Food Access and Vulnerable Populations: Mapping Food

Insecurity in Bolivar and Washington Counties

Manel Capangpangan

GIS 490

Delta State University

Introduction

Food insecurity remains a deeply rooted challenge in the Mississippi Delta, a region defined by long-standing structural inequities, limited economic opportunity, and persistent health disparities. Although national food insecurity rates have declined in recent years, Mississippi continues to report some of the highest levels in the country. Rural Delta counties, in particular, face disproportionate burdens stemming from poverty, geographic isolation, aging populations, and restricted access to nutritious foods. Bolivar and Washington Counties mirror these regional patterns. Both are predominantly rural and majority–African American, with elevated poverty rates, lower median household incomes, and substantial populations of older adults who may encounter mobility limitations or transportation barriers.

Understanding food insecurity in the Delta requires considering both socioeconomic vulnerability and geographic accessibility. Residents in rural areas often travel long distances to reach full-service grocery stores and may depend instead on convenience stores, gas stations, or dollar stores that offer limited healthy options. For households without a vehicle, these travel demands create additional barriers to obtaining adequate food. Examining where demographic vulnerability overlaps with limited physical access can help identify communities that face the most significant disadvantages.

This project assesses food access vulnerability in Bolivar and Washington Counties by integrating demographic indicators with spatial accessibility measures. Using Geographic Information Systems (GIS), four variables from the American Community Survey (ACS)—poverty, median household income, age 65 and older, and households without a vehicle—were mapped alongside 10- and 15-minute drive-time service areas around food outlets. These layers were combined into a composite vulnerability score to highlight census tracts at greatest risk. The goal of this project is to provide a spatially informed analysis of food insecurity that can assist community organizations, policymakers, and local stakeholders in planning interventions across the Mississippi Delta.

Literature Review

Food insecurity emerges from the combined influence of socioeconomic hardship and the characteristics of the surrounding food environment. National studies consistently demonstrate that low-income, minority, and rural neighborhoods tend to have fewer full-service grocery stores, greater dependence on small retailers, and limited availability of nutritious foods. Walker et al. (2010) showed that these disparities in retail access play a substantial role in shaping nutritional inequities and related health outcomes. Shanks et al. (2022) further highlighted how rural

households with low incomes experience multiple challenges—including affordability issues, inconsistent food quality, long travel distances, and the need to rely on coping strategies such as rationing or purchasing lower-quality foods.

The structure and conditions of the neighborhood environment also shape dietary patterns and overall health. Odoms-Young et al. (2024) emphasized that food access is closely tied to socioeconomic inequality, neighborhood characteristics, and broader structural disadvantages. Limited infrastructure, few healthy retail options, and geographic isolation can intensify diet-related disparities. Findings across public health research reinforce that the combined effects of economic disadvantage and physical distance from food outlets contribute to elevated rates of chronic disease among vulnerable populations.

These challenges are especially pronounced in rural areas. According to the U.S. Department of Agriculture's Food Access Research Atlas, many low-income rural communities are situated far from supermarkets, often exceeding the ten-mile distance commonly used to define low-access areas. Transportation therefore becomes a central factor in shaping food security. Households without vehicles face the greatest obstacles, especially in regions where public transit is limited or nonexistent. These national patterns closely mirror conditions across the Mississippi Delta.

Research specific to the Delta provides deeper insight into the forms of disadvantage present in Bolivar and Washington Counties. Hathaway (2025) documented experiences of long travel distances, high food prices, limited store availability, and challenges navigating supplemental food programs. Halfacre et al. (2022) reported similar barriers in several high-obesity Delta counties, finding that residents frequently encountered poor food freshness, inconsistent availability of produce, and increased reliance on food assistance programs. Reports from the Center for Research and Evaluation on Wellbeing (CREW) further underscore regional concerns, including transportation gaps, an aging population, and persistent poverty—factors that compound vulnerability to food insecurity.

