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

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Cover Page Footnote
Emily A. King is a May 2019 Honors program graduate with majors in Agribusiness and Food Science. Dr. Jennie Popp, faculty mentor, Associate Dean Honors College. Dr. Michael Thomsen is a committee member and a professor in the Department of Agricultural Economics and Agribusiness. Dr. Di Fang is a committee member and an assistant professor in the Department of Agricultural Economics and Agribusiness. Dr. Alvaro Durand-Morat is a committee member and an assistant professor in the Department of Agricultural Economics and Agribusiness.

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Meet the Student-Author

Emily King

In May of 2019, I graduated from the University of Arkansas Dale Bumpers College of Agricultural, Food and Life Sciences with degrees in Agricultural Business & Marketing Management and Food Technology. This research was conducted in partial fulfillment of the requirements for the University of Arkansas Bumpers College Honors Program. During my time at the University of Arkansas, I have been involved in Phi Mu Sorority, the Arkansas Union Advisory Committee, Food Science Club, the Volunteer Action Center's literacy and food assistance programs, and served as a Student Ambassador. I also served as a Bumpers College Honors Mentor and University of Arkansas Orientation Mentor. My most enjoyable experience at the University of Arkansas was my international study abroad in Greece where I studied agriculture and food sustainability from the Greek and European Union perspective. During the summer between my junior and senior year, I interned with ConAgra Brands in Omaha, Nebraska as a part of the Product Lifecycle Management team. While at the U of A I was named the Dale Bumpers College Presidential Scholar, Outstanding Student, and Alumni Association Senior of Significance and Razorback Classic. After graduation, I will pursue my juris doctorate at Michigan State University College of Law. I am thankful to Dr. Jennie Popp for her assistance throughout this research project as well as to my parents, Marlon and Michalle King for their guidance throughout my life.

Research at a Glance

- This study identified food deserts in the state of Arkansas, which are areas that have large proportions of households with low incomes, inadequate access to transportation, and a limited number of healthy food retailers.

- An analysis was conducted using population, internet access, vulnerable communities, and vehicle availability as criteria to identify which of the Arkansas food deserts are best suited for a program that redistributes food in a peer-to-peer way.

- From the results of this study, it is recommended that Pulaski County be targeted for a food redistribution program that provides residents with an online platform for selling unused or unwanted food items.

- This study can be used to analyze food desert locations in Arkansas for redistribution programs and serve as a baseline for future studies pertaining to the implementation of peer-to-peer economic models.

Emily in front of the Parthenon in Athens, Greece during her study abroad experience.

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Emily King*, Jennie Popp[†], Michael Thomsen[§], Di Fang[‡], and Alvaro Durand-Morat[¶]

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. 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. A multi-criteria decision analysis was conducted using population, internet access, vulnerable communities, and vehicle availability as criteria. Results suggest that based upon the proximity of priority areas, transportation access, ethnic/racial diversity, and the number of possible collection locations, Pulaski County should be targeted for a P2P food redistribution pilot program.

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Introduction

A large number of food deserts in Arkansas make it one of the most food insecure states in the country (US-DA-ERS, 2017b). 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" (USDA-ERS, 2017a).

A peer-to-peer (P2P) economic model could serve as a possible solution to the problem of urban food deserts, which make up 75% of total food deserts (National Coalition for the Homeless, 2011). A P2P economy 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. Food sharing has become more common in cities and often focuses on 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 was 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.

Materials and Methods

The assessment was conducted based on multi-criteria analysis and the methodology was inspired by the steps set forth by Haque (2016).

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% or greater or each block's median family income was less than or equal to 80% of the state-wide family income (USDA-ERS, 2017a). Data regarding grocery store and supermarket locations, typical suppliers of nutritious foods, from Burgener and Thomsen (2018) were used to determine low access. Data arrangement and mapping were completed using RStudio (RStudio®, Boston, Mass.).

Criteria for selection were based on population, internet access, vulnerable households, and vehicle access within food desert block groups. Within this study, alternatives, or block groups, were initially scored on an interval scale for internet access, vulnerable communities, and vehicle access criteria. Population was the only criterion that was not scored. Data classification by quantiles was used to classify data into a specific number of categories with an equal number of units in each catego-

ry. One thousand quantiles were calculated and used for each criterion. The quantiles ranged from 0.1th to 100th, each with a corresponding value. The census blocks were scored 1 to 1000 depending on which quantile their criteria value fell into. The rationale for each included criterion is briefly presented below.

Population

A P2P food sharing program provides users with perishable goods that cannot necessarily be shipped in 2 to 3 business days. Therefore, buyers and sellers must be in proximity to one another. To follow this idea, block groups with higher population density, or in other words more urban, are preferred for implementation of this program.

Internet Access

Peer-to-peer markets rely on sharing goods and services through new information systems on the internet (Hamari et al., 2016). 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. 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. These data were 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.

