

A Visual Analysis of Food Availability in Davidson County NC

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Abstract

Community Food Strategies provides guidance and tools to local food networks to empower them to create equitable policy change at all levels. Their vision is the realization of an equitable food system that improves the quality of life for all. In Davidson County, the recently formed Local Food Network, created under the guidance of Community Food Strategies, is working to create a more equitable and sustainable food system and is evaluating how best to apply their resources toward this end. The county is largely rural and as a whole, rural areas tend to have lower food access. Two cities, Lexington and Thomasville, have experienced economic depression over the past three decades with the exodus of furniture manufacturing overseas and as such, both cities have communities that suffer from poverty and experience food insecurity issues. Using data visualization tools to build a visual survey and analysis of local food availability will provide the base the food network needs to present the state of the local food system to those who can partner with them to help create policies that will increase equity and availability of food to everyone in the county.

CHAPTER 1

Introduction

Davidson County Local Food Network, under Community Food Strategies is working toward building an equitable and resilient food system for the health and economic welfare of the community. This project addresses their need for visualization of the food resources available within the county as well as identifying key economic and demographic markers that may contribute to food insecurity within the county. Various data visualization tools were employed to provide geocoded location mapping for food resources in the county as well as analyses of various data layers superimposed over resource location data. This project uses Information Seeing techniques.

1.1 Research Questions

This project focused on the following research questions while concurrently mapping all food availability locations in Davidson County:

1.1.1 Research Question #1 Where are food deserts and swamps located in Davidson County? Are there food deserts that have a local impact but are not included in USDA data?

USDA food deserts are called “low access” and are defined as an area where at least 500 people or 33 percent of the census population reside more than one mile from a supermarket or large grocery store. In largely rural areas the distance is increased to 10 miles. Defined as such, we might find that the local population does or does not experience the low access designation given to it by USDA. An example would be a local area being served by a well-stocked locally

owned small grocer that does not appear on the national list of supermarket locations. This area might be considered a USDA food desert but does not actually suffer from food access issues due to the local market not being picked up by USDA data analysis. Conversely, an area may be experiencing food access issues due to recent store closures or population changes that are not reflected in USDA data which tends to be from years prior.

1.1.2 Research Question #2 Is there a correlation between demographic or economic markers and food availability in Davidson County?

A well-studied economic marker that often portends food insecurity and food access is the level of poverty experienced by an area. Lower income individuals and families have less access to reliable transportation and may not have the resources to travel far to obtain groceries for themselves or their families. This affects access to food and is especially pronounced in rural areas where access to food usually requires reliable transportation. Lower incomes and poverty also are typically markers of food insecurity due to individuals simply not having money to purchase food.