The literature establishes that food insecurity is shaped by the intersection of demographic vulnerability and spatial accessibility. While many studies examine social determinants of food access or the distribution of food outlets independently, fewer integrate both elements into a single spatial model. This project addresses that gap by combining demographic indicators with drive-time accessibility to assess food access risk in Bolivar and Washington Counties.

Overview of the Topic

I.   Study Area

Bolivar and Washington Counties are located in the heart of the Mississippi Delta, a region known for long-standing structural inequities, limited economic opportunities, and persistent health challenges. Both counties are predominantly rural and majority African American, with socioeconomic and health indicators that rank among the most disadvantaged in the state. Many residents face high rates of poverty, lower median household incomes, and elevated levels of chronic disease, which increase vulnerability to food insecurity.

The geography of the region contributes to barriers in food access. Communities are widely dispersed, and full-service grocery stores are limited. As a result, residents often travel long distances to obtain nutritious foods. Households without reliable transportation, especially older adults and low-income families, are disproportionately affected. These demographic and geographic factors make Bolivar and Washington Counties important locations for spatial analysis of food access and vulnerability.

II.   Data Sources

This project used several datasets to examine both demographic vulnerability and spatial food access.

American Community Survey (ACS 2023 5-Year Estimates).
Four variables were selected due to their relevance to food insecurity research:
- Poverty rate (ACS Table S1701)
- Median household income (ACS Table B19013)
- Population age 65 and older (ACS Table S0101)
- Households without a vehicle (ACS Table B08201)

Food Outlet Data.
Food outlet locations were compiled from four sources to create the most complete inventory possible:
- Delta Health Alliance food resource lists
- Mississippi Food Network partner listings
- Google Maps business listings
- USDA SNAP Retailer Locator

These datasets were merged, cleaned, and geocoded to produce an accurate point layer of food outlets.

Geographic Data.
- Census tract boundaries from TIGER Line shapefiles
- Esri Light Gray Canvas basemap
- Network Analyst tools for service area analysis

III.   GIS Methods

The analysis followed several steps to evaluate food access in the study area.

Food Outlet Processing.

Duplicate entries across the four data sources were removed, store types were reviewed, and addresses were standardized. The cleaned dataset was then geocoded in ArcGIS Pro to create a point layer of supermarkets, grocery stores, dollar stores, SNAP retailers, and other outlets.

Drive Time Accessibility.

Using Network Analyst, 10 minute and 15 minute service area polygons were created around all food outlets. The 10 minute polygons were displayed in green with 60 percent transparency, and the 15 minute polygons were displayed in purple with 70 percent transparency. These service areas represent reasonable rural travel times for accessing food outlets.

Demographic Data Integration.

ACS variables were joined to census tracts and symbolized using the classification breaks established during map creation.
- Poverty: 0 to 5 percent, 5 to 10 percent, 10 to 15 percent, 15 to 20 percent, 20 to 40 percent
- Median household income: natural breaks
- Households without a vehicle: 0 to 5 percent, 5 to 10 percent, 10 to 20 percent, 20 to 30 percent, 30 to 60 percent
- Age 65 plus: 9.3 to 10 percent, 10 to 15 percent, 15 to 20 percent, 20 to 25 percent, 25 to 35 percent

Composite Vulnerability Score.

Each census tract received a score from 0 to 3, based on the following conditions:
- Poverty rate 20 percent or higher: +1
- Median income below the county median: +1
- Age 65 plus at 20 percent or higher: +1
- Households without a vehicle at 10 percent or higher: +1

No tract in the study area met all four criteria.

Map Production.
All maps were created in ArcGIS Pro with consistent color schemes, layouts, and labeling so that results could be easily compared.

