

# **The effect of county size and population on direct sale local food locations in PA**

Data Science: Ecology & Environment

December 14, 2022

Whitney Wyche

## **Abstract:**

Growing and consuming food are necessary parts of human life that have large ecological and individual impacts. From the resources it takes to grow and transport food to the health impacts of eating quality food, it is important to make informed decisions around this topic. Local food has many benefits, but more research is needed on its distribution and accessibility. This research focuses on mapping the number of direct sale local food locations in Pennsylvania by county size and population and examining trends between these factors. I found that local food is not affected by county size, but instead county population, which is an important step for future research on the distribution and accessibility of local food.

## **Introduction:**

Buying food locally has many benefits, from small-scale individual to large-scale environmental impacts. Some of these benefits are more immediately noticeable, such as food freshness and quality, while other benefits are less easily noticed, such as the impact on climate, because they occur at a larger scale. Local food definitions vary due to differences in population density, climate, and more. That said, in order for a food to be able to be marketed as local, the 2008 Farm Act states that its end point of purchase has to be within 400 miles of its point of origin or within state lines. However, most people regard local food on a smaller scale, often as food produced and consumed within county boundaries. The 2007 New Oxford dictionary defines a “locavore,” as a person who eats food produced within 100 miles.

One type of local food is sold through direct sales. This includes Community Supported Agriculture (CSA) where people purchase a share of food at the beginning of the season, farmers markets where farmers sell food at a central location, and on-farm markets where farmers sell their products at their farm (USDA n.d.). Direct sale local food sources such as farmers markets make local food options and education on local food more visible (Brown, 2008). One of the main forms of education includes the ability for consumers to learn about and become more knowledgeable about where their food comes from. Education also includes the ability to ask questions about food practices such as if farmers use pesticides or animal hormones. In addition to knowledge about where food comes from and how it is made, there are individual health benefits to local food accessibility, with a study finding a significant relationship between local food accessibility and public health (Deller, 2017).

At a larger scale, food produced locally is environmentally friendly because there are less fossil fuels used to transport the food. However, a UK study found that if a customer drives more than 7.4 km roundtrip to purchase local food, their carbon emissions are likely greater than a vegetable delivery service (Coley, 2008). Since traveling long distances reduces the positive environmental impacts of buying local food, sources that are close to consumers are important to keep locally produced food environmentally friendly. Research on the relationship between local food and the local population is needed. While previous studies have looked at local food availability through conventional stores, finding that local food product access is mainly based on pre existing connections between the supply chain and local food producers, more research on direct sale local food options is needed (Abatekassa, 2011).

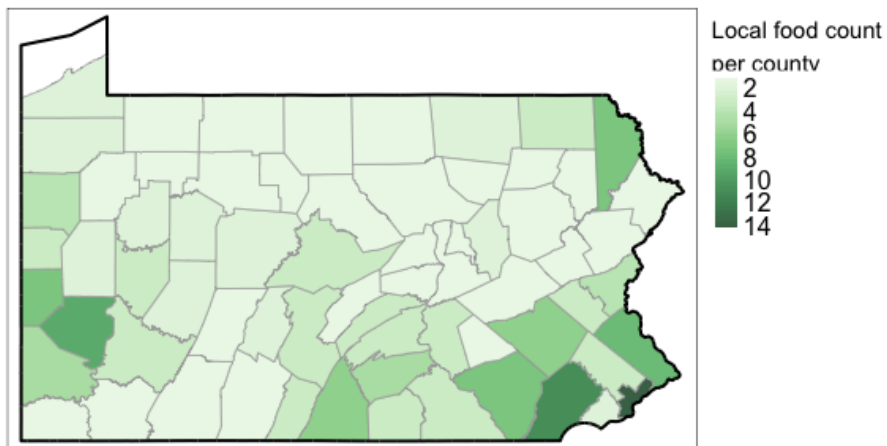
This paper examines the prevalence of local food by researching how direct sale local food options in Pennsylvania vary by the total county area and population per county.

Pennsylvania was chosen as the area of study because it has a range of county population densities that allow for comparisons between densely populated urban and sparsely populated agricultural areas. I predict that the number of local food locations will increase with both county size and population size.