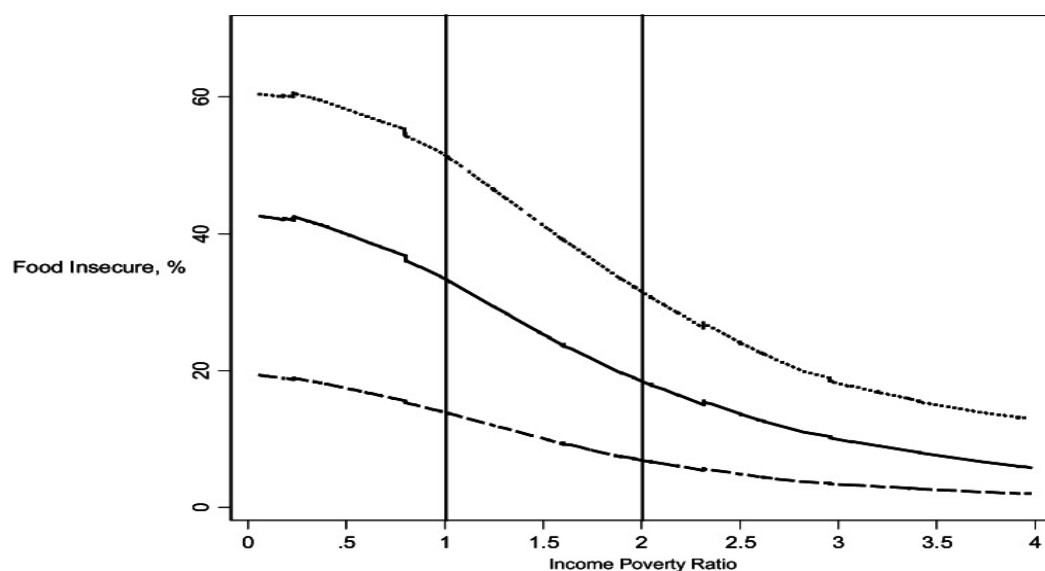


Figure 1. *From Gunderson (1) showing the relationship between poverty and food insecurity.*

1.1.3 Research Question #3 What is food leakage and does Davidson County experience it due to demand not being met locally?

Also known as a “gap analysis” or supply and demand analysis, retail food leakage is a measure often used to determine the retail opportunities that might be available in a community. It is a determination of how well the retail needs of residents are being met locally. It can also be looked at from the perspective of need and access, especially when mapped against location data separating various types of retail food outlets. High leakage will often be seen where there are no full-service grocery stores. If the income is also low in these areas it could indicate food access issues as well.

1.2 Food Availability Spatial Analysis

The main goal of this project is the creation of a deliverable county mapping of all food resources in Davidson County which will be usable and updateable by the Davidson County Local Food Network both on their website and in their future work promoting local food resources and encouraging change in food policy at the county level.

CHAPTER 2

Data Modeling

2.1 Data Collection

The data required for this visualization is location data for all food resources in the county. A list of food resources was developed in collaboration with Davidson County Local

Food Network members and includes the locations of: grocery stores/markets (both local and corporate chains), dollar stores, food pantries, farm markets, community gardens, and retail food establishments (restaurants, including fast food). Some of this location data was easily gathered from the local health department or the Nielsen TDLinx via Policy Map while other data required in depth searches using google maps and other tools. Working on a local level we wanted to encompass as much data as possible to get as complete a picture as possible of the food available in Davidson County.

2.1.1 Data Sources All Data used in this visualization is static data. Data was obtained from the most up to date source possible to avoid the possibility of incorrect data. Some data files needed to be created from Google Maps or Google search information as a tabulated data format was unavailable. Listed here are the sources of each data group and the size (col x row) of the data file obtained or created.

- Retail food establishments, Davidson County health department (20x249)
- Food pantry locations, Feeding America: Map the Meal Gap (21 x 20)
- Retail grocery locations (includes full-service and limited service stores, including dollar stores), Nielsen TDLinx via Policy Map (with additions from Google Maps) (8x57)
- Farm Markets, CDC State Indicator Report on Fruits and Vegetables (4) (22x14)
- Community Gardens, Davidson County health department

- Demographic and economic layer mapping data obtained from US Census data via Policy Map

2.2 Data Cleaning Process and Tools Used

Microsoft Excel was employed for data organization with the free mapping add-on, Mapcite, which was used to geocode and verify accuracy of location data. Geocoding was attempted with multiple techniques including using R and Python programming and the online tool BatchGeo with mixed results. Mapcite was a late addition to the project's geocoding process when other methods did not provide good accuracy. Mapcite proved to be an easy to use, comprehensive and accurate tool. Data was manually checked for missing and incorrect data by cross referencing ambiguous spatial data with a Google Map search. Policy Map was used for data analysis and overlay mapping with data layers. Google MyMaps and Google Docs will be used to provide a usable and updateable final product to the partner organization for embedding on their website and other future use.

CHAPTER 3

Methodology

3.1 Data Layer Analysis

All three research questions were explored using data visualization as an analysis tool. All data analysis using data layers was performed using Policy Map software, adding built-in data layers and data points to single layer maps and performing visual pattern analysis on the results. Analysis was done twice, using built-in location data for one analysis and the more up-

to-date and complete location data set built for this project and uploaded into Policy Map for the second.

3.2 Spatial Analysis

The final deliverable Google location map is still in production and will be an interactive map built using Google Docs for the background csv location files. Google My Maps will provide the embeddable interactive map which will pin locations using different pin types for the various food resource types, providing an easy to use information seeing tool for Davidson County Local Food Network.