IV.   Mapping Results

Patterns across the maps show clear geographic concentrations of vulnerability in both counties. Several census tracts with elevated poverty rates and lower median household incomes appear in the central and southern portions of the study area. These same tracts frequently overlap with higher proportions of older adults and households without access to a vehicle, indicating that multiple demographic challenges are occurring in the same locations.

The drive-time analysis further emphasizes these disparities. A number of rural tracts fall beyond both the 10-minute and 15-minute service areas, meaning residents in these locations face longer travel distances to reach full-service food outlets. When these accessibility gaps are viewed alongside the demographic indicators, several tracts emerge as high or very high risk. These areas typically represent communities that face economic limitations, limited transportation options, and reduced physical access to nutritious foods.

The composite risk map brings these patterns together in a single visualization, making it easier to identify priority areas where interventions may be most effective. By combining demographic conditions with drive-time access, the map shows how social vulnerability and geographic isolation intersect to create the highest levels of food access risk in Bolivar and Washington Counties.

Discussion and Conclusions

The analysis demonstrates a clear relationship between demographic vulnerability and limited food access in Bolivar and Washington Counties. Census tracts marked by higher poverty rates, lower median household incomes, larger elderly populations, and a greater proportion of households without a vehicle frequently appeared outside both the 10-minute and 15-minute service area boundaries. When these factors converge in the same locations, they create substantial obstacles for residents attempting to access healthy and affordable food. This overlap illustrates how socioeconomic and geographic disadvantages compound one another in rural areas of the Mississippi Delta.

These outcomes align closely with existing research on Delta communities. Earlier studies consistently document transportation barriers, economic hardship, and limited availability of full-service grocery stores as major contributors to food insecurity in the region. The high-risk tracts identified in this project reflect many of the conditions described in qualitative research—such as long travel distances, inconsistent access to fresh foods, and mobility challenges among older adults. This correspondence between the mapped patterns and the broader literature reinforces the reliability of the findings.

Using a composite vulnerability score proved effective for pinpointing areas where multiple risk factors intersect. This approach helps clarify which communities may rely more heavily on convenience stores, dollar stores, or food assistance programs because of restricted transportation options and lower household resources. Although similar trends are observed nationally in rural regions, the challenges appear more pronounced in the Mississippi Delta due to persistent poverty and fewer full-service retail options.

Improving food access in these counties will require strategies that address more than the presence or absence of grocery stores. Any effort to reduce food insecurity must consider transportation limitations, the distribution of demographic vulnerability, and the broader structural issues that shape access. The integration of demographic indicators with drive-time analysis in this project highlights meaningful differences across communities and offers a practical way to understand how multiple barriers intersect.

Food insecurity in the Mississippi Delta is shaped by the combined influence of income, age, vehicle access, and travel distance to food outlets. Recognizing where these factors overlap can support more targeted interventions by local agencies, nonprofit organizations, and policymakers. The results from this project provide a foundation for future planning efforts and offer an evidence-based perspective to guide initiatives aimed at improving food access throughout Bolivar and Washington Counties.

Recommendations

The findings of this project point to several opportunities for strengthening food access in Bolivar and Washington Counties. Because the most vulnerable areas are those where low income, limited transportation, and long travel distances intersect, effective strategies must consider both the social conditions and the geographic isolation influencing food insecurity.

Improving transportation access is a critical starting point. Local governments, nonprofits, and community organizations could explore coordinated transportation initiatives such as shuttle routes to major grocery stores, volunteer driver networks, or reduced-fare programs designed for older adults and households without vehicles. Expanding mobility options would help reduce the dependence on convenience or dollar stores and increase access to full-service retailers.

In addition to transportation, increasing the availability of healthy food within high-risk areas can help meet immediate needs. Mobile markets, rotating farmers' markets, and pop-up produce vendors offer flexible ways to bring fresh foods directly into underserved neighborhoods. Small retailers could also be supported through incentives or technical assistance to expand their inventory of fresh fruits and vegetables.