Children Under 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. These data were 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.

Minority Population

Poverty also is an indicator of food deserts (USDA-ERS, 2017a). 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; Bread for the World, 2018). 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. 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.

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). 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. 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.

Each criterion was given weight. 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. Criteria with heavier weights are more important in determining the location most suitable for P2P activity. Based on the above-mentioned literature as well as Gal-Or (2017), Wright et al. (2016), and Feeding America, 2018), criteria were placed in this order of importance and assigned the following weights: internet (32%), Children Under 18 (26%), Minority Population (22%), and vehicle availability (20%).

Each criterion was scored. Initial scores (1–1000) 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 1000 total points. Urban food desert blocks that scored 75% or more of the possible points (750 or more points) were identified as priority blocks. 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.
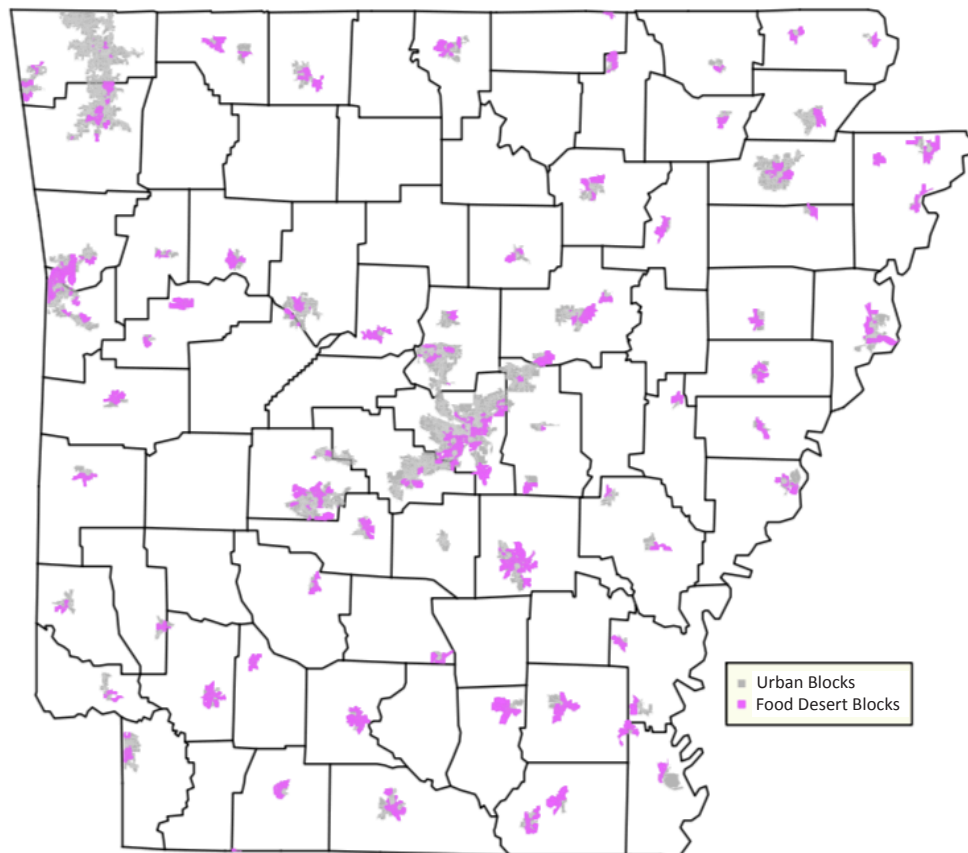
Fig. 1. Identified food desert blocks layered on top of urban blocks.
Source: King 2019, using data from 2010 U.S Census, Burgener and Thomsen 2018.

Results and Discussion

To begin, 26,700 food desert blocks in Arkansas were identified, and they appeared in every county. 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, Fig. 1 was derived and shows the identified urban food deserts layered on top of the urban blocks. Figure 1 shows 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. 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 75% or more of the possible points (750 or more points) were identified as priority blocks.

In Fig. 2, there were areas including Pulaski and Garland County that have multiple priority areas in proxim-ity to one another. The high number of priority areas in and around Little Rock in Pulaski County, as shown in Fig. 3, makes it of high interest. There are roughly 14 priority areas in Pulaski County. Given their proximity and likelihood to reach a lot of people, there are three specific large priority areas, circled in Fig. 3.

