Local and Regional Food System Quality Index

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Index Components

1. Accessibility
2. Affordability
3. Inequality
4. Nutritional Quality
5. Infrastructure

- Describing what makes a local food system strong and equitable is a subjective task
- Goal: distill the integral parts of a well-functioning food system
- Five categories were chosen
- Severe lacking in any one of these components would result in the nutritional requirements of the local population to fail to be met

Accessibility

- The presence of sufficient quantities of food and the ability to access it

Five variables included in accessibility:

- percent of population with low/no access to store
- food banks per county
- Food deserts
- Retail Food Density Index
- food insecurity rate

Affordability

- The ability for consumers to be able to comfortably purchase adequate food

Three variables included in affordability:

- median income
- unemployment level
- percent of people over the age of 16 who are below the poverty level

Inequality

- The uneven distribution of food and food resources or access to those resources within a community
- Those with sufficient resources will be able to acquire food regardless of the local food system they are in. To that end, income inequality is a reasonable measure the equality of a food system's distribution

One variable included in inequality:

- Gini coefficient

Nutritional quality

The nutritional quality of a local food system refers to the nutrient content and overall health benefits of the food produced and consumed within a specific community or region. It focuses on the nutritional value and potential health impacts of locally grown or produced food.

Six variables included in nutritional quality:

- fast food restaurants per 1000 people
- convenience stores per 1000 people
- full service grocery stores per 1000 people
- specialized food stores per 1000 people
- Health Factors Z-Score
- Health Outcomes Z-Score

Infrastructure

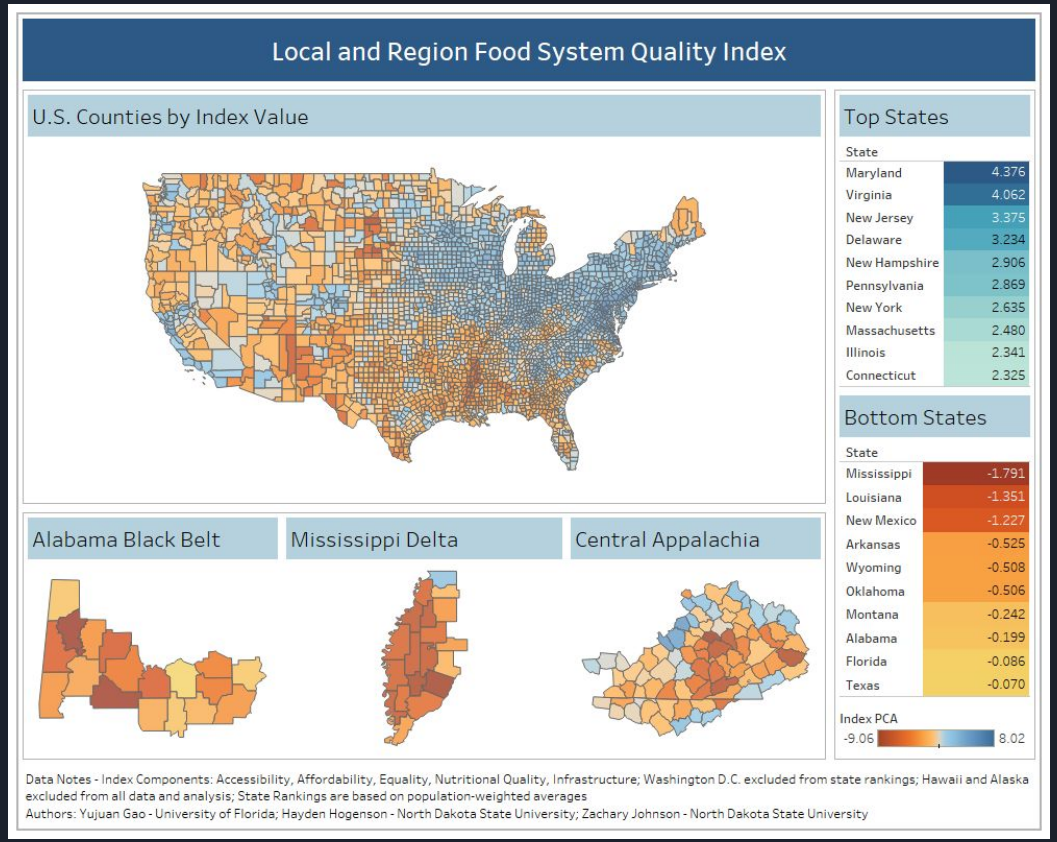
- Physical, logistical, and institutional framework that supports the production, processing, distribution, and consumption of locally grown or produced food within a specific community or region
- This component is a highly regional measure. It depends not on the resources within a county but on which are available to that county's population
- We define a region as a 350 radius from the population-centroid of a county

Five variables included in the infrastructure:

- number of food hubs within 350 mi.
- number of farmers markets within 350 mi.
- number of meat packing plants within 350 mi.
- number of community-supported agriculture businesses within 350 mi.
- the percentage of farms selling direct and intermediated

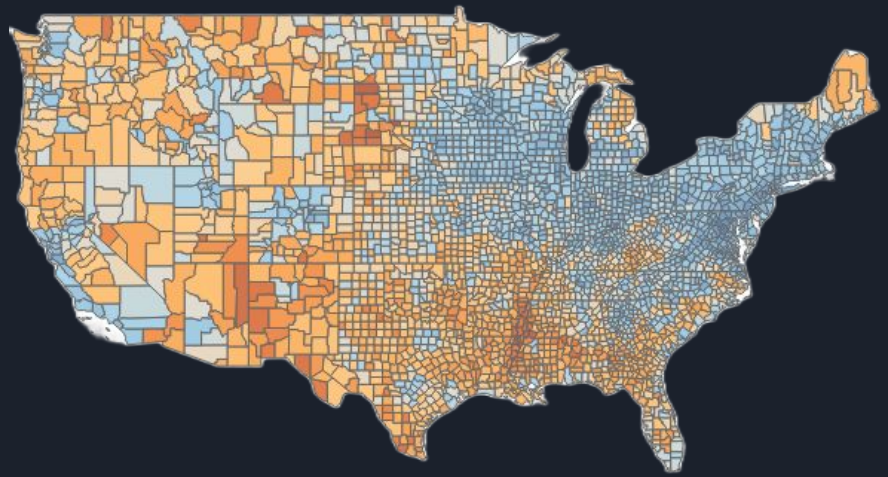
Index Development and Structure

- Scoring
  - Each variable is transformed into a z-score before being combined into one of five categories which are combined into the overall index
  - Standardizing the data prevents biases from the scale of the original values in the PCA
- Principal Components Analysis
  - To conduct PCA, we filled missing values using the 3 nearest neighbors imputation method
  - Reduce the variables to a single dimension while retaining as much of the variation as possible
  - Eliminates multicollinearity, but assumes all variables are deemed to be equally relevant to the category
  - Using the same process to construct the overall index yields the following weights:
    - Accessibility - 24.8%
    - Inequality - 7.9%
    - Affordability - 21.8%
    - Nutritional Quality - 20.2%
    - Infrastructure - 25.2%



Full Index Visualization

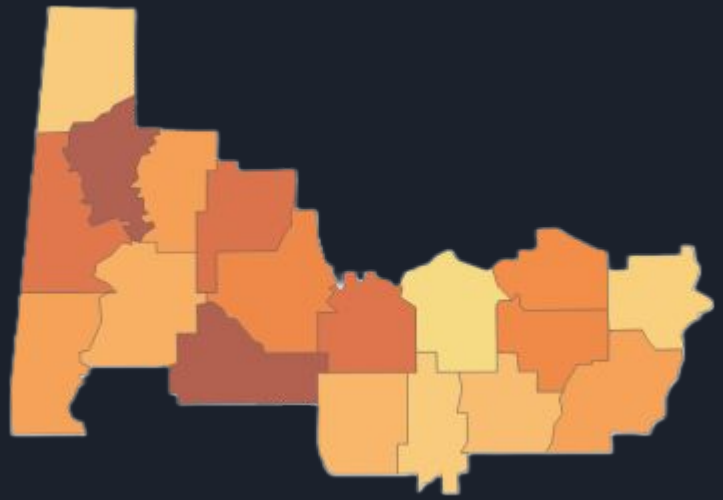
Full Map of Lower 48 States



Visualizing the index for each county shows few to no discontinuities across state lines. Rather, areas with higher and lower values transition smoothly across regions and geographies.

Higher values are predominantly located in the North-East through the Midwest and in counties containing major cities. Lower values are concentrated in the South and the western states.

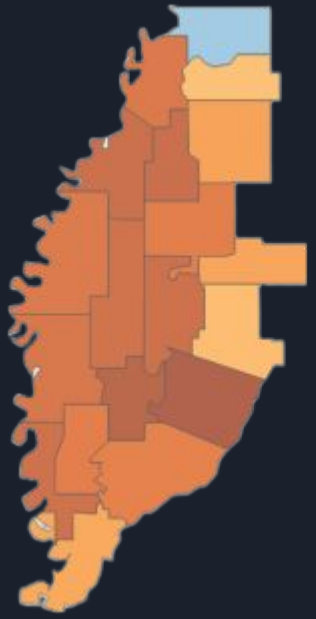
Alabama Black Belt



This predominantly Black set of counties in Alabama has a population-weighted average score of −2.26 while the rest of the state has an average score of 0.05. The state as a whole has an average of -0.199.

This region (known primarily for its demographics) has food systems significantly weaker than the rest of Alabama as measured by our index. This is due to Accessibility and Affordability scores which are much lower than the rest of the state.

