A research project to analysis food insecurity and digital divide indicators in the city of Philadelphia to inform and spatially identify the potential locations for establishing food and Wi-Fi network.

By Hasa Reddy

CPLN 680: Advanced Topics in GIS

06th May 2022

(Page intentionally left blank. Paper starts on next page)

CONTENTS

1. INTRODUCTION

This paper is written as a part of my capstone project as a component of my master's in urban spatial analytics the University of Pennsylvania.

According to the Philly government nearly "17% of trash sent to the landfill is wasted food This adds up to around 116 million pounds of food waste coming from commercial properties such as restaurants and other food service establishments. "[1] While on the other hand this enormous population suffers from food insecurity. It's reported that in one in four (22.4%) households are facing food insecurity in Philadelphia which is well above the national average of 16.5% for all households with children. [2] The project will make sure people have basic internet access to improve their digital literacy, which will help people to browse and access various Governmental programs and promote the awareness of various smart cities initiatives.

In the first step, three main datasets will be collected. The first one is wi-fi resources datasets. That will help in identifying the location of existing internet locations and the conditions. The second one is food supply resources datasets. This dataset mainly comes from supermarkets, cafeterias, food hubs etc. The restaurants data will be scarped from yelp and maps, which will help in establishing the proximity and density of food collections points. The third one is census datasets, it will give us demography data and let us know the information about the community. Various indicators like, median household income, women and children population, homeless shelters, poverty to name a few would help identify our target users. Building on the analysis of the source, users and infrastructure is analysis, we would be drawing data on a host of public spaces, like parks, public libraries, churches, public parking lots to name a few to organise these drives.

As the project develops and collects data from these sites, it would be able to produce a community-level grid that can be reproduced into many other areas and also and also be able to predict the extent of usage of the sites and if these any site is under serving or overcrowded or in case of natural calamity, the network can easily adjust itself to suit the needs.

2. LITERATURE STUDY

a. Food insecurity

Hunger and starvation thought conditions caused by lack of access to food are very often easily mistaken as similar and used generically. They are very distinct, and degrees of conditions caused due to lack of access to food due to various reason. According to Food and Agriculture Organization (FAO) of United Nations, anyone who doesn't have regular access to healthy food for their development and growth is said to be food insecure. The inaccessibility could be due to multitude of reasons like not having access to fresh food or lacking financial capabilities to purchase food on a regular basis, poverty or unemployment or lack of access to healthcare facilities or racial discrimination. Food insecurity can be experienced at different levels of severity. In 2020, an estimated 1 in 8 Americans were food insecure, equating to over 38 million Americans, including almost 12 million children.[3]

FAO states a person being hunger as a sensation of discomfort caused due to lack of food momentary while food insecurity is caused due to lack to accessibility to resources or means to

afford food at a household level. Food insecurity sounds like could be closely related to poverty, but not everyone below poverty line is always experiencing are food insecure, people who doesn't have access to healthy and nutritious food to overall development of their health due to lack of access to fresh food are also considered to be insecure. In most cases people in low-income brackets, no education, unemployment, people of colour facing discrimination to opportunities, woman, children, and senior citizen are prone are at higher risk. These social issues in culmination are determinants of "conditions in the environments in which people are born, live, learn, work, play, worship and age that affect a wide range of health, functioning and quality-of-life outcomes and risks." [4]

Philabundance part of Feed America, is small organisation working towards recusing food and distributing to people in need quotes that 'Throughout the nation, about 12 percent of people are food insecure — lacking enough food in a year to lead a healthy life, according to data from Feeding America in Chicago, the largest hunger-relief nonprofit in the country. In Philadelphia, it's 21 percent. In North Philadelphia, food insecurity runs as high as 30 percent.' It's one of the organisations that work in tandem with City of Philadelphia in providing free meals to those in need. [5]

b. Digital literacy

Asking me colleagues around and reading about it on the internet, I got a myriad of varying answer of what people perceive it as. According to American Library Association (ALA) defines digital literacy as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills."[6] In today's day and age where everything is on the internet or technologically driven, it is almost a primal

requirement to know and have the skills to navigate through them, be it for school, securing a job or to even get information regarding governmental programs.

Like information literacy, digital literacy requires skills in locating and using information and in critical thinking. Beyond that, however, digital literacy involves knowing digital tools and using them in communicative, collaborative ways through social engagement. ALA's Digital Literacy Task Force defines digital literacy as "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills."[7]

One may wonder how digital literacy helps or even more fundamentally what caused this disparity in communities. It was estimated that around 42 million Americans, prior to covid did not have the means to setting up broadband. With the onset of covid that divide only further aggerated with onset of covid and subsequent preventive methods such as series of mandatory lockdowns during which a lot of people were either laid off or faced pay cuts. This led to them being barely being able to afford essentials such as food, rent etc., and very obviously not being able to pay bills for mobile phones or broadband. This causes digital divide: which is fundamentally a divide caused between demographics or regions that can access Information and Communications Technology and those who couldn't.