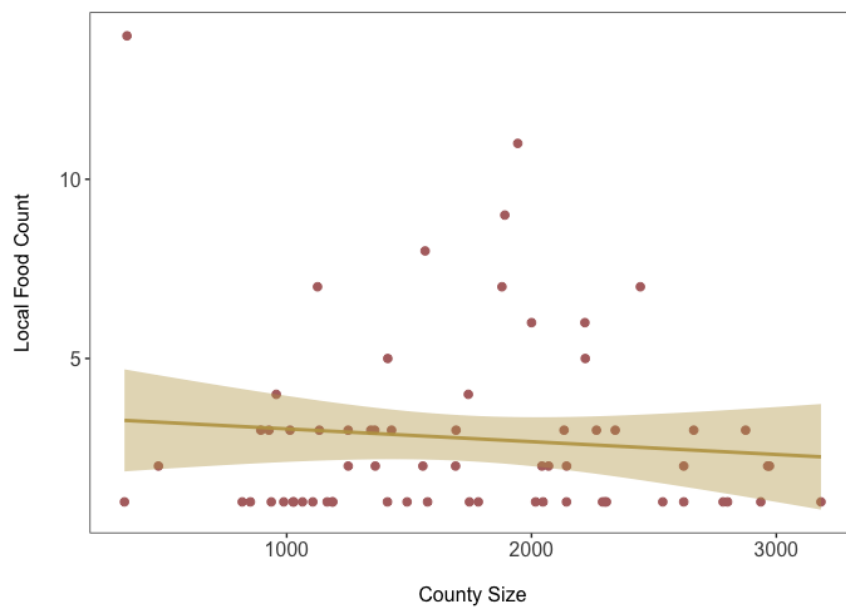
### **Methods:**

Population and cartographic data were accessed from the United States Census Bureau website including cartographic boundary shape files of county lines and population per county for 2021 (US Census Bureau). Data on the locations of CSAs, farmers markets, and on-farm markets were accessed from the USDA website (USDA, n.d.). R statistical program was used for all analyses. Only data from Pennsylvania were used. The sf package was used to read and process shapefiles, the ggplot package was used to create graphs, and the tmap package was used to create maps of counties in Pennsylvania. The mean density of direct food locations per county was calculated by counting the number of direct food location points per county polygon and taking the mean of points per polygon. The local food count per 100,000 county residents was also calculated. A linear regression was run on the relationship between county size and direct sale local food location density per county as well as the relationship between county population and direct sale local food coconuts per county. An animated map showing the CSA locations, farmers market locations, on-farm markets, all direct sale local food locations, and food hub locations was made using the animation package.

