Food Insecurity and Resource Access in Allegheny County, Pennsylvania: Using GIS to Identify High Need Communities and Assess Food Recovery and Redistribution Efficacy - 2021 Update

GIS Analyst: Melinda Angeles, GIS Solutions Engineer, Allegheny County

INTRODUCTION

Nearly one in six people in the United States is food insecure (Feeding America, 2020), while 54.2 million tons of food produced goes to waste, meaning that it is never eaten (ReFED, 2020). There are a multitude of factors that impact food insecurity, such as agricultural production, biodiversity loss, climate change, and in the past year, global pandemics. There are three lenses through which to address food insecurity, viewing the issue as either a production challenge, a consumption challenge, or "a socioeconomic challenge, which requires changes in how the food system is governed," (Garnett, 2012). 412 Food Rescue interprets food insecurity as a socio-economic challenge that can be solved by utilizing emergent technology to improve resource allocation and logistics, which would solve limitations of transportation and food distribution bottlenecks. This perspective is particularly important when considering that 24% of food supply is lost or wasted in the supply chain (Kummu, 2012).

There are a multitude of organizations working to resolve food insecurity, and while all approaches are valuable, traditional resources often rely on preserved or canned food donations. Many organizations are unable to secure fresh produce and groceries, which results in communities in need lacking access to a variety of nutritious foods. Meanwhile, fresh surplus food is thrown away or left unused by grocers, restaurants, and other suppliers. 412 Food Rescue solves these issues of food surplus and food insecurity by rescuing fresh foods from being thrown away and redistributing this food where it is most needed. Through its groundbreaking Food Rescue Hero technology, 412 Food Rescue organizes a corps of volunteers to pick up surplus food from retailers and deliver it immediately to distribution centers. This requires 412 Food Rescue to understand where excess food must be directed, which the organization has done on a small scale by identifying food insecure areas. Utilizing the organization's records of rescued food, it is possible to interpret 412 Food Rescue's effect on at-risk communities in the Pittsburgh area and to identify communities that still require more support.

This paper will report which areas of Pittsburgh are most in need of food access in Allegheny County based on the criteria of poverty rates, location within a food desert, and location within a transit desert, and will report efficacy of food recovery and redistribution by 412 Food Rescue.

TRANSIT ACCESS AFFECTS FOOD ACCESS

Communities lacking access to food resources, such as grocery stores, and with an above-average poverty rate are more at-risk for food insecurity. Additionally, lack of transit access can also make a household more food insecure. A simple lack of transportation or mobility prevents individuals from accessing grocers and food resources that could be relatively nearby, which coincides with the fact that a lack of transportation compounds the challenges of poverty (White, 2015). This is further exacerbated when considering that many food assistance resources, such as food pantries,

have limited hours, and individuals in need may have jobs that keep them occupied during those hours. Therefore, lack of transit access is considered a third vitally important aspect of food insecurity in this study.

In their 2013 article "Transit Deserts: The Gap Between Demand and Supply," Junfeng Jiao and Maxwell Dillivan developed a method for quantifying and calculating transit supply and demand using census data. This method was used to create transit desert data for Allegheny County. The resultant data was used in combination with food desert information from the United States Department of Agriculture's Economic Research Service and poverty data from the U.S. Census Bureau to generate mapping of Allegheny County's areas of greatest unmet food assistance need. The resulting maps inform 412 Food Rescue's areas of prioritization.