Expanding the reach and effectiveness of food assistance programs is another important approach. Raising awareness of SNAP and WIC benefits, supporting EBT acceptance at farmers' markets, and strengthening partnerships with food pantries can help households better navigate financial constraints. Educational resources such as nutrition workshops or budgeting assistance may further support residents' ability to make healthy food choices.

Sharing the outcomes of this project with agencies and local leaders can also inform long-term planning. The composite risk map provides a clear understanding of where multiple vulnerabilities co-occur and can guide decisions about resource allocation. Integrating these findings into an ArcGIS Experience Builder application would allow stakeholders to interact with the data and identify priority areas more effectively.

Ultimately, addressing food insecurity in Bolivar and Washington Counties will require a multifaceted approach that combines transportation improvements, expanded retail options, and strengthened assistance programs. Focusing efforts on the census tracts identified as most vulnerable can help local partners work toward reducing disparities and improving food access across the Mississippi Delta.
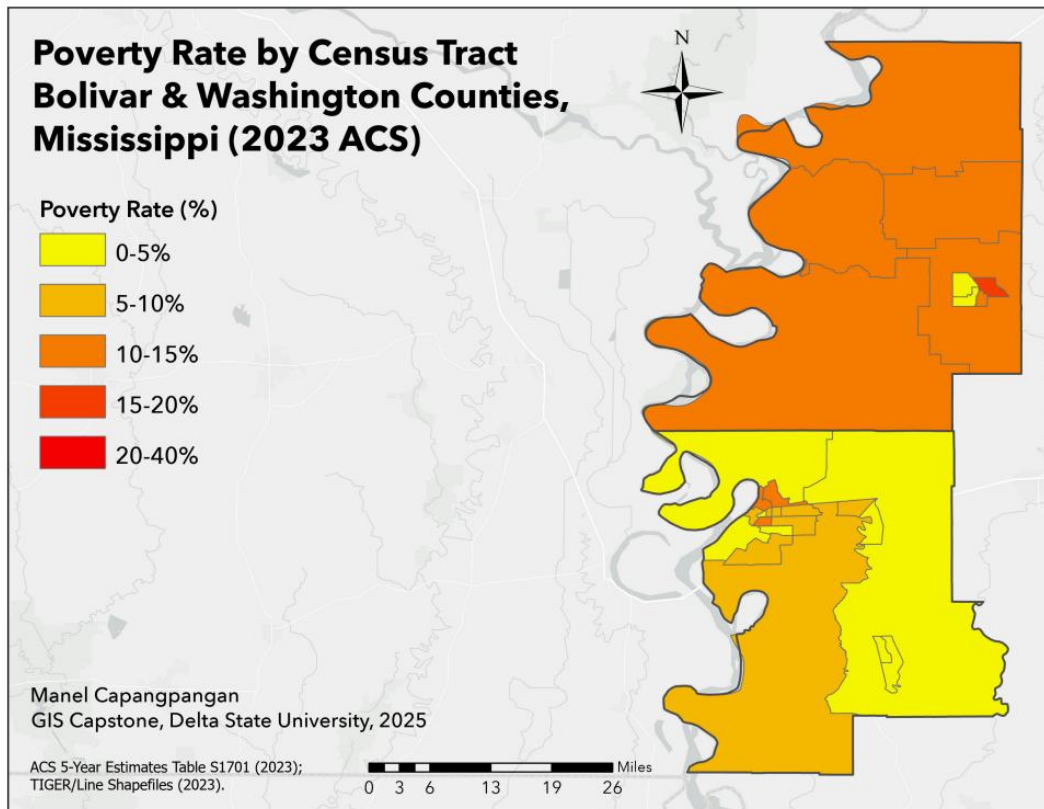
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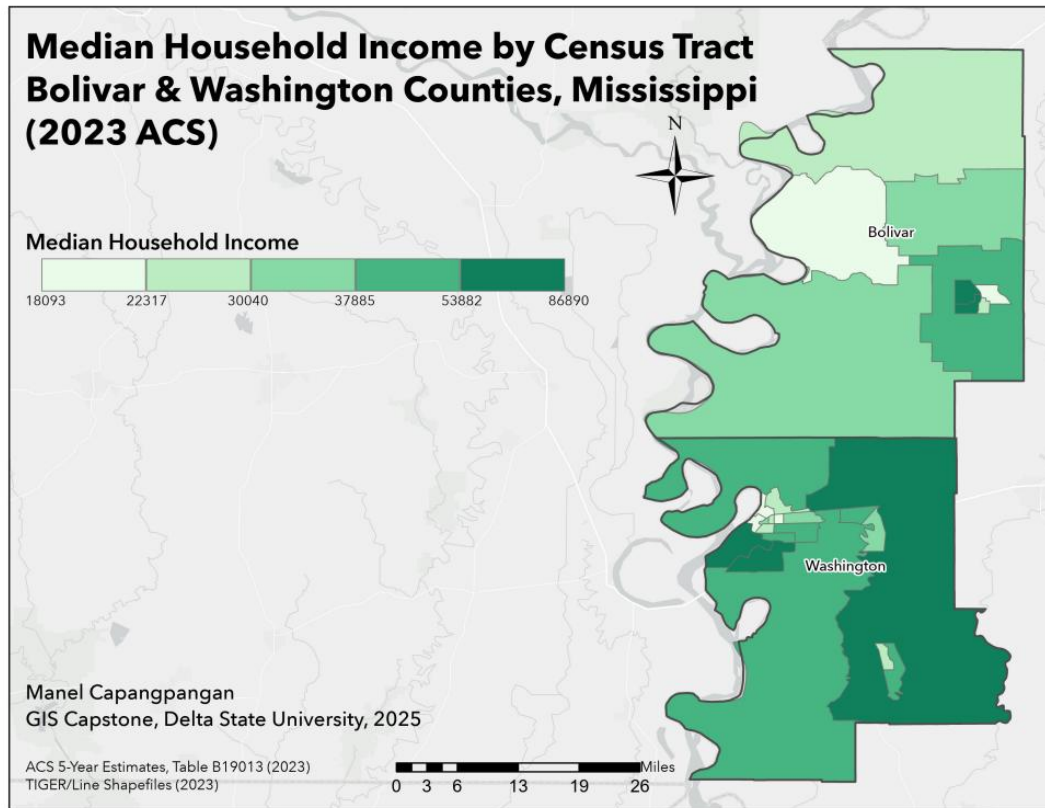   in the United States: A review of food deserts literature. *Health & Place, 16*(5),
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Appendix