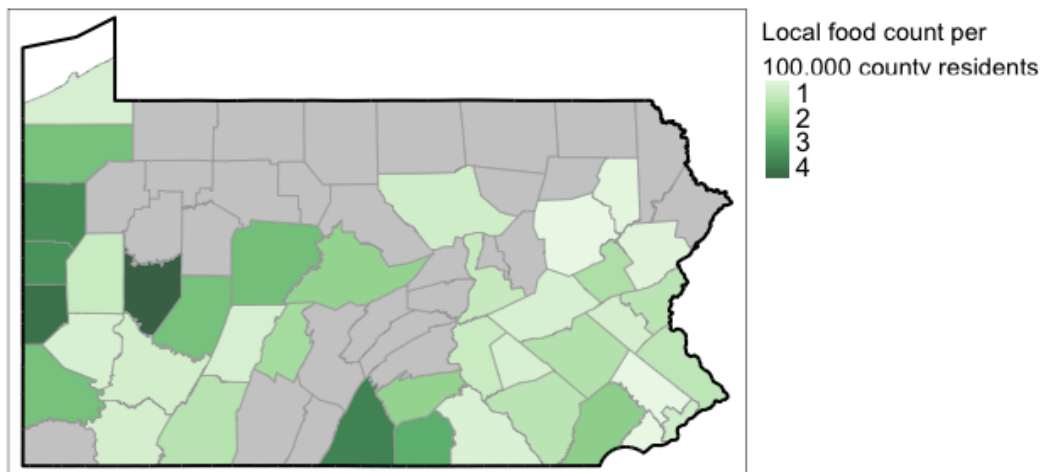
### **Results:**



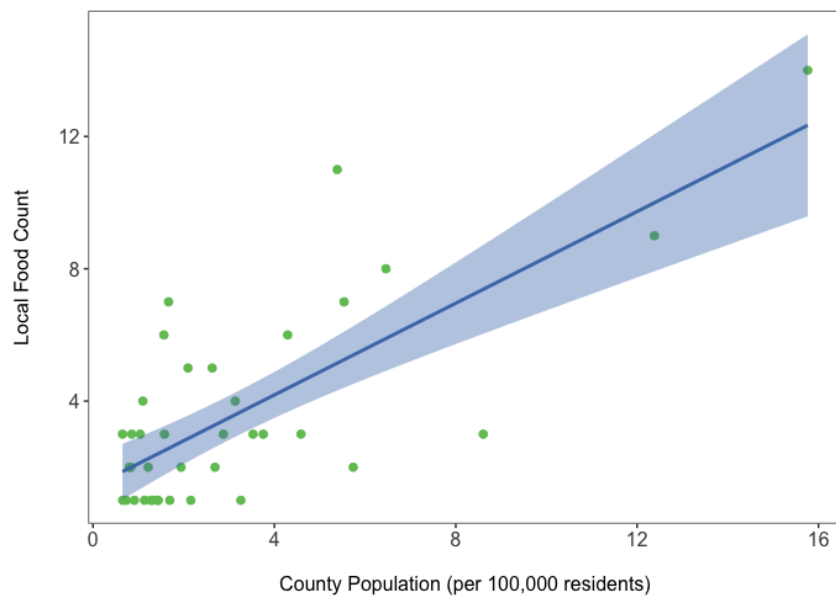
**Figure 1. Local food count per county size.**



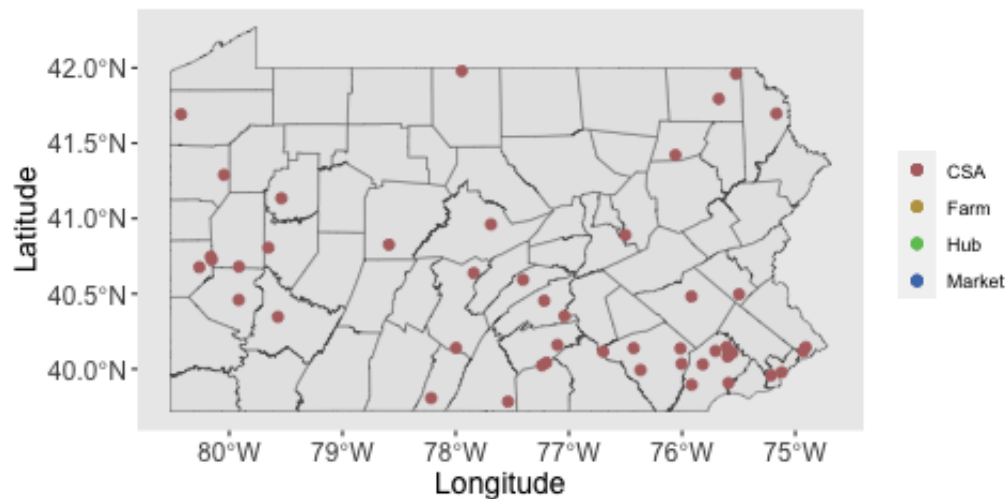
**Figure 2. The effect of county size on the number of local food locations.** The linear regression found no significant effect of county size on local food count ( $R^2 = 0.00927$ ,  $F=0.608$ ,  $df=65$ ,  $p = 0.438$ ).



**Figure 3. Local food count per 100,000 county residents.**



**Figure 4. The effect of county population on the number of local food locations.** The linear regression found a significant effect of county population on local food count ( $R^2 = 0.5466$ ,  $F=44.61$ ,  $df=27$ ,  $p < 0.001$ ).