METHODS

Identifying Populations in Poverty:

Low-income neighborhoods were determined using the metric from the Department of Treasury's New Markets Tax Credit (NMTC) program, specifically if a tract's poverty rate is greater than 20 percent. Analysis did not take into account if a tract's median family income is less than or equal to 80 percent of the State-wide median family income; or if the tract is in a metropolitan area and has a median family income less than or equal to 80 percent of the metropolitan area's median family income. (Current Vintage 2015-2019 of ACS Census data https://412foodrescue.maps.arcgis.com/home/item.html?id=0e468b75bca545ee8dc4b039cbb5aff6 → http://www.arcgis.com/home/item.html?id=0e468b75bca545ee8dc4b039cbb5aff6)

Identifying Food Deserts

Food deserts have been determined by the United States Department of Agriculture. Economic Research Service. Using the "LA1and10" attribute, which flags census tracts with low access tracts at 1 mile for urban areas or 10 miles for rural areas. (2017 data)

Identifying Transit Deserts

Household drivers =
(population age 16 and over) – (persons living in group quarters)

Transit-dependent household population =
(household drivers) – (vehicles available)

Transit-dependent population =
(transit-dependent household population) + (population ages 12–15) +
(non-institutionalized population living in group quarters)[2]

The above calculation was performed for each census block group. For block groups with more vehicles than household drivers, the transit-dependent household population was considered to be zero. The reasoning for this is that no block group should have a negative number of people who are transit-dependent.

This calculation changes the focus from why individuals may not drive (age, income, mobility) to identifying where there are limited vehicles available for individuals to use. This means areas with large disparities between auto drivers and autos available are more likely to be transit-dependent than areas that have nearly a one-to-one ratio of cars to people. Once this calculation was performed, the total number of the transit-dependent population was divided by acres for each block group and a z-score was calculated.

Transit service (supply) was determined by four criteria:

1. number of bus and rail stops in each block group
2. frequency of service for each bus and rail stop per day (weekday service) in each block group
   - Note that the frequency was manually calculated with the current timetables, which may have modified for covid
3. number of routes in each block group
4. length of bike routes and sidewalks (miles) in each block group

Each criterion was divided by acres to get a density value and then a z-score value was calculated to standardize them. Finally, the values for each criterion were aggregated to determine the level of supply. In the end, demand and supply are subtracted and a final numerical value was calculated for each census block group to determine an excess or lack of supply (Hulchanski 2010).

Identifying Reach of Existing Networks

Traditional food access network locations mainly came from Allegheny County-hosted GIS datasets derived from the Greater Pittsburgh Community Food Bank, which included soup kitchens or food pantries from Allegheny, Beaver, Butler, Somerset, and Lawrence Counties. Names and locations of food pantries from Armstrong, Washington, Fayette, and Westmoreland Counties were taken from their respective food bank websites. (2021 data)

Identifying Reach of 412 Food Network

412 Food Rescue works with an ever-growing network of nonprofit partners that spans across 5 counties throughout the Greater Pittsburgh Region. The organization's nonprofit partners include housing authorities, daycare centers, churches, community centers, and more. Food donations are matched with a local organization that can most accurately accommodate and distribute the surplus to their clients.

RESULTS

Definitions:

Population in poverty refers to a population in which individuals are living below the federal poverty line on average.

Food desert is an area in which the population lives "far" from a supermarket, supercenter, or large grocery store, when "far" is considered one mile in an urban area and ten miles in a rural area.

Transit desert is an area in which the population has is inadequate access to transit services compared to transit-dependent population

High risk indicates areas which populations are considered to have all three factors combined: food deserts, transit deserts, and in poverty

Reached by Existing Networks means that an individual is within a fifteen minute walking distance of traditional food distribution network, such as food banks or other food access organizations

Reached by 412 Food Rescue means that an individual is within a fifteen minute walking distance of a 412 Food Rescue distribution organization

Reached by 412 Food Rescue, Not Reached by Existing Networks means that individuals are within a fifteen minute walking distance of a 412 Food Rescue distribution organization, but are not within a fifteen minute walking distance of a traditional food distribution network

Not Reached by Either 412 Food Rescue or Existing Networks means that individuals are not within a fifteen minute walking distance of either a 412 Food Rescue distribution organization or a traditional food distribution network