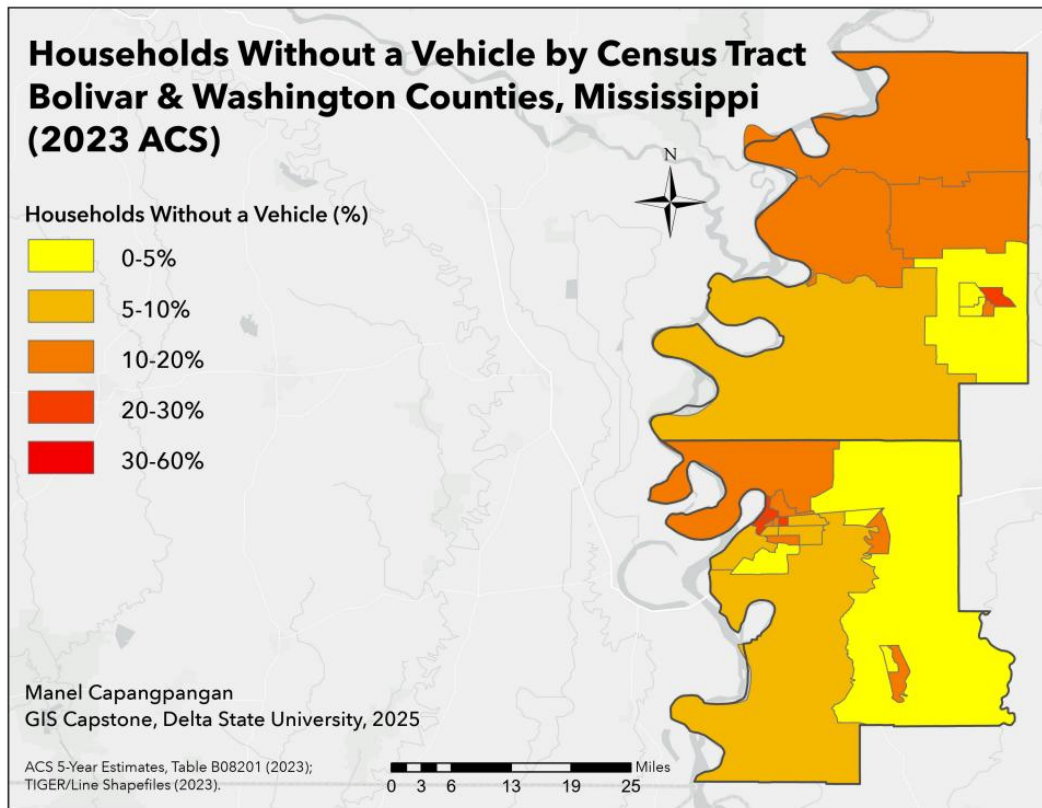## Appendix A. Poverty Rate by Census Tract