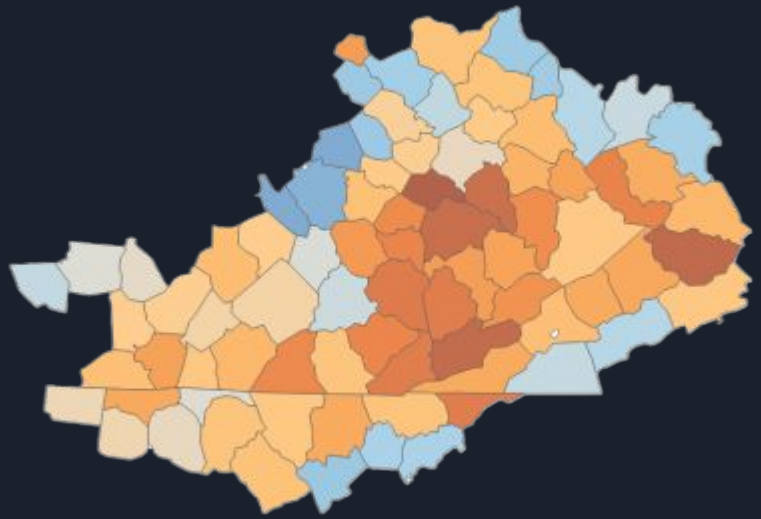
Mississippi Delta



The Mississippi Delta is the region between the Mississippi and Yazoo rivers. This region contains approx. one-third of Mississippi's African American population.

This region has a population-weighted average score of -2.37 while the rest of the state has an average of -1.66. The state as a whole has an average of -1.79. This deflated score is due to lower values across all five categories relative to rest of the state.

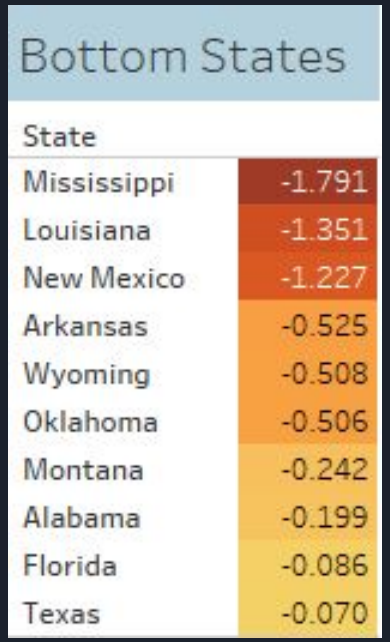
Central Appalachia



Central Appalachia (as designated by the Appalachian Regional Commission) lies mostly within Kentucky, but extends into Virginia, West Virginia, and Tennessee as well.

This region has a population-weighted average score of -0.37. While this is not extremely low, it is a significantly different score from the surrounding regions (which are almost entirely positive by a rather large margin). This region's lower scores are due to Accessibility, Affordability, and Nutritional Quality.

Bottom 10 States



Bottom States

State	
Mississippi	-1.791
Louisiana	-1.351
New Mexico	-1.227
Arkansas	-0.525
Wyoming	-0.508
Oklahoma	-0.506
Montana	-0.242
Alabama	-0.199
Florida	-0.086
Texas	-0.070

Averaging the county values (weighted by population) to find the 10 lowest scoring states again shows the poor performance of the South.

Even though many of these states have higher scoring counties in more populated areas, the low scores in less populated areas are sufficient to bring these states to the bottom.

Top 10 States

Top States

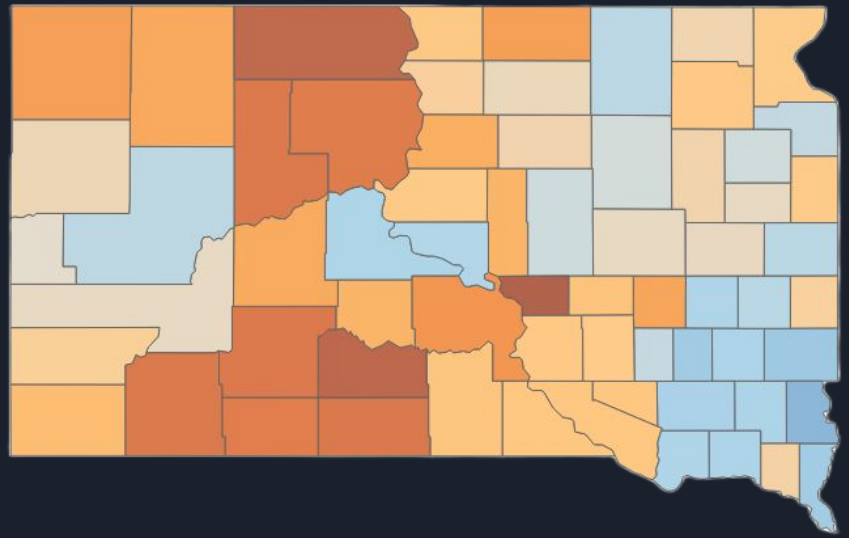
State	
Maryland	4.376
Virginia	4.062
New Jersey	3.375
Delaware	3.234
New Hampshire	2.906
Pennsylvania	2.869
New York	2.635
Massachusetts	2.480
Illinois	2.341
Connecticut	2.325