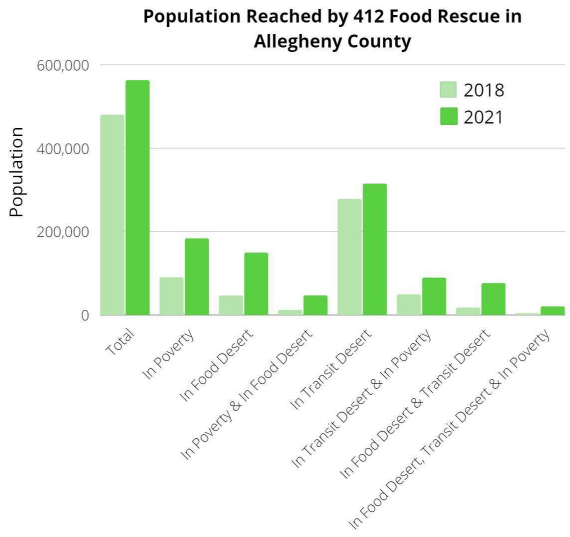
Population Reached by 412 Food Rescue in Allegheny County

Table 1.

Population Reached by 412 Food Rescue	2018	2021	% Change
Total	479,770	562,569	17%
In poverty	90,004	182,886	103%
In a food desert	46,403	148,673	220%
In a food desert, in poverty	12,020	46,295	285%
In a transit desert	277,726	314,351	13%
In a transit desert, in poverty	48,922	88,797	82%

In a food desert and a transit desert	17,739	75,761	327%
In a food desert and a transit desert, in poverty	4,256	19,793	365%

Chart 1.



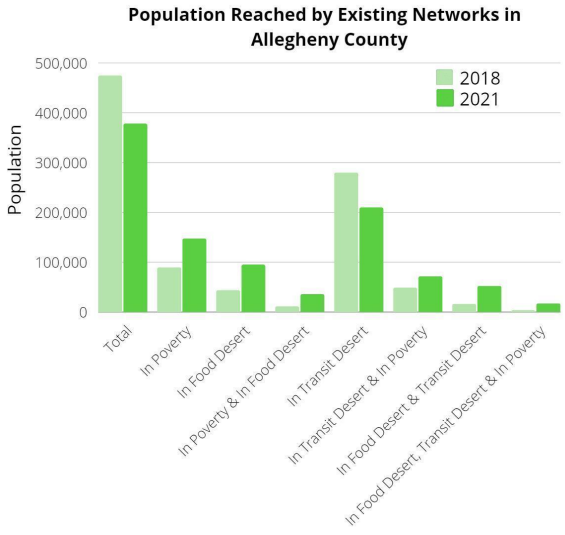
Between 2018 and 2021, the total population reached by 412 Food Rescue partner sites (food donation recipient organizations) increased by almost 100,000 individuals. 412 Food Rescue more than doubled the number of individuals served living in poverty. The organization also more than tripled the number of individuals served living in a food desert and living in a food desert/and in poverty. The largest percentage increases in the populations served were in populations living in a food desert/and in a transit desert, as well as in populations at highest risk, which are those populations living in a food desert/and in a transit desert/and in poverty.

Population Reached by Existing Networks in Allegheny County

Table 2.

Population Reached by Existing Networks	2018	2021	% Change
Total	474,297	377,857	-20%
In poverty	89,181	146,883	65%
In a food desert	43,542	94,675	117%
In a food desert, in poverty	11,305	35,428	213%
In a transit desert	279,212	209,684	-25%
In a transit desert, in poverty	48,478	71,035	47%
In a food desert and a transit desert	16,025	51,615	222%
In a food desert and a transit desert, in poverty	3,642	16,613	356%

Chart 2.



