI was announced in 2010. The purpose of the initiative was to “provide financial and technical assistance to healthy food producers and retailers, food hubs, and mid-tier value chains that serve healthy food retailers and other healthy food business enterprises to improve access to, and expand the supply of, healthy food in low-income, underserved communities.” (§243(a)(1)). The grocery store and supermarket projects funded by this initiative are built in the urban and rural areas they seek to serve. Typically stores built in underserved communities, which includes those constructed under the HFFI have higher operating cost that they pass onto consumers creating the affordability issue previously discussed (Anderson, 2007).

The HFFI also provides resources for the establishment of farmers markets in low-income areas which provides the second category of proposed food desert amelioration

(ACFgov, c2010; Wadlington, 2017). There are problems that arise when considering farmers markets as a solution to food deserts. First, despite motivation from the HFFI, a high percentage of farmers markets are located in areas of high socioeconomic status and in urban areas not considered food deserts (Wadlington, 2017). These farmers markets pose many issues including increased distance from low-income communities. A study conducted in Arizona in 2015 found that farmers markets that accepted food assistance benefits were less accessible to those living in surrounding food deserts (Yanamandra et al., 2015). Farmers markets located in food desert communities do provide consumers with a source of fresh produce at reasonable prices, but they usually are not permanent establishments and have strict seasonal schedules (Becker, 2006). Families with children participating in the National School Lunch Program have a greater need for healthy, accessible, and affordable food during the winter months because of winter vacation. The seasonality of farmers markets prevents these families from accessing farmers markets benefits during the cold winter months when they are in need.

The inability for previously implemented programs to provide food desert residents with a variety of accessible and affordable food items year-round indicates there is a need for a new program model. The rising use of the internet in low-income areas can be leveraged to provide a digital food distribution program for those living in food deserts. A study completed by the National Telecommunications and Information Administration in 2017 determined for households with incomes below \$25,000 per year internet use increased from 57% to 62% since 2015 (NTIA.doc.gov, 2018). The increase in internet use combined with consumer interest in sharing programs such as Uber and Airbnb could support the development and implementation of a sharing, or P2P style food redistribution program.

## *Sharing Economy*

The phenomenon known as the sharing economy has emerged as an effect of many factors including the rise of the internet, enabling connectivity, and the trend to urbanization (Bardhi and Eckhardt, 2012; Michelini et al., 2016). While still relatively new to literature, many definitions for sharing economy have been found. In 2007 Russell Belk, who boosted the study of sharing and consumer behavior, described sharing economy as an alternative to private ownership and commodity exchange distribution (Belk, 2007). Moreover, sharing economy is any activity, digitally facilitated, that enables people to share assets that would otherwise be unused or under-used (The feasibility of measuring the sharing economy, 2016). The concept of sharing economy has become attached to a variety of models, most notably access-based consumption and collaborative consumption (Michelini et al., 2016). Access-based consumption describes services such as Zipcar where a transaction is mediated through a market, but no actual transfer of ownership occurs (Bardhi and Eckhardt, 2012). For food sharing and distribution an access-based model is not applicable because food cannot be rented or reused. Food sharing is a commodity better served by the collaborative consumption model. Collaborative consumption is given this name because of the coordination of the exchange or sharing access to goods amongst peers (Hamari et al., 2016). Airbnb is a commonly used example of collaborative consumption platforms. The transfer of goods between peers without the use of a company or business has given rise to another term for collaborative consumption, or P2P. Most literature centered around the idea of a sharing economy has focused on the traditional business-to-consumer facets, but this study will view the sharing economy through a P2P collaborative consumption lens (Kumar et al., 2017; Guyader, 2018).

## ***Peer-to-Peer***

It is difficult to discuss P2P economies without addressing the online platforms upon many have positioned themselves (Hamari et al., 2016). The growth of the internet and rapid developments in information technology, such as open source software, have permitted the growth of online platforms that facilitate information exchange between users (Hamari et al., 2016; Frenken and Schor, 2016; Kaplan and Haenlein, 2010). Wikipedia, YouTube, The Pirate Bay, Kiva, and Kickstarter are examples of how platforms promote user-generated content, collaboration, and sharing (Kaplan and Haenlein, 2010). These platforms proliferate consumption models, like P2P, because peer communities form and pool resources, products, and services that can be shared amongst its members (Belk, 2009; Gansky, 2010; Bardhi and Eckhardt, 2012).

Online marketplaces are great examples of how P2P works through open source online platforms. There are P2P marketplaces for education (SkillShare), clothing (Rent the Runway), and services (Care.com). Food sharing P2P marketplaces do exist such as Eat With, Let's Lunch, Traveling Spoon, and Meal Sharing. Each of these providers is service-based platforms that offer meals to community members. This study examines how P2P models can be used to provide consumers with grocery goods instead of solely meals.

In an article written for Harvard Business Review Rachel Botsman and Roo Rogers organized examples of P2P models into three types of systems (2010). The first is a product service system that allows companies to provide a good as a service instead of asking consumers to purchase said good (Botsman and Rogers, 2010). Consumers can pay for the usage of a good instead of its ownership (Botsman and Rogers, 2010; Mun, 2013). RenttheRunway members use this type of system to rent high-end fashion items for a reduced price.

The second system is for consumers with similar lifestyles to collaborate and exchange less-tangible assets like time, space, skills, and money (Botsman and Rogers, 2010). Due to the recent trend of people sharing their time and labor, platforms like TaskRabbit have arrived (Mun, 2013). TaskRabbit allows users to post tasks that they need to complete and people, or Rabbits, who are interested in completing the task bid on it. The lowest bidder is typically selected to complete the task.

Neither the product service system nor the collaborative lifestyle system is best for food sharing because of foods single use and tangible properties. The third and last system, known as the redistribution collaborative consumption model, is for preowned goods that are taken from somewhere they are not needed and redistributed to an area where they are (Botsman and Rogers, 2010). With the expansion of the internet exchanging goods, which has been done for years, has become much more efficient (Mun, 2013). In this system goods may be free, swapped, or sold for cash (Botsman and Rogers, 2010). ThreadUp is an online community where members who want to swap and redistribute clothing are equipped with free shipping boxes and earn credit after their clothing is “sold.” Similar to the redistribution of clothing and durable goods, food redistribution can already be seen. Food banks and local charity organizations move donated food through a central distribution center from an area it is not needed to an area of need (Hulten, et al. 2016). In this study redistribution between consumers and consumers will be the main focus instead of redistribution from food banks or charities.

### ***Proposed Peer-to-Peer Program***

The P2P program as envisioned for this study follows the redistribution collaborative consumption model. The purpose of the program is to provide a platform and organized system for consumers to sell unused or unwanted food items to other consumers, primarily those in food

deserts. Consumers who purchase too many food items, primarily those not requiring refrigeration, can post their groceries on the program webpage or app at a reduced price. Consumers looking to purchase groceries at a reduced price can shop the site for items they wish to purchase. Facilitated through an internet webpage for computer access and a mobile phone application participants can easily update and check what is available for purchase. After items are purchased through the site the buyer and seller have two options for exchange. The first option is to have the buyer and seller choose whether to pick-up or drop-off the items themselves. Participants can communicate through the website or app to coordinate times, dates, and locations for exchange. This could be beneficial for buyers who do not have vehicle access or are unable to leave their home, whether that be due to an illness or disability. The second option is for the sellers to drop-off sold items at a collection location where the buyers can pick the groceries up. This collection and distribution point could be a farmers market, food pantry, church, or other community center located in a food desert.

P2P programs such as the one described do offer a variety of benefits for buyers and sellers (Mun, 2013; Supangkat and Kurniawan, 2014; Puschmann and Alt, 2016; Botsman and Roo, 2010). Sharing, in general, has been praised for its benefits of improving access to consumers (Supangkat and Kurniawan, 2014). P2P consumption gives people the benefits of ownership with reduced personal burden and cost (Mun, 2014; Puschmann and Alt, 2016; Botsman and Rogers, 2010). Consumers can get grocery items at a reduced price because they are not sold at a supermarket and the travel cost is cut down. Another benefit of the program is its ability to run year-round because it is not dependent on consumers shopping outside or on seasonal produce like many farmers markets are. Aside from buyers, the program can also benefit the sellers as well. Surplus food redistribution is promoted as a way of reducing food



waste and building a more sustainable food chain (Midgley, 2014). Previous studies show that American consumers have a very accurate perception of the impact food waste can have on the environment and what types of foods are wasted (Zepeda and Balaine, 2017). This being said, consumers who understand the impact of food waste may be interested in participating in this program. The second benefit of the program is targeted at farmers. In Arkansas specifically, there many rural farmers that are not too far from urban areas. Producers or farmers can benefit from a P2P economy through new business models and new services (Puschmann and Alt, 2016). If farmers cannot sell all their produce to large retailers or at the farmers market they are able to sell the remainder of it on the site or through the app to food desert residents.