**Figure 5. Local food locations by type.**

Although there is not a significant relationship between county size and the number of local food locations per county (Fig. 2), there is a significant relationship between population size and the number of local food locations per county (Fig. 4). There also appears to be more local food locations per area in counties with major cities such as Philadelphia and Pittsburgh (Fig. 1). However, while these counties have a total count of local food locations higher than counties with smaller populations, they have a smaller per capita local food count than surrounding counties (Fig 3). Out of the direct sale local food options, food hubs are the least prevalent local food type, while on-farm markets and CSAs had the most locations in Pennsylvania.

## **Discussion:**

My two main findings are that county size is not correlated to local food count per county while population size has a significant positive effect on local food count per county. My results align with part of my hypothesis in that the number of local food locations increase with

population size as predicted. However, the number of local food locations did not increase with county size as predicted. This could be because county size is not representative of the characteristics of a county, such as land use. Although county size and local food count do not have a significant relationship (Fig. 2), counties with major cities had a higher density of local food locations than counties with smaller populations (Fig. 1). This indicates that there are more local food locations in more densely populated areas. Yet, when examined at a per capita level, densely populated counties do not have the highest number of local food locations (Fig 3). Densely populated counties could have less local food locations per capita than other counties because there is a drastic increase in population in major cities compared to rural populations. Due to this start difference in population, although there is a significant trend between county population and local food count, the number of food locations per capita is still less than that of counties without major cities (Fig. 4).

These findings are relevant because they lay the groundwork for future research on direct sale local food options in Pennsylvania. Accessibility to local food is an important option, for the many positive environmental and human impacts that come from purchasing and consuming local food. From this research I found that population is a factor that significantly affects the number of local food options. This is an important preliminary finding because it establishes a baseline for future research on local food.

While broad, this research is limited by data availability. Population information derived from the US census was limited in that counties with populations less than 5,000 were not reported. This could have affected results related to rural counties. There are many possibilities for future research on direct sale local food options in Pennsylvania. Instead of looking at county size, research can look at primary land use per county to compare the number of local food

locations in counties dominated by agriculture, suburban areas, and more. Additionally, while studying the number of local food locations is an important first step, we don't know the capacities of these locations. Some farmers markets may have the capacity to support more people than others, or receive more consumers than others. These are important topics to research in order to support a future with accessible local food options. Previous research has looked at other ways to make local food more accessible to low income communities, including a cost-offset CSA, since distance is not the only barrier to consuming local food (White, 2018). That said, more research is needed on factors affecting local food distributions and how to make local food more accessible.



## Literature Cited

- Abate-Kassa, G., & Peterson, H. C. (2011). Market access for local food through the conventional food supply chain. *International Food and Agribusiness Management Review*, 14(1030-2016-82895), 63-82.
- Brown, C., & Miller, S. (2008). The impacts of local markets: A review of research on farmers markets and community supported agriculture (CSA). *American journal of agricultural economics*, 90(5), 1296-1302.
- Coley, D., Howard, M., & Winter, M. (2009). Local food, food miles and carbon emissions: A comparison of farm shop and mass distribution approaches. *Food policy*, 34(2), 150-155.
- Deller, S., Canto, A., & Brown, L. (2017). Food access, local foods, and community health. *Community Development*, 48(5), 657-680.
- US Census Bureau. Tiger/line shapefiles. Census.gov. Retrieved from <https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2020.html#list-tab-L3W3H82MCMNS9ECMSJ>
- USDA. (n.d.). *Local Food Directory listings*. Local Food Directory Listings | Agricultural Marketing Service. Retrieved from <https://www.ams.usda.gov/services/local-regional/food-directories-listings>
- U.S. G.P.O., Food, Conservation, and Energy Act of 2008 (2008). Washington.
- White, M. J., Pitts, S. B. J., McGuirt, J. T., Hanson, K. L., Morgan, E. H., Kolodinsky, J., ... & Seguin, R. A. (2018). The perceived influence of cost-offset community-supported agriculture on food access among low-income families. *Public health nutrition*, 21(15), 2866-2874.