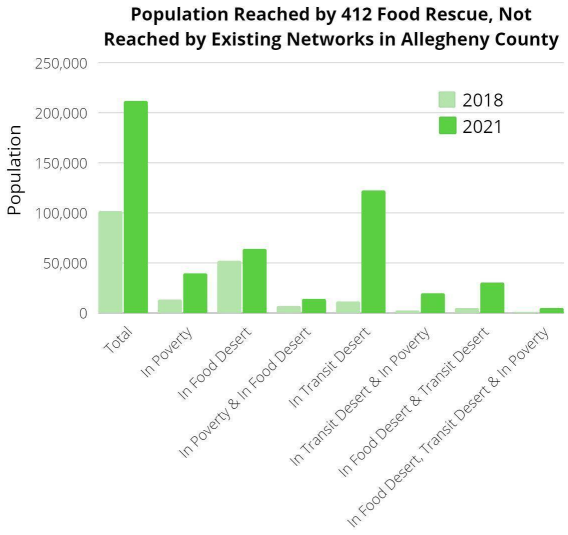
The total number of individuals reached by Existing Networks decreased by about 100,000 individuals between 2018 and 2021. Despite the decrease, Existing Networks were able to greatly expand their outreach to populations living in poverty with an increase of about 55,000 individuals. Existing Networks also more than doubled their support of populations living in food deserts. Additionally, these organizations also more than tripled their reach to populations in a food desert/and in poverty, as well as to populations in a food desert/and in a transit desert. The largest increase in outreach by Existing Networks was with populations at highest risk, those in a food desert/and in a transit desert/and in poverty, more than quadrupling the number of individuals reached.

Population Reached by 412 Food Rescue, Not Reached by Existing Networks in Allegheny County

Table 3.

Population Reached by 412 Food Rescue, NOT Reached by Existing Networks	2018	2021	% Change
Total	101806	211649	108%
In poverty	13317	39318	195%
In a food desert	52003	63762	23%
In a food desert, in poverty	6951	13745	98%
In a transit desert	11566	122210	957%
In a transit desert, in poverty	2632	19357	635%
In a food desert and a transit desert	4974	30110	505%
In a food desert and a transit desert, in poverty	1103	4693	325%

Chart 3.



Between 2018 and 2021 the population reached by 412 Food Rescue and not reached by Existing Networks more than doubled, with an increase of approximately 110,000 individuals. The population reached who are living in a food desert/and in poverty almost doubled, while the population reached who are living in poverty nearly tripled. The largest increases in populations reached were in those living in a transit desert/and in poverty, as well as those in a food desert/and in a transit desert; 412 Food Rescue saw a more than five-fold increase in reach to both populations. Finally, the high risk population outreach to individuals in a food desert/and in a transit desert/and in poverty more than quadrupled between 2018 and 2021.

High Risk Areas

Table 4.

Allegheny County Census Area	High Risk, Yes/No	
	2018	2021
Carnegie	Yes	No
Hazelwood/Glenwood	Yes	No
Millvale	Yes	No
West End	Yes	No
Wilkinsburg	Yes	No
East Pittsburgh	Yes	Yes
Eden Park	Yes	Yes
Pitcairn	Yes	Yes
Sharpsburg	Yes	Yes
Tarentum/Brackenridge	Yes	Yes
Turtle Creek/Newton	Yes	Yes

In 2018, eleven High Risk Areas were identified: East Pittsburgh, Sharpsburg, Eden Park, Tarentum/Brackenridge, Pitcairn, Turtle Creek/Newton, Carnegie, West End, Millvale, Hazelwood/Glenwood, Wilkinsburg. Of those eleven, six have been identified as High Risk Areas again in 2021.

DISCUSSION

412 Food Rescue has greatly expanded its reach between 2018 and 2021 to serve high risk populations, which are populations in a food desert/and in a transit desert/and in poverty. 412 Food Rescue was able to increase its activity in these areas by 365%, with donations reaching a population area of 19,793 in 2021, compared to 4,256 in 2018. This is an increase of 15,537 people.

This increase in high risk individuals reached by 412 Food Rescue is due to deliberate efforts to onboard more nonprofit organizations in the high risk areas identified in the 2018 study and increase the frequency and volume of food donations to these partners. This approach was successful. During the 2019 calendar year, 9 of the 11 high risk areas identified received more food donations by the end of that year compared to the start..