There are potential risks that come up alongside a P2P program. They would need to be considered during the design and before the implementation of the program. There is a greater risk in P2P economies that one party will not produce the good or service they are expected to, or the quality will be poor and there is a risk the buyer will not pay. These are risks incurred by other sharing companies including Uber and Airbnb. These companies use background checks and buyer or seller reviews to control these risks.

It is important to note this research discusses the need and qualifications for the P2P program for the demand, or buyers, side.

## **Objective and Methods**

### ***Objectives***

The objective of this study is to identify census blocks within the state of Arkansas that are best suited for and in the most need of the implementation of a P2P food redistribution program. To complete the objective a multi-criteria decision analysis using five criteria was conducted.

### ***Multi-criteria Analysis (MCA)***

Broadly multi-criteria analysis (MCA) refers to the assessment of alternative options based on select criteria. Brooks et al. 2009 define MCA as “any structured approach used to determine overall preferences among alternative options, where the options accomplish several objectives” (Brooks et al., 2009 pg. 46). The indicators/criteria can be either qualitative or quantitative to compare many different options including social, economic, and environmental (Haque, 2016). To consider different criteria, formal MCA approaches provide an explicit relative criteria weighting system (Multi-criteria analysis: a manual, 2009). Weighing and scoring alternatives can identify a single preferred option, ranked options, a short list of acceptable options, or to distinguish between acceptable and unacceptable options (Multi-criteria analysis: a manual, 2009). A key feature of MCA is its ability to be driven by a decision-making team (Brooks et al., 2009). Projects using MCA typically enlist the assistance of stakeholders to develop alternatives and selection criterion. However, in this study “alternatives” are the different food desert blocks in Arkansas and the criteria were selected through literature. MCA is an appropriate analysis method for this research because it is applicable to solving problems that are “characterized as a choice among alternatives “ (Natural Resource Leadership Institute, 2011).

This assessment is conducted based on MCA and the methodology is inspired by the steps set forth by Haque, (2016). The following methodological steps were followed in order to perform the assessment of different food desert blocks:

Step 1 Set forth the goal of the assessment and develop alternative options. The goal of this study is to determine which food desert blocks in the state of Arkansas would be the best fit for a P2P food redistribution program. To begin all food desert blocks in the state of Arkansas

were identified based on income level and access to nutritious foods. Poverty and median income data from the U.S Census were used to determine whether each block's poverty rate was 20 percent or greater or each block's median family income was less than or equal to 80 percent of the state-wide family income (Food Access Research Atlas, 2017). Data regarding grocery store and supermarket locations, typical suppliers of nutritious foods, from Burgener and Thomsen (2018) was used to determine low access. Data arrangement and mapping were completed using RStudio.

Step 2 Select the criterion for assessing the alternative options. In this study the set criterion, as shown in *Table 1* and *Table 2* focus on population, internet access, vulnerable households, and vehicle access within food desert block groups. These criteria are based on the aforementioned literature review and a recent assessment by the U.S. Economic Research Service.

### ***Population***

The geography of food security is shaped by problems of financial access to nutritious food (Sonnino, 2016). These problems are especially evident in urban areas where residents are not directly involved in food production and rely on purchasing their food with cash (Sonnino, 2009). Unlike sharing programs like Rent the Runway and Thread Up which focus on the redistribution of nonperishable goods, a P2P food sharing program provides users with perishable goods that cannot necessarily be shipped in 2-3 business days. Therefore buyers and sellers must be in close proximity to one another, similar to ridesharing programs like Uber. To ensure a large enough number of buyers (passengers) and sellers (drivers) Uber largely enters markets based on population, working from large to small (Hall et al., 2017). To follow this idea

block groups with higher population density, or in other words, more urban is preferred for implementation of this program.

Population and urban classification are the first assessment criteria. The U.S Census Bureau defines urban areas as those that “represent densely developed territory, and encompasses residential, commercial, and other non-residential urban land use” and contains 50,000 or more people (United States Census Bureau, 2010). In the state of Arkansas, many cities like Little Rock, Fayetteville, and Springdale have more than 50,000 residents and are easily considered urban. However, there are some cities whose population falls outside of the urban category but have a high concentration of residents living in close proximity. To ensure these cities were included in this research U.S Census Bureau’s census-designated places were used instead of raw population data. A census-designated place (CDP) is a statistical counterpart to an incorporated place and provides data for a settled concentration of population identifiable by name but not legally incorporated under state laws (Census.gov: Geography, 2010). Areas can be considered a census-defined place, but are not legally incorporated because they are not the entire area considered to be the respective city by the state. The census-designated place data was collected from the 2010 U.S. Census. For the purpose of this study, only census blocks with a census-designated place will be considered urban and were evaluated.

### ***Internet Access***

The sharing economy and P2P markets rely on sharing goods and services through new information systems on the internet (Hamari et al., 2016). Websites like Airbnb and Lending Club, a P2P network where users can invest and receive interest payments, have become common resources. Many of these P2P resources can be accessed on mobile devices now through downloadable applications, most notably payment applications like Venmo and Square

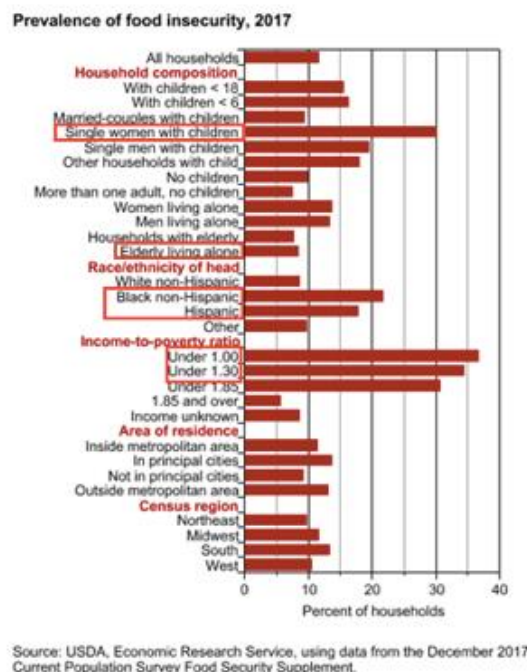
Cash. The ability to stay connected to these P2P payment networks through mobile devices has increased their use to 44% of consumers in a study conducted by Bank of America in 2018 (Trends in Consumer Mobility Report, 2018). Beyond payment applications, popular networks like Uber and Poshmark have smartphone apps now as well. In order for a P2P food redistribution program to work within a food desert, the residents need access to the internet through a subscription or other means.

For this reason, the second assessment criteria selected is the percentage of each food desert block group population that has an internet subscription or access to the internet without a subscription. The percentage of households with internet access was determined using the 2013-2017 American Community Survey 5 Year Data Table B28002 Presence and Types of internet Subscriptions in Household. Using RStudio and ‘tidycensus’ package the total number of households with either an internet subscription (B28002\_002) or internet access without a Subscription (B28002\_012) was calculated as a percentage of total households (B28002\_001). These data are calculated at the census tract level because the information is not collected at the census block group level. Tracts with a high percentage of households with internet access are likely highly compatible with the P2P program. Tracts with a low percentage of households with internet access are likely less compatible with the program.

### ***Vulnerable Communities***

The assessment of “household food security (Coleman-Jensen et al., 2018) shows that food insecurity disproportionately affects vulnerable populations, including children, the elderly, minorities, and low-income households.” (Current and Prospective Scope of Hunger and Food Security in America: A Review of Current Research, 2014) This disproportionate effect is shown in *Figure 1*. Although many households in food deserts experience the negative consequence of

food insecurity, “certain populations are more sensitive and/or experience this challenge more acutely.” (Current and Prospective Scope of Hunger and Food Security in America: A Review of Current Research, 2014). According to the report, 11.8 percent of U.S households are food insecure, an overall decrease from 2016 (Coleman-Jensen et al., 2018). There are groups of households that have rates of food insecurity higher than the national average and within this study will be considered vulnerable communities. All households with children (15.7 percent), households headed by Black non-Hispanics (21.8 percent) and Hispanics (18 percent) are the vulnerable communities observed in this study (Coleman-Jensen et al., 2018).