This map displays poverty percentages for census tracts in Bolivar and Washington Counties using ACS 2023 estimates. Class breaks include 0 to 5 percent, 5 to 10 percent, 10 to 15 percent, 15 to 20 percent, and 20 to 40 percent.

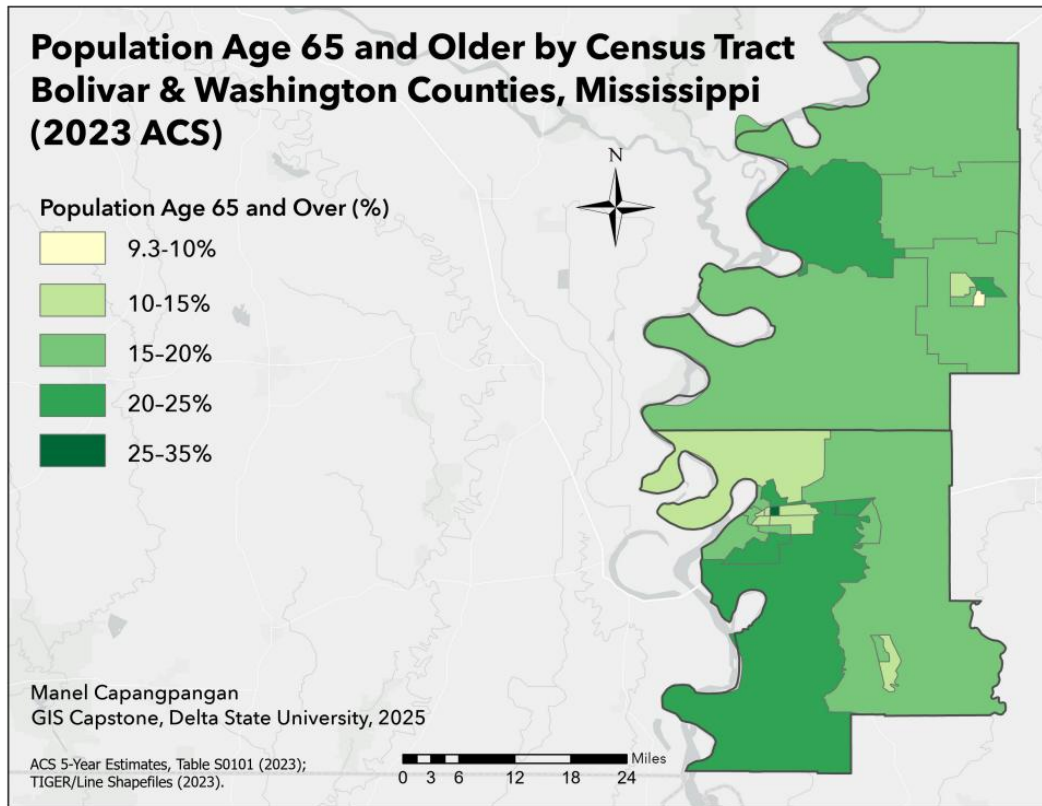## Appendix B. Median Household Income by Census Tract