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
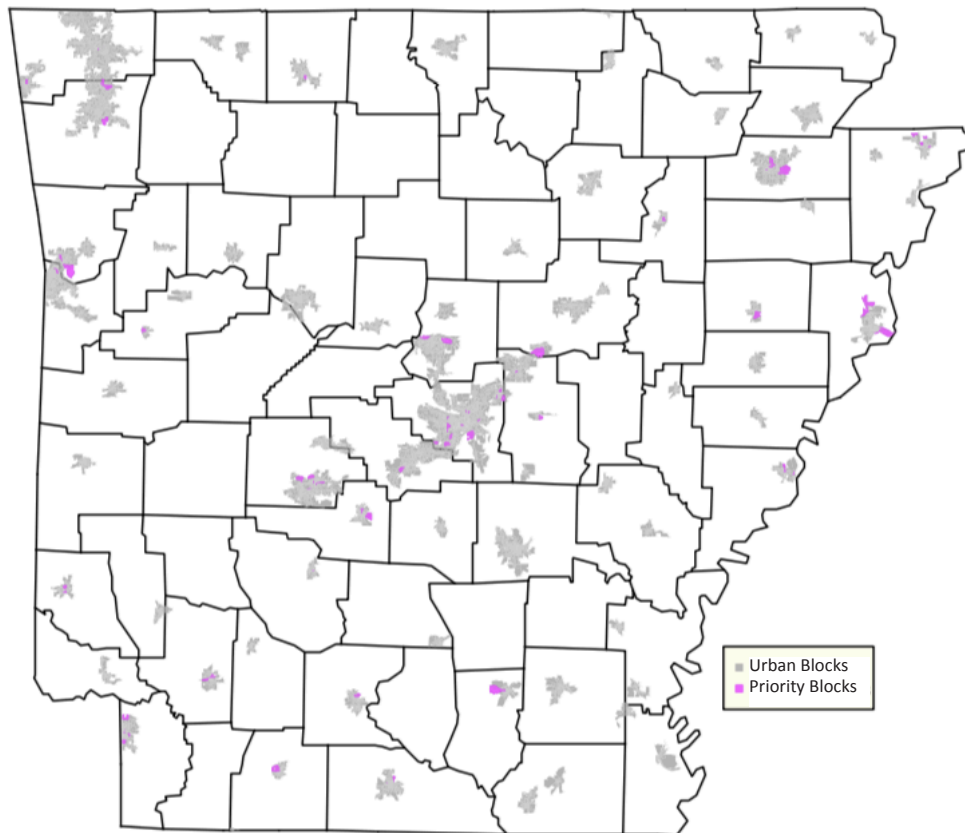
Fig. 2. Identified priority blocks, those with 750 or more points layered on top of urban blocks
Source: King 2019, using data from 2010 U.S. Census and 2013–2017 American Community Survey 5 Year Data Tables.
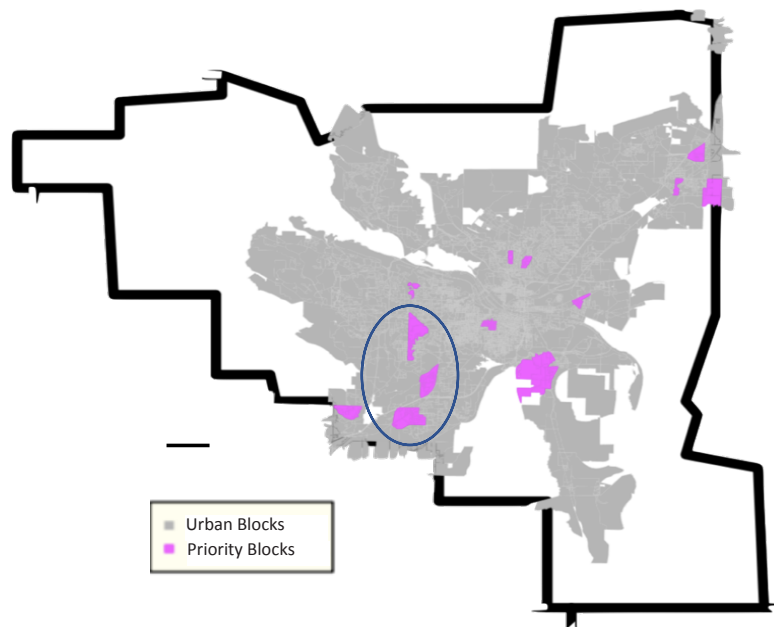
a food desert (2017 American Community Survey 1 Year data. Tables B17001A, B17001B, and B17001I; Bread for the World, 2018). Pulaski County and Little Rock are ethnically and racially diverse, which further identifies them as good locations for P2P activity.

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 establishments, therefore, finding a location for a P2P program collection and distribution point would be easier.

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 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 (1623.5 people per square mile), it is estimated P2P activity in these areas could service around 7500 residents (Census. gov: QuickFacts: Little Rock city, Arkansas; Pulaski Coun-

ty, 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 be amongst the first to be targeted for a P2P food redistribution program pilot.

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.

Fig. 3. Identified priority blocks in Pulaski County, 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.

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.

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.

Conclusions

This study may be used to 1) help analyze food desert locations for P2P activity implementation in Arkansas, and 2) expand the study to include other states and food deserts in the U.S. 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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