***Figure 1 Prevalence of food insecurity, 2017 as shown by the USDA Economic Research Survey***

## *Children*

During the 2016 – 2017 school year 20 million children participated in free and reduced-price school lunch through the National School Lunch Program (NSLP) as stated in the 2018

report conducted by the Food Research & Action Center. The report further states the summer of 2017 saw just over 3 million children, or one in seven, participate in the Summer Nutrition Program (SNP) whose goal is to ensure low-income children have access to healthy meals during summer vacation. The modest fraction is on trend with the year prior where 153,000 fewer children were served through the SNP (Hunger Doesn't Take a Vacation: Summer Nutrition Status Report, 2018). One of the primary reasons the Summer Nutrition Program has begun to lose ground is that there are insufficient public and private funding for summer programs aimed at providing "educational and enrichment activities for low-income students." (Hunger Doesn't Take a Vacation: Summer Nutrition Status Report, 2018 p. 3) The decrease in funding has hit the state of Arkansas particularly hard from 2016 to 2017. Arkansas saw a 16% decrease in SNP average daily participation placing them 34<sup>th</sup> in the United States for participation (Hunger Doesn't Take a Vacation: Summer Nutrition Status Report 2018). Further, the average daily participation in the Summer Food Service Program (SFSP) decreased 23.9% while participation in the NSLP increased 2.7% (Hunger Doesn't Take a Vacation: Summer Nutrition Status Report, 2018). Finally, the number of SFSP sponsors decreased by 20.7% and the number of SFSP sites decreased by 33.4% (Hunger Doesn't Take a Vacation: Summer Nutrition Status Report, 2018). These decreases in SFSP participation occur in a state with the third highest rate for childhood food insecurity, 23.3% (Map the Meal Gap, 2018).

For families living in food deserts with children age 18 and under the Summer Food Service Program is a way to access two nutritious meals daily during a time of the year that would typically exacerbate food insecurity (Huang et al., 2015). The downward trend in SFSP participation provides a reason for a P2P food redistribution program, especially during the summer. The third assessment criteria selected is the percentage of each food desert block group

population that is children under the age of 18. The percentage of residents in each food desert block group under the age of 18 was determined using the 2013-2017 American Community Survey 5 Year Data Table B01001 Sex by Age. Using RStudio and the ‘tidycensus’ package the total number of males age 0-17 (B01001\_003, B01001\_004, B01001\_005, and B01001\_006) and females age 0-17 (B01001\_027, B01001\_028, B01001\_029, and B01001\_030) was calculated as a percentage of the total population (B01001\_001). These data are calculated at the census block group level. Block groups with a high proportion of children are likely at a higher need for the P2P program. Block groups with a lower proportion of children are likely at a lower need for the program.

### *Minorities*

Ethnic minority households exhibit the greatest risk for food insecurity (Franklin et al., 2012). Further, in the United States, food insecurity affects Black and Hispanic households disproportionately (Coleman-Jensen et al., 2018; Hernandez et al., 2017; Kamdar et al., 2018). As previously mentioned Black non-Hispanic and Hispanic households have a food insecurity rate higher than the national average. On the Feeding America website, these two minority groups are the only two with featured areas of research, providing further evidence they are amongst the most vulnerable.

Food insecurity mirrors economic indicators, most notably poverty (Rabbitt et al., 2017). Poverty also is an indicator of food deserts (Food Access Research Atlas, 2017). In Arkansas Black and Hispanic households are roughly two times more likely to live in poverty, elevating their risk of food insecurity and residing within a food desert (2017 American Community Survey 1 Year data. Tables B17001A, B17001B, and B17001I; Ending Hunger in Arkansas, 2018). For these reasons the fourth assessment criteria selected is the percentage of each food



desert block group population that is Black and/or Hispanic. The percentage of residents in each food desert block group that are either Black and/or Hispanic was determined using the 2013-2017 American Community Survey 5 Year Data Table B03002 Hispanic or Latino Origin by Race. Using RStudio and the 'tidycensus' package the total number of Black residents (B03002\_004) and Hispanic residents (B03002\_013, B03002\_014, B03002\_015, B03002\_016, B03002\_017, B03002\_018 B03002\_019, B03002\_020, and B03002\_021) was calculated as a percentage of the total population (B03002\_001). These data are calculated at the census block group level. Block groups with a high proportion of Black and/or Hispanic residents are likely at a higher need for the P2P program. Block groups with a low proportion of Black and/or Hispanic residents are likely at a lower need for the program.

### ***Vehicle Availability***

Food desert residents without access or ownership of a vehicle may be at a higher risk for food insecurity as a result of limited full-service food retailer access or high food prices at local food retailers (Fitzpatrick and Ver Ploeg, 2010). A study conducted in 2018 (Crowe et al., 2018) analyzed focus group data from a poor, majority Black neighborhood to describe how residents in urban food deserts access food and what barriers they experience in doing so. Transportation, along with safety, economic, and community, was one of the primary stressors identified by participants (Crowe et al., 2018). Respondents of the study believed that quality and affordable food options were further away and require access to transportation. This idea that some sort of transportation beyond walking is required to grocery shop in stores with better selection and prices has been echoed in the literature (Barnes et al., 2015). Without access to a personal vehicle residents of food deserts can walk to a neighborhood food retailer, which in food deserts are commonly convenience stores or small retailers (Fitzpatrick and Ver Ploeg, 2010). When

shopping in these retailers consumers are likely to consume lower nutritionally composed foods due to lower quality and less selection (Rose et al., 2009). Another option to access food retailers is public transportation which can severely limit where residents shop and how much they can purchase (Crowe et al., 2018; Fitzpatrick and Ver Ploeg, 2010). When residents must carry groceries back onto a crowded bus or train they are likely to purchase less especially if they are elderly or disabled. Public transportation can also increase the time cost associated with food acquisition (Barnes et al., 2015). Respondents in the study previously discussed cited hesitation to walk or use public transportation because of safety concerns (Crowe et al., 2018). The final option for residents is to rely upon family and friends for rides to and from grocery stores, but this can be inconsistent and unreliable. Vehicle availability, an individual-level factor contributes to the accessibility to healthy food and should, therefore, be considered when selecting areas for a P2P food sharing program.

For these reasons the fifth and final assessment criterion selected is the percentage of each food desert block group population that does not have a vehicle available. The percentage of residents in each food desert block group without access to a vehicle was determined using the 2013-2017 American Community Survey 5 Year Data Table B25045 Tenure by Vehicles Available by Age of Householder. Using RStudio and the 'tidycensus' package the total number of homeowners (B25045\_004, B25045\_005, and B25045\_006) and home renters (B25045\_013, B25045\_014, and B25045\_015) age 15 and older with no vehicle available was calculated as a percentage of total occupied housing units (B25045\_001). These data are calculated at the census block group level. Block groups with a high percentage of residents who do not have an available vehicle are likely in high need of the P2P program. Block groups with a low percentage of residents who do not have an available vehicle are likely in low need of the program.

Step 3 Scoring each alternative based on the selected criteria. Within this study alternatives, or block groups, are initially scored on an interval scale for the internet access, vulnerable communities, and vehicle access criteria. There was not any literature to identify percentages to segment the data into intervals. However, there have been studies that have classified data using categories defined by sample quantiles (Borkowf et al., 1997; Dai and Gahegan, 2006; Martincus and Carballo, 2010). Data classification by quantiles is a method used to classify data into a specific number of categories with an equal number of units in each category. When quantile classification is used there is the risk that identical attribute values will be placed into different categories (NCGIA.UCSB.edu, n.d). To minimize this risk one thousand quantiles were calculated and used for each criterion. The quantiles ranged from 0.1<sup>th</sup> to 100<sup>th</sup> each with a corresponding value. The census blocks were scored 1 to 1,000 depending on which quantile their criteria value fell into. For example, if a census block group had a proportion of households with either an internet subscription or internet access without a subscription equal to the value calculated for the 8.5<sup>th</sup> quantile it would receive a score of 85 out of 1000. For internet access, a higher score refers to a higher proportion of households with either an internet subscription or internet access without an internet subscription and higher compatibility with the outlined program. For children, a higher score refers to a higher proportion of children under the age of 18 and a higher need for the program. For minorities, a higher score refers to a higher proportion of Black and Hispanic residents and a higher need for the program. For vehicle availability, a higher score refers to a lower proportion of households with a vehicle available (or a higher proportion of households with no vehicle available) and a higher need for the program.