This map shows median household income using natural breaks classification. Darker shades represent higher incomes, while lighter shades indicate lower-income areas.

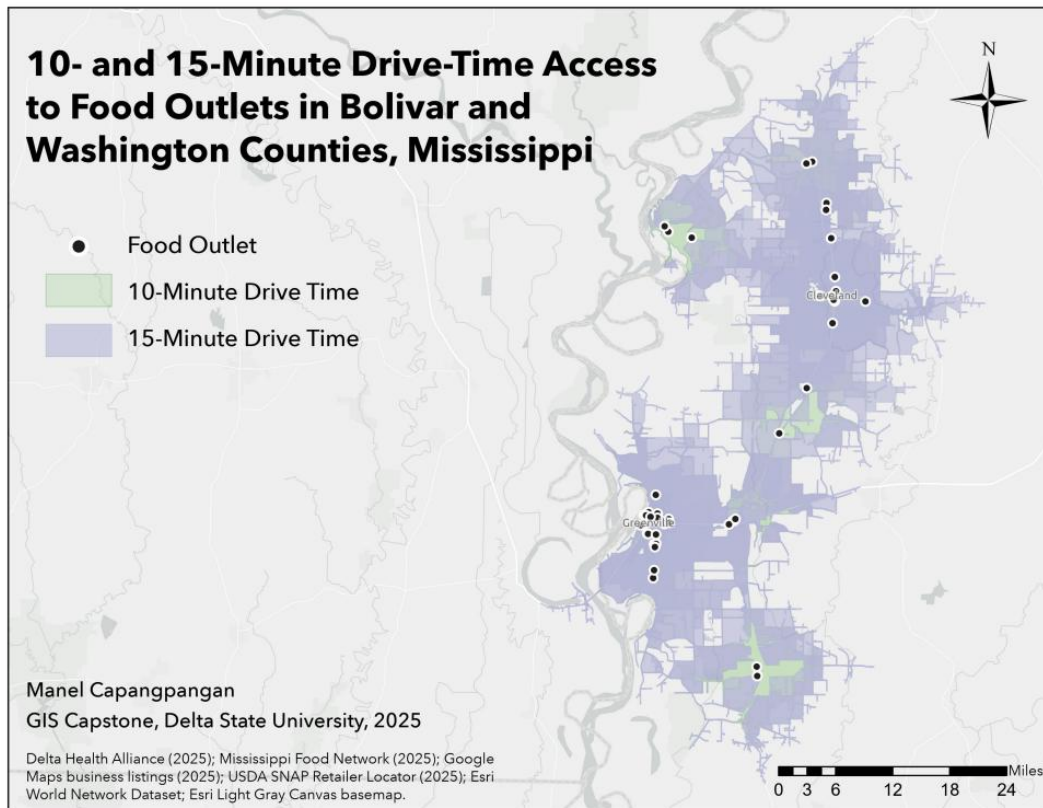## Appendix C. Households Without a Vehicle