*Washington D.C. excluded

Each of the top ten states lies within or near the Northeast. Unlike the lowest ranked states (which often have counties with high and low scores), these states have high values across the board with very few counties scoring below zero.

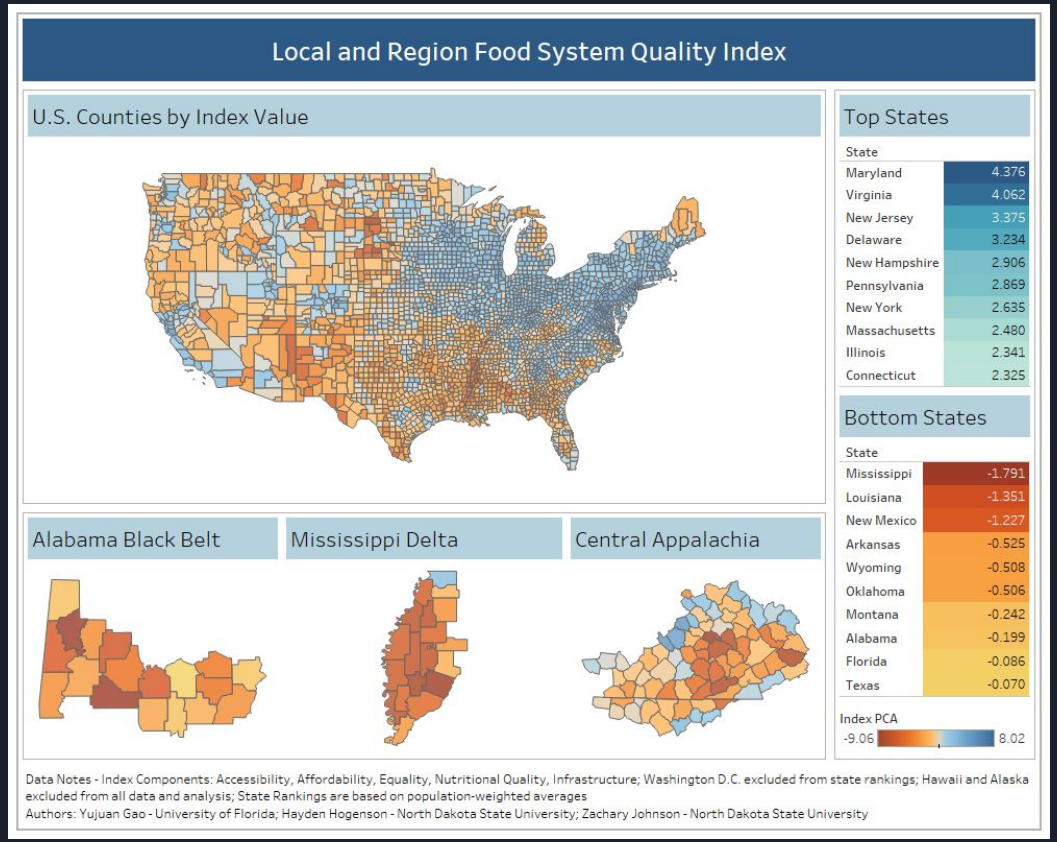
The high scores of these states and counties are strongly supported by the region's exceptional food-system infrastructure (which exceeds that found anywhere else in the US).

South Dakota



Particular attention must be paid to South Dakota, the home of the three lowest scoring counties in the dataset. The first and third lowest values are found in the Crow Creek (-9.06) and Standing Rock (-7.97) Reservations. The second lowest is Mellette (-8.18), adjacent to the Rosebud reservation.

Despite containing many of the lowest ranked counties, South Dakota as a whole ranks as the thirteenth lowest state and has a positive population-weighted average score of 0.452.


Local and Region Food System Quality Index
U.S. Counties by Index Value
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Alabama Black Belt
Mississippi Delta
Central Appalachia
Index PCA
-9.06
8.02
Data Notes - Index Components: Accessibility, Affordability, Equality, Nutritional Quality, Infrastructure; Washington D.C. excluded from state rankings; Hawaii and Alaska excluded from all data and analysis; State Rankings are based on population-weighted averages
Authors: Yujuan Gao - University of Florida; Hayden Hogenson - North Dakota State University; Zachary Johnson - North Dakota State University

Questions?