CHAPTER 4

Results

4.1 Food Deserts and Swamps in Davidson County

Visual Analysis shows that there are areas of low food access in the county. Two different measurements were used which paint two differing visuals of food access in the county. Both analyses included here were built using Policy Map and used the Nielsen TDLinx grocery location data.

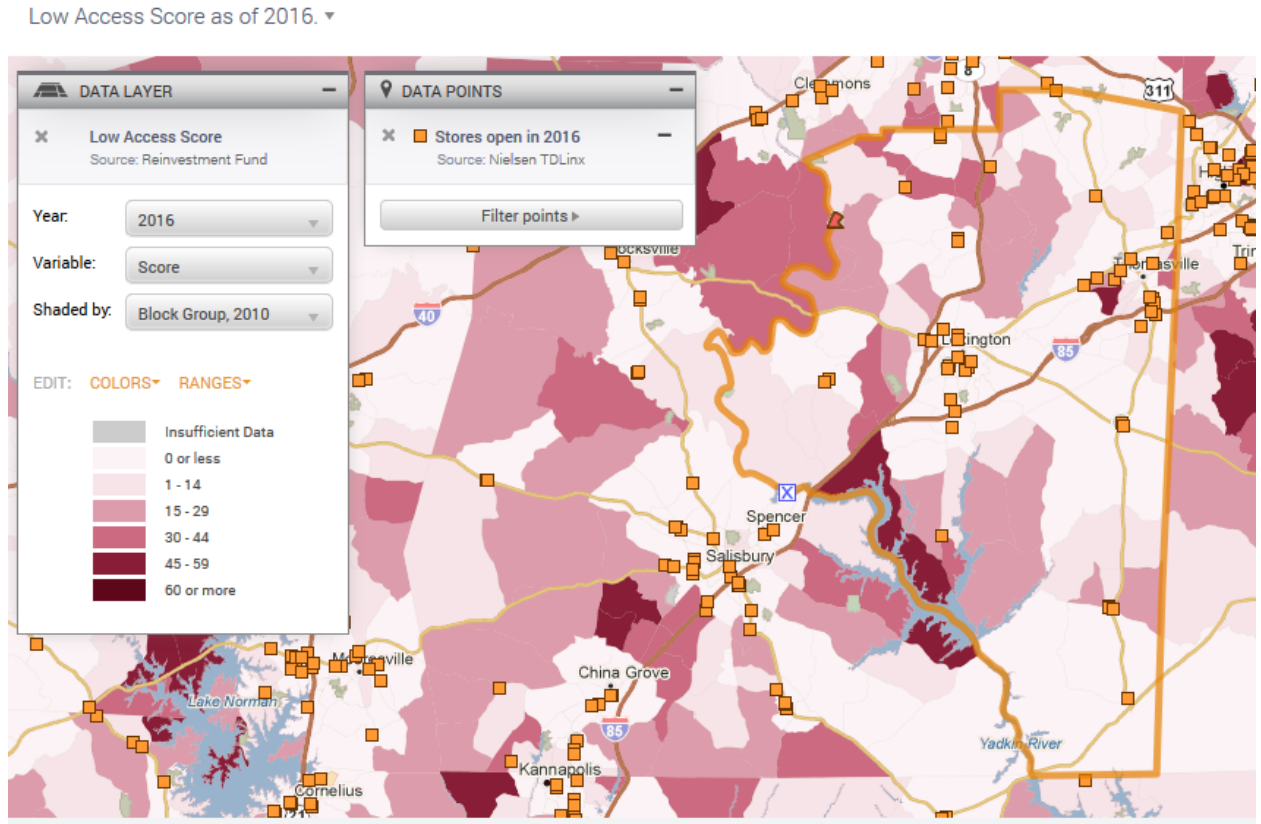


Figure 2. *Reinvestment Fund Low Access Score by Block Group for Davidson County. Source: Policy Map (2)*

The following description from Policy Map explains the Low Access Score as pictured above in Figure 2. This analysis shows various areas of low access to food around the county, particularly in rural areas. Using the grocery locations, we can see that these areas would likely be considered food deserts by the USDA if they had greater population density.