This map visualizes the percentage of households without access to a vehicle. Class breaks include 0 to 5 percent, 5 to 10 percent, 10 to 20 percent, 20 to 30 percent, and 30 to 60 percent.
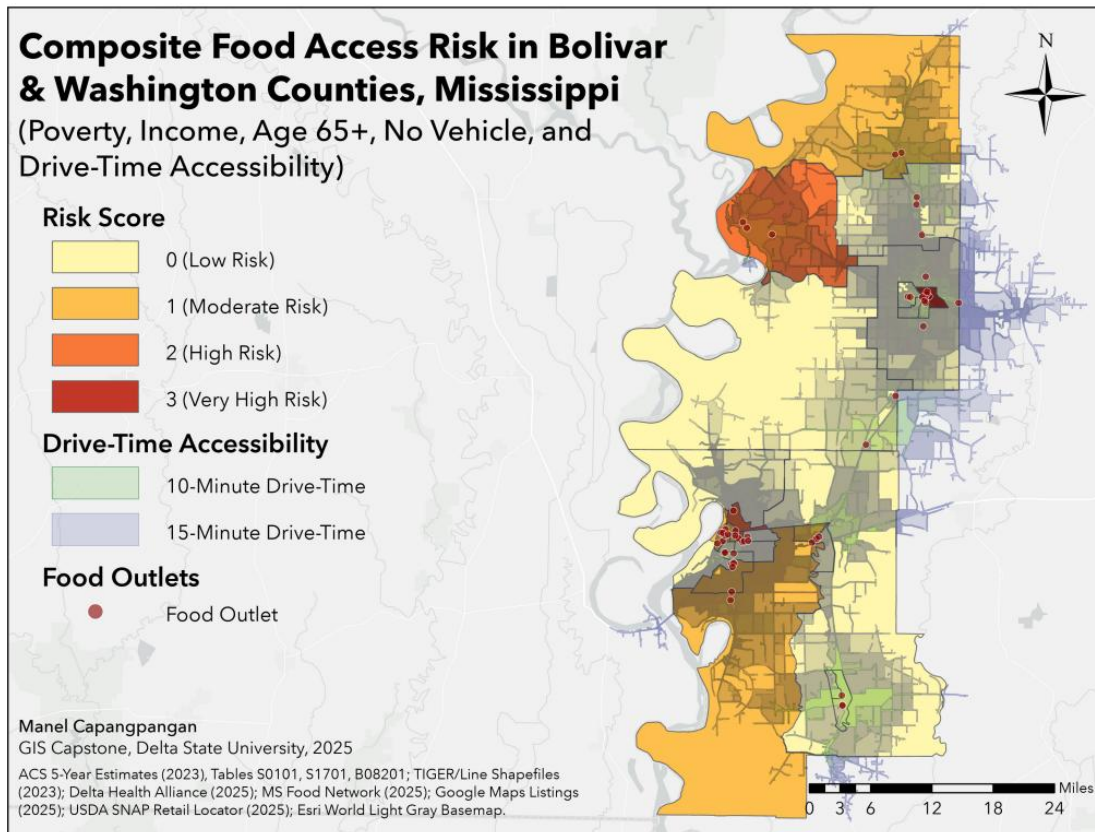
Appendix D. Population Age 65 and Older

This map presents the proportion of older adults (age 65 plus) by census tract. Class breaks include 9.3 to 10 percent, 10 to 15 percent, 15 to 20 percent, 20 to 25 percent, and 25 to 35 percent.

Appendix E. Ten and Fifteen Minute Drive Time Service Areas

This map illustrates the 10 minute (green, 60 percent transparency) and 15 minute (purple, 70 percent transparency) drive time polygons generated using Network Analyst. Food outlet locations are marked within the service areas.

Appendix F. Composite Food Access Risk Score

This final map shows the composite vulnerability score for each census tract using four indicators: poverty, median income, age 65 plus, and households without a vehicle. Scores range from 0 for low risk to 3 for very high risk.