**Table 1. List of selected criteria and indicators**

Category of Criteria	Indicators	Units	Objective
<b>Population</b>	<b>Urban area OR Census designated place</b>	<b>Urban</b>	<b>Urban</b>
<b>Internet Access</b>	<b>Presence and type of Internet availability</b>	<b>"1-1000"</b>	<b>Max</b>
<b>Vulnerable Communities</b>	<b>Children under age 18</b>	<b>"1-1000"</b>	<b>Max</b>
	<b>Black and Hispanic residents</b>	<b>"1-1000"</b>	<b>Max</b>
<b>Vehicle Access</b>	<b>Household vehicle availability</b>	<b>"1-1000"</b>	<b>Max</b>

*Source: Haque, 2016*

**Table 2. Explanation of criteria**

Criteria	Explanation	Comments
<b>Population</b>	<b>The census block contains a census designated place as identified by the U.S Census Bureau</b>	<b>Urban blocks are preferred for the food sharing program</b>
<b>Presence and type of Internet availability</b>	<b>The total number of households with either an Internet subscription or Internet access without a subscription was calculated as a percentage of total households</b>	<b>Higher score refers to higher proportion of households with either an Internet subscription or Internet access without a subscription</b>
<b>Children under age 18</b>	<b>The total number of males age 0-17 and females age 0-17 was calculated as a percentage of the total population</b>	<b>Higher score refers to higher proportion of children under the age of 18</b>
<b>African American and Hispanic residents</b>	<b>The total number of Black residents and Hispanic residents was calculated as a percentage of the total population</b>	<b>Higher score refers to higher proportion of Black and Hispanic residents</b>
<b>Household vehicle availability</b>	<b>The total number of homeowners and home renters age 15 and older with no vehicle available was calculated as a percentage of total occupied housing units</b>	<b>Higher score refers to lower proportion of households with a vehicle available</b>

*Source: Haque, 2016*

Step 4 Weighting each assessment criterion. The criterion, with the exception of population, have an impact range of 1000, meaning the maximum score for each criterion is 1000. To value certain criteria more than others the four criteria were weighted according to importance as shown in *Table 3*. Criteria with heavier weights are more important in determining

the location most suitable for P2P activity. To easily segment the scored block groups into priority and non-priority blocks the weights are manipulated in such a way that creates a normal distribution of scores with a mean score of 500 points. This is why the criterion weights were not intentionally set at integers of five or ten.

Internet access was considered to have very high importance because most successful P2P companies (Uber, Airbnb, and TaskRabbit) are web-based platforms that bring consumers together (Gal-Or, 2018). The program proposed in this research is meant to be an internet-based resource for residents of food deserts, therefore they must have access to either an internet subscription or to the internet without a subscription. The very high level of importance is translated to the largest criteria weight of 32%. This weight is set specifically at 32% to provide a mean overall score of 500.

Both vulnerable community criteria are considered to be of high importance. The percentage of the population under the age of 18 is weighted at 26% and the percentage of the population that is either Black or Hispanic is weighted at 22%. These criteria are weighted lighter than internet access because they are not crucial components of the P2P food redistribution program. However, they are important in addressing groups that are most likely to have limited access to food. Money is the most important factor that limits access to food (Wright et al., 2016). According to 2017, American Community Data from the U.S. Census Bureau children under the age of 18 and Black and Hispanic Americans are amongst the most likely to experience poverty (Sauter, 2018). Therefore they are weighted heavily in this study. Children are weighted heavier than minority groups because in the state of Arkansas 1 out of 4 children are food insecure (Map the Meal Gap, 2018). These weights are set specifically at 26% and 22% to provide a mean overall score of 500.

The vehicle availability criterion was weighted at 20%. That was decided because second to money, no vehicle access is the most important factor that limits access to food (Wright et al., 2016). This also explains why vehicle availability was not weighted heavier than vulnerable communities most likely to live in poverty and be food insecure. Vehicle availability was not weighted heavier than internet access because it is not as crucial of a program component as internet access. This weight is set specifically at 20% to provide a mean overall score of 500.

**Table 3. Weighted criteria**

<b>Category of criteria</b>	<b>Criteria</b>	<b>Impact Range</b>	<b>Units</b>	<b>Importance</b>	<b>Weights</b>
<b>Internet Access</b>	<b>Presence and type of Internet availability</b>	<b>1000</b>	<b>"1-1000"</b>	<b>Very high</b>	<b>32%</b>
<b>Vulnerable Communities</b>	<b>Children under age 18</b>	<b>1000</b>	<b>"1-1000"</b>	<b>High</b>	<b>26%</b>
	<b>Black and Hispanic residents</b>	<b>1000</b>	<b>"1-1000"</b>	<b>High</b>	<b>22%</b>
<b>Vehicle Access</b>	<b>Household vehicle availability</b>	<b>1000</b>	<b>"1-1000"</b>	<b>Moderate</b>	<b>20%</b>

*Source: Haque, 2016*

Step 5 Score alternatives based on weighted assessment criterion. Initial scores (1-1,000) were multiplied by the corresponding criteria weight. Final scores were totaled to provide a single score for each block group. Each block group was able to score up to 1,000 total points.

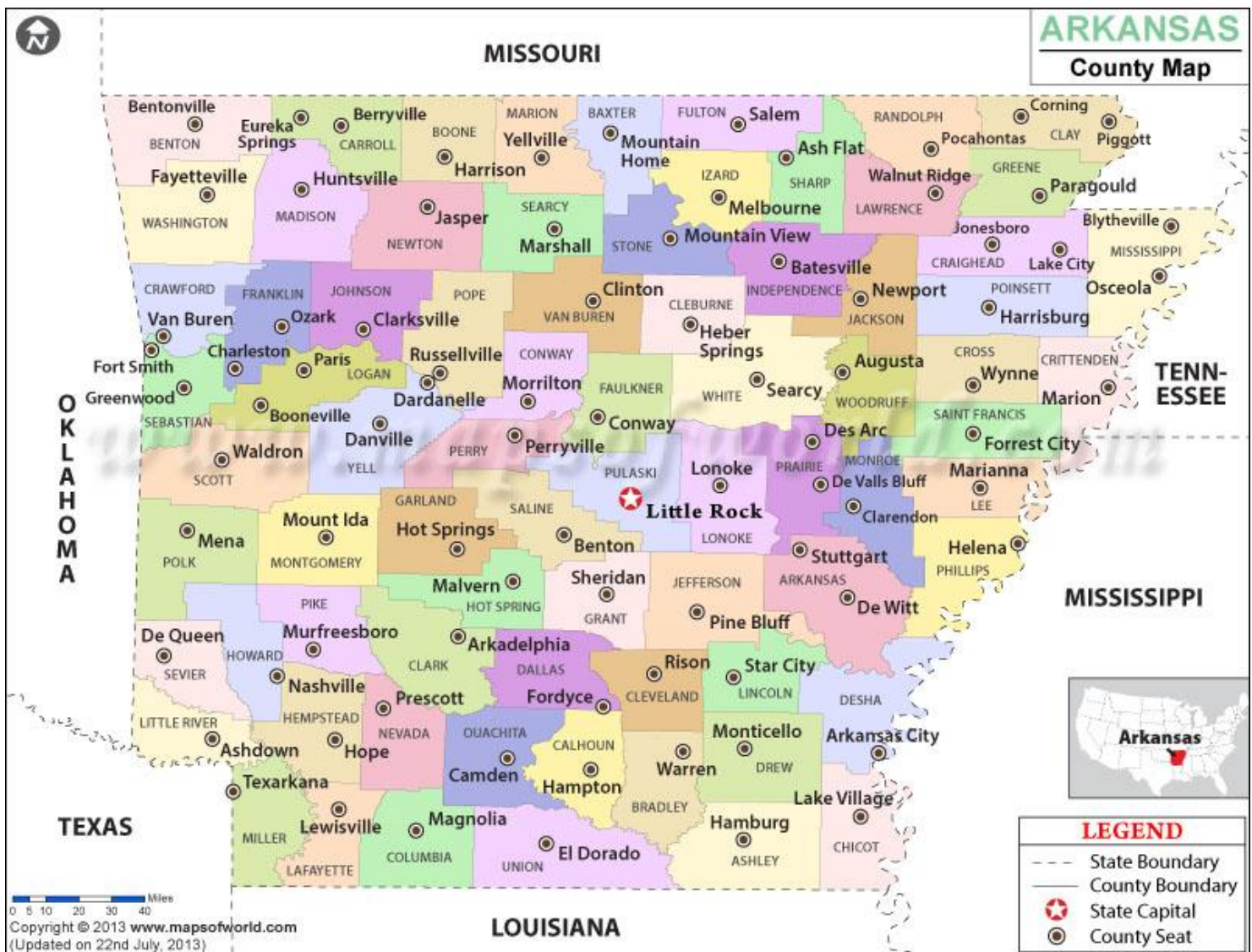
Step 6 Finally, the scores from all block groups are organized from highest to lowest and conclusions are drawn about which block groups are the best fit for the P2P food redistribution program. Urban food desert blocks that scored 75% or more of the possible points (750 or more points) were identified as priority blocks. This number was selected because it is between the third quartile (603.2) and the maximum (942.2). Selecting 603 points as the determinant gave nearly 14,000 priority blocks, which was too large to fully analyze. Selecting a larger determinant provides a more limited number of priority blocks that have an elevated need for P2P activity. It is expected the priority blocks will be dispersed around the state. To determine if

there is one specific area of the state that is far more in need of the pilot program the top five (or less) priority areas were identified. Using 900 points (90%) as the determinant was able to provide less than five high priority block areas.