Description from Policy Map data dictionary:

“Low Access Score: Reinvestment Fund LSA Analysis 2016

The Low Access Score as of 2016. A block group's Low Access Score represents the percent by which a block group's distance to the nearest supermarket must be reduced to equal the reference distance for that block group's population density and car ownership class. Low Access Scores

indicate the degree to which residents are underserved by supermarkets. Residents of a block group with a higher Low Access Score must travel longer distances to access a supermarket than residents of block groups with lower Low Access Scores. Low Access Scores on Policy Map range from 0 to 100; block groups with a Low Access Score of 0 have a distance to the nearest supermarket that is less than or equal their population density and car ownership class's reference distance.”

In Figure 3 below we see USDA Low Access tracts from 2015. Many of these low access tracts fall in more urban areas with higher population density and lower car ownership. This analysis is done by census tract as opposed to the block group analysis presented above. This analysis was not available by block group. The Census tract covers a larger area and does not always catch smaller areas of low food access if they are isolated pockets in a census tract. When evaluated by the larger census tract area as seen here many of these smaller pockets merge into the larger census tract average and seem to disappear.

Description from Policy Map data dictionary:

“Low Access Status: USDA

Low Access status, as of 2015. Includes tracts with at least 500 people or 33 percent of the population living more than .5 miles (in urban areas) or more than 10 miles (in rural areas) from the nearest supermarket, supercenter, or large grocery store. Tracts for where no data were available are labeled "Insufficient Data" on the map.”