Additionally, 412 Food Rescue greatly expanded its reach to population areas considered to be a food desert/and transit desert, expanding its population area by 58,022 individuals from 2018 to 2021. This was an increase of 327%. Other notable expansions were in populations in food deserts and in populations in food deserts/and in poverty. Overall, 412 Food Rescue improved its reach into every type of vulnerable population over the past three years.

This overall improvement in operations and outreach could be attributed to targeting high risk areas and 412 Food Rescue's pandemic response which included the development of new programs such as bus stop distributions, drive thru distributions, and home delivery.

412 Food Rescue will utilize the findings from this report and story map to further improve its outreach to vulnerable populations by increasing nonprofit organization partnerships and making a deliberate effort to increase food donation volume to these areas.

APPENDIX

Transit desert data for calculations

Population and Household (Vehicle) Data by Census Block Group: Census ACS 5-year 2019 or Esri 2020 estimates derived from ACS 5-year 2019 unless otherwise noted

i. Population

1. Total Population (B01001_001E/M) (ACS 2019)
2. Total Population 10-14 years of age were an addition of Male and Female 10-14 attributes (ACS 2019)
3. A household includes all the people who occupy a housing unit (B09019_002E TotalPop_households). (ACS 2019 data)
4. Population 16+ from Esri
5. People not living in households are classified as living in group quarters. A housing unit is a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters. Population living in group quarters and noninstitutionalized population in group quarters (2010 decennial census data obtained via Esri)

ii. Total Vehicles Available (B992512_001E): These data show the number of passenger cars, vans, and pickup or panel trucks of one-ton capacity or less kept at home and available for the use of household members. Vehicles rented or leased for one month or more, company vehicles, and police and government vehicles are included if kept at home and used for non-business purposes. Dismantled or immobile vehicles are excluded. Vehicles kept at home but used only for business purposes also are excluded. (obtained via ACS 2019)

Transit Stops, Routes, and Frequency

i. For Allegheny County: WPRDC for Port Authority transit stops and routes (port authority open data https://open-data-paac.hub.arcgis.com/) (current)

1. For all other counties: SPC Open Data Portal routes & stops (2020 data) https://spcarcgis.org/arcgis/rest/services/Transit/Non_PAAC_Routes_Stops_2016/MapServer
2. For frequency of both, manually looked through time tables for each route and related the frequency to each stop to estimate total frequency. Slight deviations with routes skip stops throughout the day, but pretty solid estimates. (current)

Bike Lanes

i. For (some of) Allegheny County: WPRDC for BikePGH (May 2017 data) https://data.wprdc.org/dataset/shape-files-for-bikepgh-s-pittsburgh-bike-map

ii. For the SPC region, which includes all of the counties in the AOI: SPC Open Data Portal https://spcgis-spc.hub.arcgis.com/datasets/trail-and-bicycle-network (current)

iii. Other trails: Go To Trails https://gototrails.com/ (https://services1.arcgis.com/Ps1YVQiv5JQLIFu2/ArcGIS/rest/services/GoTo_TRAILS_04202016/FeatureServer/0) (current)

Sidewalks downloaded from SPC Open Data Portal for whole AOI https://spcgis-spc.hub.arcgis.com/datasets/sidewalks-1 (current)

Transit Desert Analysis

Transit-dependent populations for each city were calculated at the census block group level based a formula developed by the U.S. Department of Transportation (Steiss 2006)1 and slightly modified in a recent transportation study performed by the Capital Area Transit Authority in Lansing, Michigan (CATA 2011). This formula

acknowledges that while identifying transit-dependent populations is an important tool for determining where new transit service should be provided or how existing systems can be modified to better service the population in need, calculating a single value that represents those who are transit-dependent can be difficult. While transit dependents are usually classified as those who are too young, too old, or too poor or who are physically unable to drive, Census data on these topics do not account for the fact that these groups often overlap. Simply counting each criterion and adding them together may double or even triple count certain individuals. The formula used to calculate transit dependents is as follows:

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