### **Results and Findings**

The objective of this study was to identify census blocks within the state of Arkansas that are best suited for and in the most need of the implementation of a P2P food redistribution program. The criterion weights used for internet access, child population, minority population, and vehicle access were acceptable because the block group overall scores were normally distributed with a mean score of 500.8 points.

To help identify counties and cities in Arkansas *Figure 2* was used. The map can be used as a reference.



*Figure 2 Arkansas county map*

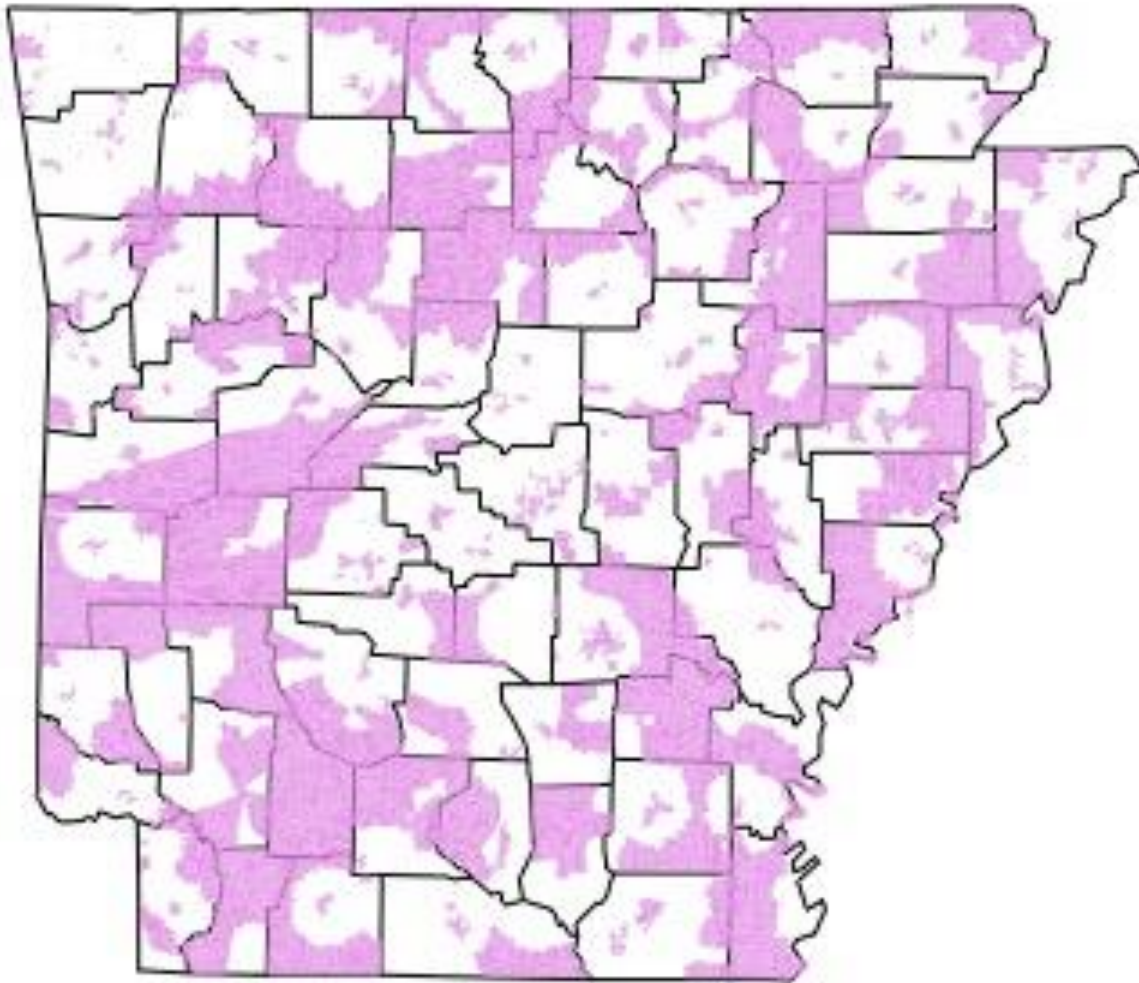
Source: <https://www.mapsofworld.com/usa/states/arkansas/arkansas-county-map.html>



### ***Food Deserts***

To begin, 26,700 food desert blocks in Arkansas were identified. *Figure 3* shows all blocks whose poverty rate is 20 percent or greater or whose median family income is less than or equal to 80 percent of the state-wide family income. These blocks are also either one mile (urban) or ten miles (rural) from a grocery store or supermarket. From the map, it appears that food desert blocks are spread-out across the state and located in every county. This result is consistent with the USDA's Food Access Research Atlas map for 2015 (Food Access Research Atlas, 2017). After mapping, circular desert outlines became apparent, for example in Columbia County around Magnolia in the southwest part of the state. These areas are likely to have a grocery store or supermarket located in the center that serves the surrounding one or ten- mile radius. This map can be deceiving because the larger (smaller) food deserts do not necessarily indicate more (less) people residing in a food desert or the severity of a food desert. Instead, the size of a food desert, as shown on the map, indicates the population density of a census block. Larger census blocks, such as the entirety of Nevada County in the southwest, have lower population densities while small census blocks such as those located in Pulaski County around Little Rock, in the center of the state have much higher population densities.

## Food Desert Blocks



*Figure 3 Food desert block groups in the state of Arkansas*

Source: King 2019, using data from the 2013-2017 American Community Survey 5 Year Data Tables and Burgener and Thomsen 2018

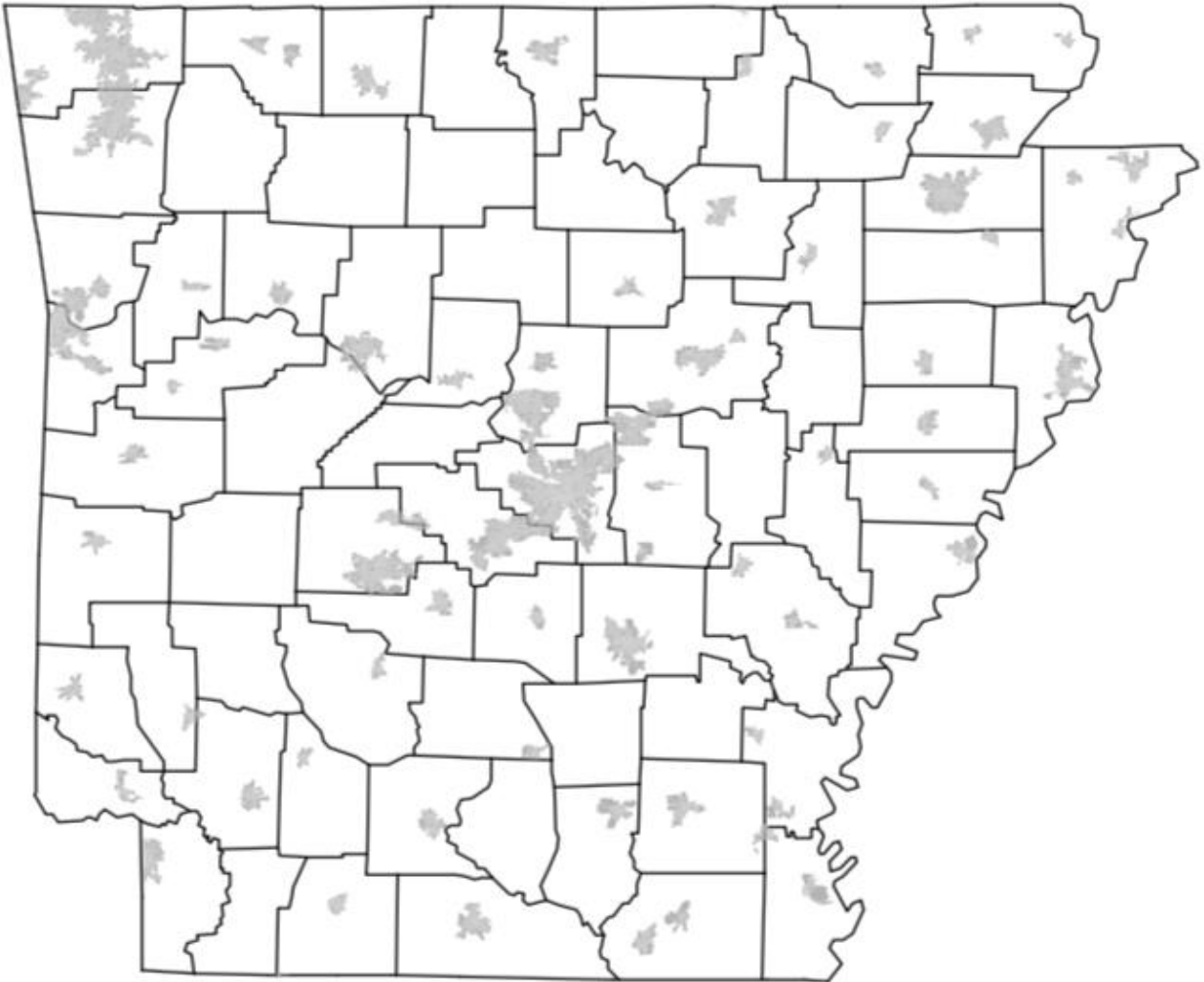
### *Urban Census Blocks*

For the implementation of the proposed program census blocks with higher population density, or more urban areas were preferred. Using the U.S. Census Bureau's census-designated places *Figure 4* was derived to show the 57,925 urban blocks, as defined in this study. As expected, cities with over 50,000 residents such as Little Rock, Fayetteville, Springdale, and

Jonesboro were included in the urban block mapping. Due to census designated places, cities with populations below 50,000 such as Texarkana and El Dorado in the southern part of the state and Russellville and Mountain Home in the northwestern quadrant of the state were included in the map as well. It was important that these cities be included in the urban classification despite their population because they are amongst the most populated in Arkansas. *Figure 5* was also derived and shows the identified urban food deserts layered on top of the urban blocks.