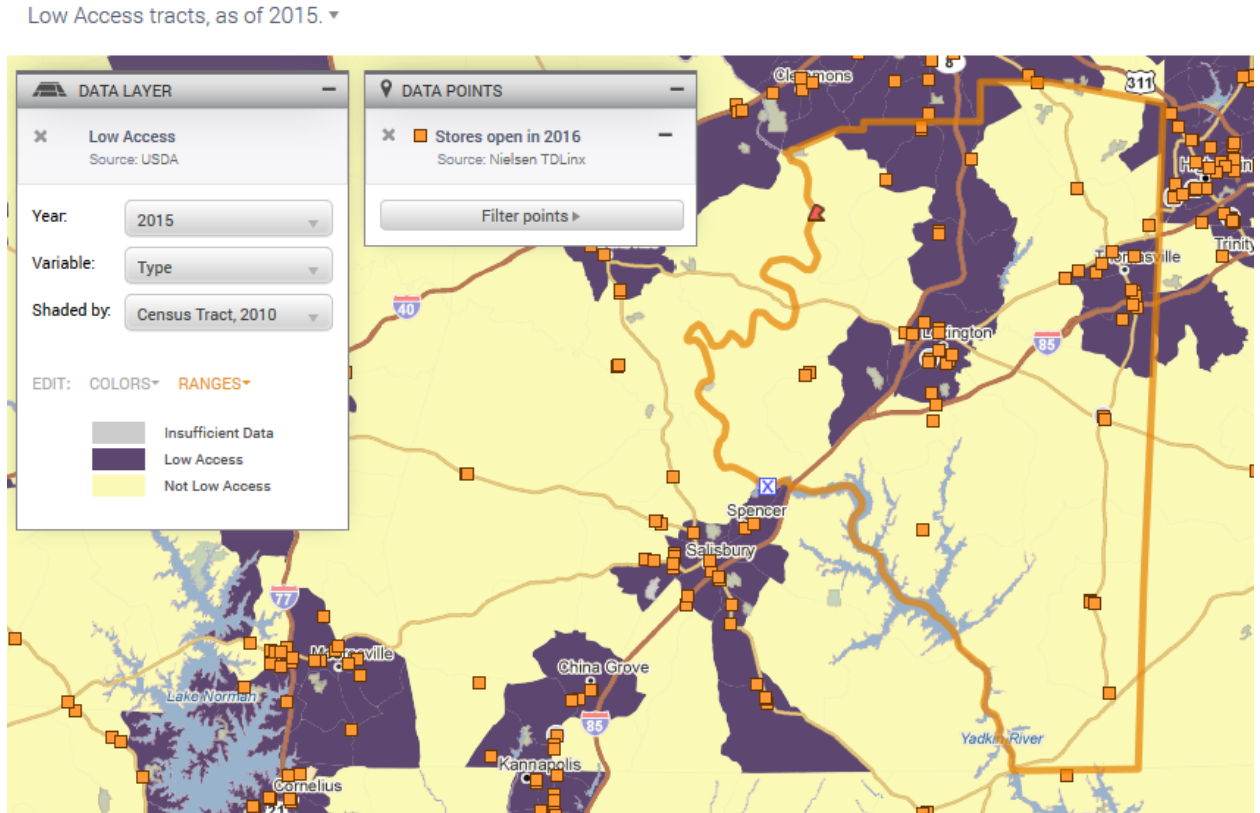


Figure 3. *USDA Low Access Score by 2010 Census Tract. Source: Policy Map (2)*

Mapping analysis using the retail food establishment data acquired for this project shows that most retail food establishments, including fast food, tend to be concentrated in the same areas as the concentrated areas of retail grocery locations. A food swamp is generally thought of as an area where there is easy access to fast food with limited access to full service grocery stores. Thus, food swamps are not as much of an issue in Davidson County as they have been found to be in neighboring urban areas like Greensboro.

4.2 Demographics and Food Access in Davidson County

The following are some basic demographic statistics from the 2012-16 US Census:

Davidson County Population

- Total Population: 164,058
- Non-White Population: 22,199
- Black Population: 14,750

Poverty Statistics ((% of population living below poverty level)

- of County Population: 16.24% (26,643)
- of Black Population: 31.78% (4,687)
- of city of Lexington Population: 24.6%

As discussed in the introduction, poverty is often linked with food insecurity and food access. Davidson county experiences high levels of poverty, especially in urban areas, and especially among people under 18. 42% of people under 18 living in the city of Lexington live in poverty. Davidson county has a very small black population, but they experience poverty at a very high percentage when compared against the whole population. Of note, single female head of households with children experience poverty in Davidson county (particularly in the city of Lexington) at an extremely high rate compared to other areas in the region as can be seen in the bar graph in Figure 5.

Low access and low-income areas often overlap as can be seen in Figure 6 when compared to Figure 3 above. A correlation between these two variables can be seen very strongly in the two urban areas of the county, Lexington and Thomasville, showing us that in Davidson County, income and food access do go hand-in-hand.

	United States (National)	North Carolina (State)	Winston-Salem, NC Metro Area (Metro Area, 2013)	North Carolina's 13th District (Ted Budd - R), NC (Congressional District, 115th)	Davidson, NC (County, 2010)	Lexington, NC (County Subdivision, 2010)
Percent Families with Single Female and Children in Poverty	39.75% See Values for States	42.7% See Values for Counties	44.8% See Values for Counties	44.98% See Values for Counties	49.77% See Values for County Subdivisions	62.55% See Values for Census Tracts
Ranking		15 of 52 States See Rankings	433 of 929 Metro Areas See Rankings	101 of 437 Congressional Districts See Rankings	1149 of 3189 Counties See Rankings	4727 of 23719 County Subdivisions See Rankings

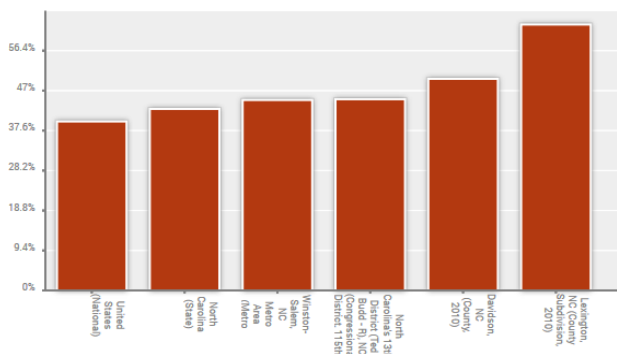


Figure 5. *Percent of families with single female and children in poverty.* Source: Policy Map (2)

Low Income and Low Access tracts, as of 2015. ▾

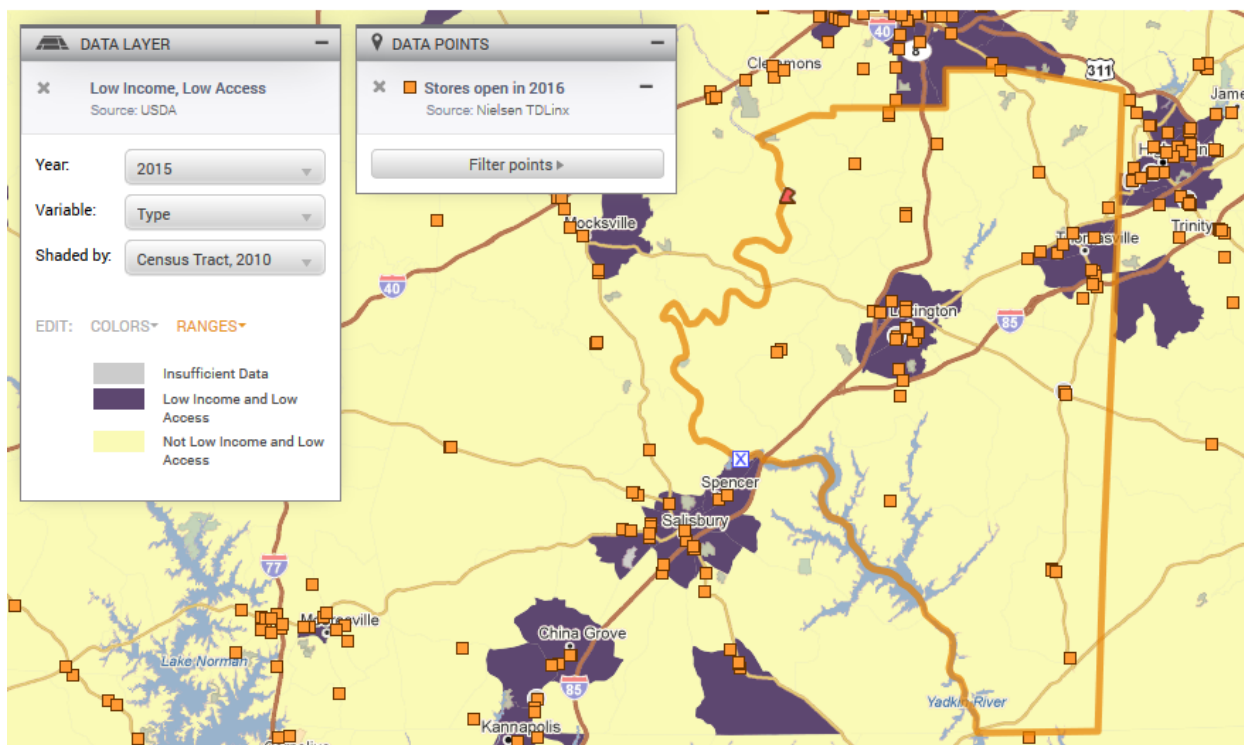


Figure 6. *Low Income and Low Access by 2010 Census Tract.* Source: Policy Map (2)

4.3 Food Leakage in Davidson County

Supply and demand analysis using Policy Map shows large areas of retail food leakage in the county. When mapped against retail grocery locations, we can observe that much of the leakage takes place in areas where the only grocery retail locations are dollar stores or other limited service grocery locations. This analysis is an important consideration for a local food council. Food leakage not only shows us where demand is not being met locally, it also shows us how much food revenue might be leaving the county.