Census blocks such as those in Madison, Newton, Searcy, Van Buren, Izard, and Stone counties in the northwest that have food deserts do not have food deserts with an urban classification. This could pose as a potential problem because as locations are selected for the implementation of the P2P food redistribution program a large section of the state could be left unattended. Some cities have food desert blocks spread across urban areas such as Fayetteville, Springdale, and Little Rock. Other cities like Camden and Hope in the southwest and Marianna in the east-central part of the state have urban areas completely covered by food desert blocks.

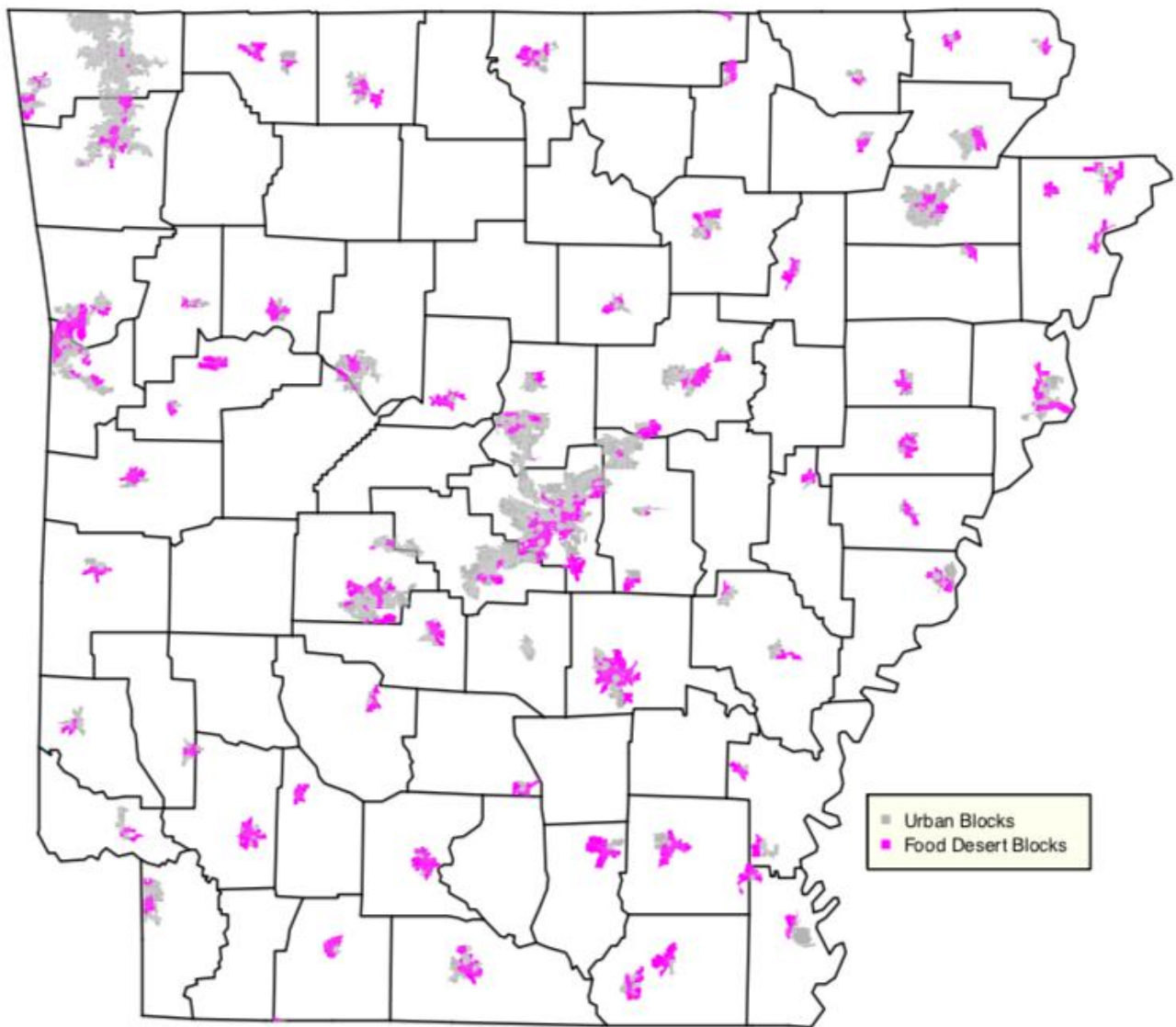
## Urban Blocks



*Figure 4 Urban blocks in Arkansas as identified by the U.S. Census Bureau as containing census-defined places*

Source: King 2019, using data from 2010 U.S. Census

## Urban Food Desert Blocks



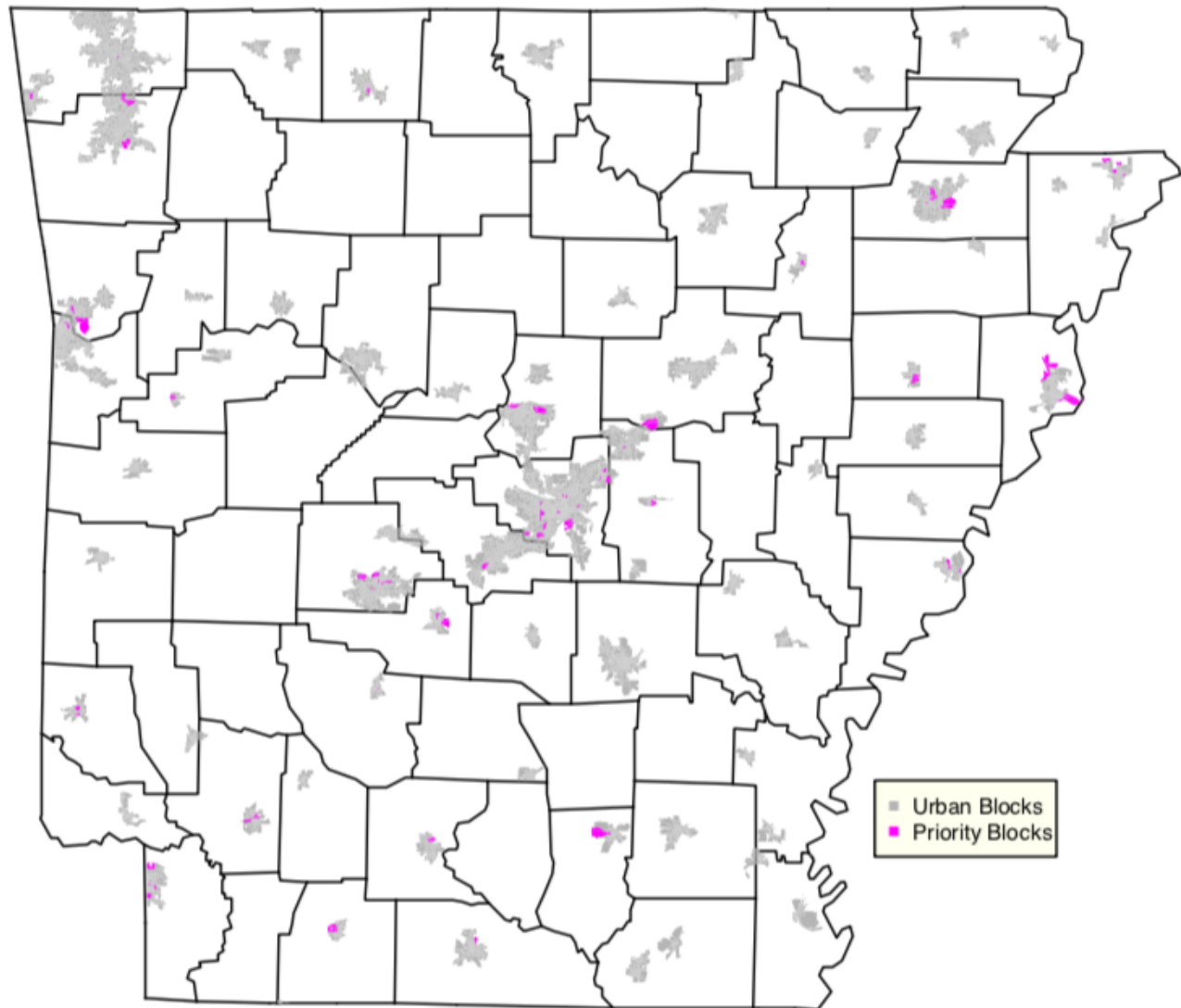
*Figure 5 Identified food desert blocks layered on top of urban blocks.*