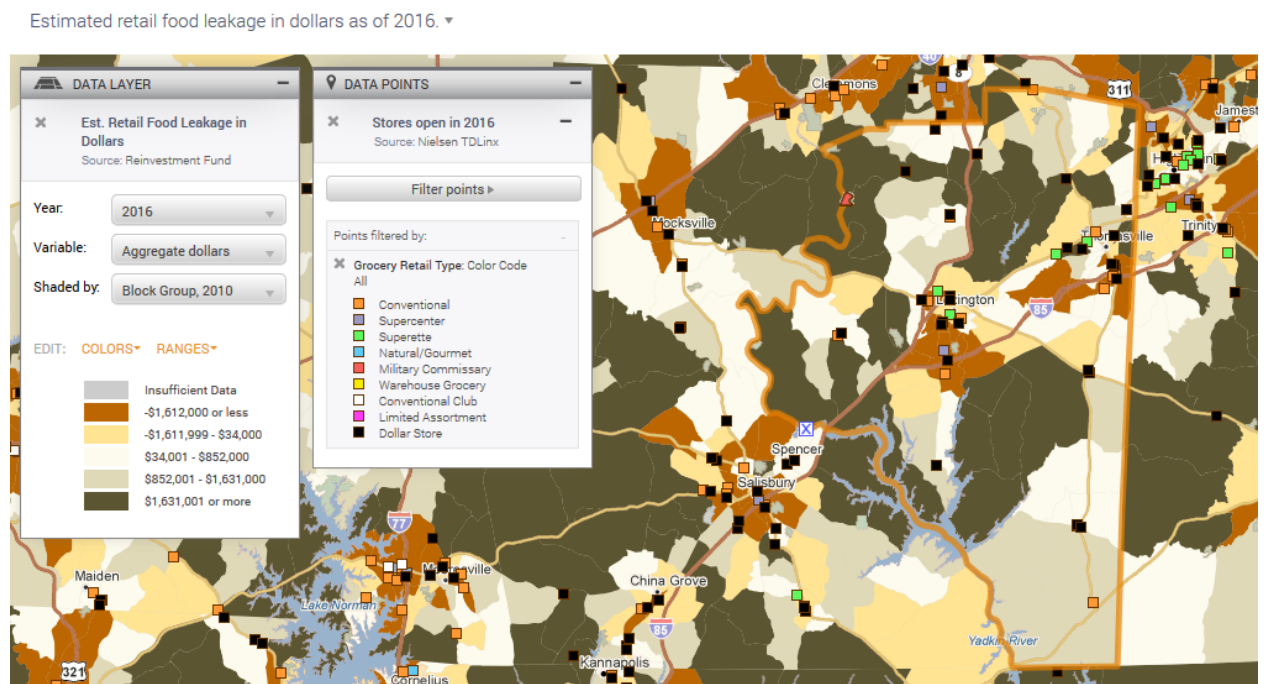


Figure 7. Food Leakage in Davidson County. Source: Policy Map (2)

CHAPTER 5

Conclusion

5.1 Key Findings

- Davidson County does experience localized urban and some rural food deserts that are

not captured in USDA food desert data. Food swamps do not appear to be largely present.

- Poverty is experienced at a high rate in parts of Davidson County. Of note, 42% of people under 18 in the city of Lexington live in poverty. Food Insecurity is often linked to poverty. Even if this population has access to food they may not have the means to obtain it.
- Davidson County experiences high retail food leakage in some areas which signifies there is need in those areas that is not being met. Many of these areas are served only by limited service stores such as dollar stores.

5.2 Contributions

The final deliverable GIS Food Availability mapping of Davidson County will be a valuable contribution towards expanding the efforts of Community Food Strategies and the Davidson County Local Food Network. With this tool they will have a clearer knowledge of food access and availability in the county and will be able to use this to work toward better access to local food and greater food equity.

5.3 Transition to Practice

I will be continuing my work with the Davidson County Local Food Network until such time that the final Google Maps embeddable map is completed and properly working. The final iteration will include csv files of all spatial location data as well as a user friendly, interactive map.

References

1. Gunderson, C. 2013. Food insecurity is an ongoing national concern. *Advances in nutrition* (Bethesda, Md.), 4(1), 36-41. doi:10.3945/an.112.003244
2. Policy Map. <https://www.policymap.com/> Accessed fall 2018.
3. Alkon, A.H. 2008. From value to values: Sustainable consumption at farmers markets. *Agriculture and Human Values* 25(4): 487–498.
4. Centers for Disease Control and Prevention. *State Indicator Report on Fruits and Vegetables*, 2018. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2018.