Source: King 2019, using data from 2010 U.S Census, Burgener and Thomsen 2018

### ***Priority Blocks***

After locating the urban food desert blocks four further criteria; internet access, child population, minority population, and vehicle availability were used to score and weight the varying block groups. Urban food desert blocks that scored seventy-five percent or more of the possible points (750 or more points) were identified as priority blocks. Of the 186,211 blocks in the state of Arkansas 3,438 were calculated to have more than 750 points (Census.gov: Geography: Maps & Data: Tallies: 2010 Census Tallies of Census Tracts, Block Groups & Blocks, 2010). *Figure 6* shows the identified priority blocks layered on top of urban blocks. Similar to all food desert blocks the priority blocks are spread out over the state. Around Little Rock, there are a number of priority areas clustered together. South Fayetteville and Van Buren in the northwest, Conway in the center, and Texarkana also have priority area clusters. Areas such as Wynne in the east-central, Magnolia in the southeast, and Harrison in the north-central appear to have a single priority area. Cities such as Russellville in the northwest, Searcy in the center, and Monticello in the southeast had urban food desert blocks did not have any priority blocks.

## Priority Blocks



*Figure 6 Identified priority blocks, those with 750 or more points layered on top of urban blocks*

Source: King 2019, using data from 2010 U.S. Census and 2013- 2017 American Community Survey 5 Year Data Tables

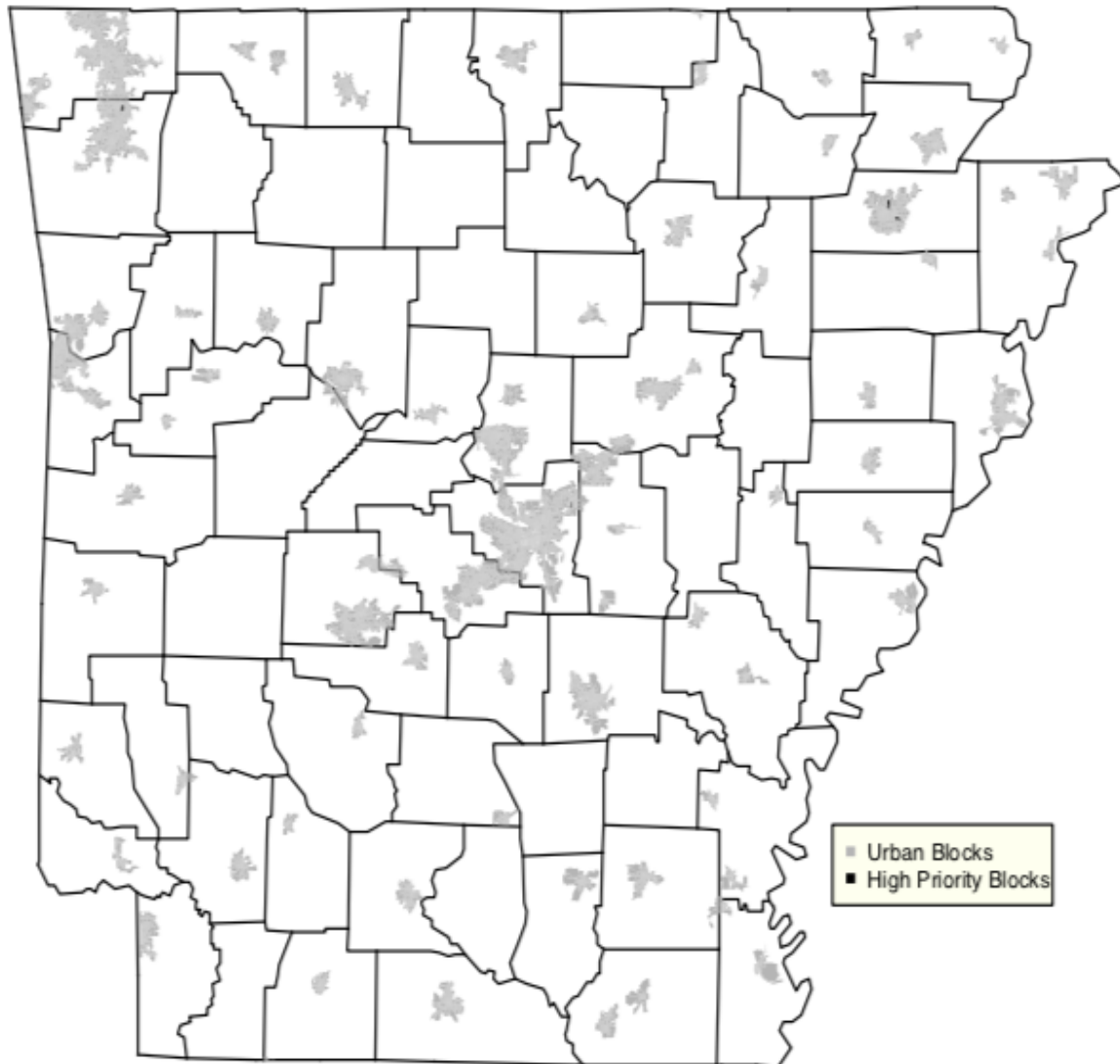
### ***High Priority Blocks***

To further identify areas best suited for and in need of the implementation of the program urban food desert blocks that scored ninety percent or more of the possible points (900 or more points) were identified as high priority blocks. Of the 186,211 blocks in the state of Arkansas 717 were calculated to have more than 900 points (Census.gov: Geography: Maps & Data: Tallies: 2010 Census Tallies of Census Tracts, Block Groups & Blocks, 2010). *Figure 7* shows the identified high priority blocks layered on top of the urban blocks.

Only four locations in the state were identified when narrowing the search to blocks with 900 or more points. Those locations include one in Springdale, two in the Jonesboro area, and one in the northeastern portion of Pulaski County in an area believed to be Jacksonville. From this map, it appears that a score of nine hundred severely limits the number of areas in the state suitable for the P2P program. For this reason, only the map of priority blocks (750 or more points) was analyzed further.



## High Priority Blocks



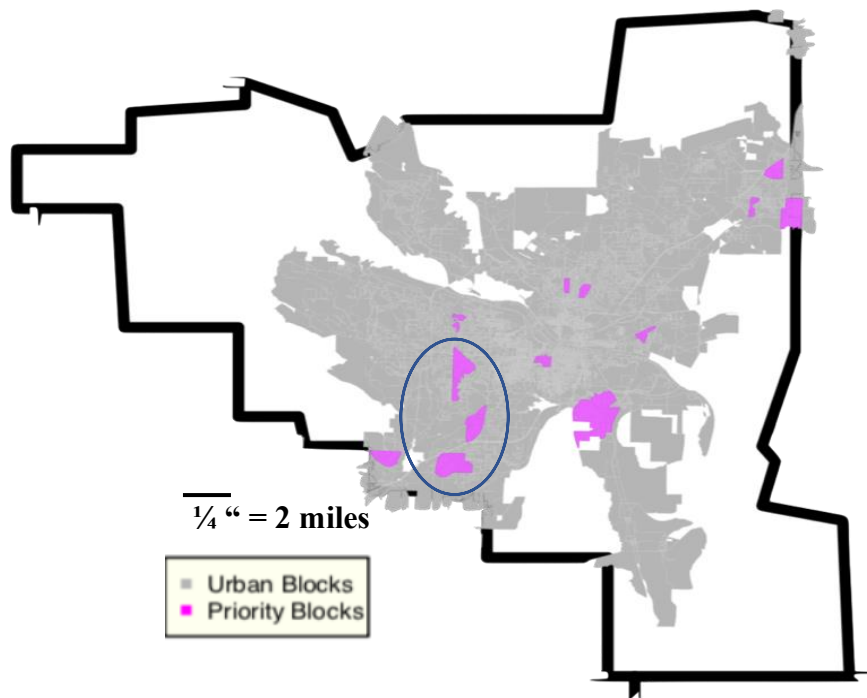
*Figure 7 Identified high priority blocks, those with 900 or more points, layered on top of urban blocks.*

Source: King 2019, using data from 2010 U.S. Census and 2013- 2017 American Community Survey 5 Year Data Tables

## ***Pulaski County***

In *Figure 6* there are areas including Pulaski and Garland County that have multiple priority areas in close proximity to one another. This is important to note because a P2P program placed in these areas would be able to impact multiple priority areas whereas placing the program in Logan in the northwest or Bradley County in the southeast, for example, would only serve one priority area. The high number of priority areas in and around Little Rock in Pulaski County, as shown in *Figure 8*, makes it of high interest. There are roughly fourteen priority areas in Pulaski County. There are three specific large priority areas, circled in *Figure 8*, that are of particular interest. The top priority area is just under two miles from the middle area and the middle area is just under two miles from the bottom area.

### **Pulaski County Priority Blocks**



***Figure 8 Identified priority blocks, those with 750 or more points layered on top of urban blocks***

Source: King 2019, using data from 2010 U.S. Census and 2013- 2017 American Community Survey 5 Year Data Tables

There are variables that were not included in the scope of this analysis, but still, play a role in the success of the P2P program. These variables include transportation access, ethnic/racial diversity, and the number of possible collection locations. If food is being transported from surrounding cities or states there needs to be an efficient way to access food desert areas. Little Rock possesses this ability because it is located at the intersection of two major highways, Interstate 30 and Interstate 40. This location makes the transportation of redistributed food easier than it would be if the program was placed in an area such as Jonesboro or Hot Springs.

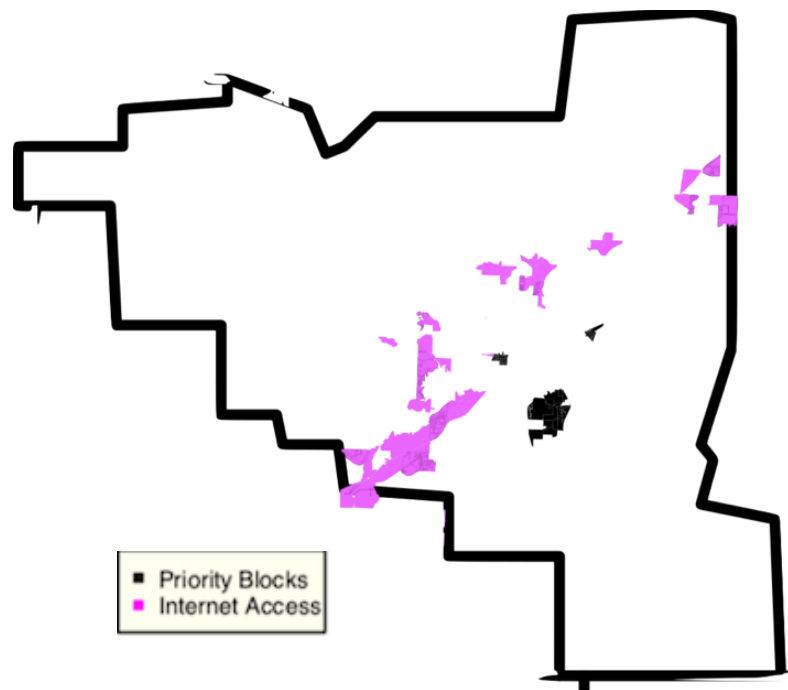
As previously mentioned, in Arkansas Black and Hispanic households are more likely to live in poverty, elevating their risk of food insecurity and residing within a food desert (2017 American Community Survey 1 Year data. Tables B17001A, B17001B, and B17001I; Ending Hunger in Arkansas 2018). According to the U.S Census Bureau, the population of Arkansas as a whole is 5.7% Black and 7.6% Hispanic or Latino (Census.gov: QuickFacts: Little Rock city, Arkansas; Pulaski County, Arkansas; Arkansas, 2018). Pulaski County and Little Rock specifically have populations that are 37.2% and 41.6% Black (Census.gov: QuickFacts: Little Rock city, Arkansas; Pulaski County, Arkansas; Arkansas, 2018). Little Rock has a population that is 6.8% Hispanic or Latino (Census.gov: QuickFacts: Little Rock city, Arkansas; Pulaski County, Arkansas; Arkansas, 2018). These minority proportions are similar to or much larger than the proportions for the entire state of Arkansas. Pulaski County and Little Rock are ethnically and racially diverse which further identifies them as good locations for P2P activity.

Though collection and distribution location data were not included in this study it is assumed there are numerous places in Pulaski County to choose from. Pulaski County is the most populated county in Arkansas and Little Rock is the most populated city. It is well known that

larger cities and counties have more places, therefore, finding a location for a P2P program collection and distribution point would be easier.

To further investigate Little Rock and Pulaski County as a potential location for the P2P program, the proportion of internet access needs to be observed. These blocks did score highly overall but it is important to understand if they scored highly in internet access particularly because of the crucial role the internet plays in the P2P program. *Figure 9* shows the blocks identified as priority blocks and blocks with fifty percent or more of the population with internet access layered on top. Of the fourteen priority blocks, eleven have fifty percent or more of the population with internet access. The three close large priority areas circled in *Figure 8* all have fifty percent or more of the population with internet access.

#### **Pulaski County Internet Access**



***Figure 9 Identified blocks with fifty percent or more internet access layered on top of priority blocks***

Source: King 2019, using data from 2010 U.S. Census and 2013- 2017 American Community Survey 5 Year Data Tables

### ***Recommendation***

As shown in this study there are multiple reasons to target Pulaski County for a P2P food redistribution program. First, Pulaski County possesses three large priority areas with high levels of internet access in close proximity. These priority areas are just under two miles apart, therefore, placing a P2P activity hub in between the top area and the middle area and between the middle area and bottom area would provide food access less than one mile from residents. This could transition these priority areas away from food desert classifications. Using the U.S. Census Bureau's population density for Little Rock (1,623.5 people per square mile) it is estimated P2P activity in these areas could service around 7,500 residents (Census.gov: QuickFacts: Little Rock city, Arkansas; Pulaski County, Arkansas; Arkansas, 2018). Next, Pulaski County is located at the intersection of two major highways making it easy to access by transportation. Pulaski County is more ethnically and racially diverse than the state of Arkansas as a whole indicating it is in more need of a food access program. Finally, Pulaski County has a high population and many potential locations for collection and distribution sites. Based on the results of this study, it is recommended that Pulaski County is amongst the first to be targeted for a P2P food redistribution program pilot.

### **Limitations and Recommendations:**

Should additional studies further examine issues related to a P2P modeled food redistribution program in Arkansas, the following recommendations are made. First, the identification of collection and distribution points are needed. This study simply identifies where in the state of Arkansas is most suitable and in the most need of a food redistribution program, but it does not pinpoint specific locations for the program's primary hub. Data regarding the locations of farmers markets, churches, and pantries were not included in this study. Within the

priority blocks and the clusters of priority blocks, it would be beneficial to identify farmers markets, food pantries, churches, or other community facilities to serve as collection and distribution points. After finding these locations it would be helpful to then determine the number of food desert residents that could be reached and impacted by the program.

Secondly, government funding may play an important role in launching a program of this size, especially if SNAP benefits are to be used via the app or website. For program funding and policy implementation, it is important to show if this program in the selected location can benefit minorities and SNAP beneficiaries. This study takes a broad approach in determining priority areas which include the minority population, but not the number of SNAP beneficiaries. Within the priority blocks and the clusters of priority blocks, it would be beneficial to identify where large populations of minorities are located just as was done in the map of internet access in Pulaski County. It would also be beneficial to show the number of SNAP beneficiaries in the priority blocks to signal if there is a need for P2P accessible SNAP benefits.

Finally, this study does not determine whether residents of these areas would enjoy or participate in the outlined P2P program. After areas and collection/distribution points are identified and before the program is implemented, it would be important to understand if residents would be interested in joining a P2P style system and what obstacles they foresee. Allowing residents to play a role in designing the final program can help ensure they participate in it after implementation.

Finally, this study does not conduct a sensitivity analysis for the criteria weights. This is a limitation because different percentages may better identify priority areas. In future studies conducting a sensitivity analysis may be useful.

**Conclusion:**

As diet-related health problems associated with food deserts rise it is important that barriers to access to affordable and nutritious foods be reduced. It is also increasingly important that assistance programs become easier and quicker to access through technology. This study briefly outlined one option, a P2P model that could be used to alleviate food deserts as well as using multi-criteria analysis to identify census blocks best suited and in need of the program. It was determined Pulaski County would be the best location for the beginning of the P2P program.

This study may be used to 1) help analyze food desert locations for P2P activity implementation in Arkansas, and 2) to expand the study to include other states and food deserts in the US. Finally, this study could serve as a baseline to a future study that examines the location of P2P food redistribution collection points and the number of consumers they could reach.

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