"Digital literacy builds upon the concept of digital divide to indicate the ability not just to access digital infrastructure, but also to utilize it." [8]

c. Food wastage

"Up to 40 percent of the food in the United States is never eaten" [9]

"Food takes up more space in US landfills than anything else" [10]

"17% of trash sent to the landfill is wasted food" [11]

We often find ourselves checking expiration dates on labels at grocery stores, a slight blemish on product is considered lower quality, restaurants preparing quantities and portions larger than required to keep up the trends and need, leftovers at home being tossed away but rarely do we stop a moment to empathy and appreciate countless people who would more than happy take this very food that we just rejected or trashed because they don't have the means to afford it or could a meal they haven't had in days that we just mindless reject on a daily basis. "Most wasted food ends up in landfills, where it generates methane, a greenhouse gas that is up to 86 times more powerful than carbon dioxide." [12]

Food ending in landfills that add compound to the other greenhouses gases, is said to be amounting to 8% of the total greenhouse gases emitted. Besides of this, the resources to produce food like fuel, fertilisers, water, manpower, to pack it and food miles they are packed with as often food we consume is rarely grown locally due to various factors.

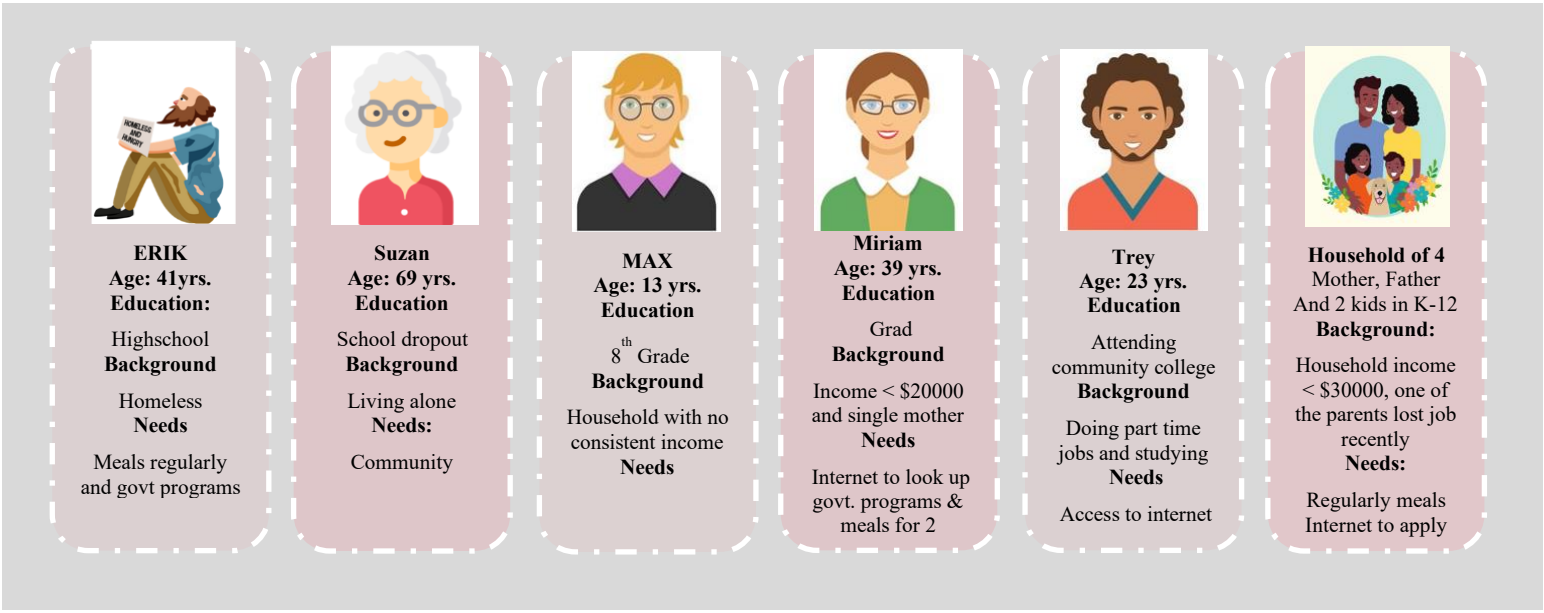
"In the United States, food waste is estimated at between 30–40 percent of the food supply. This figure, based on estimates from USDA's Economic Research Service of 31 percent food loss at the retail and consumer levels, corresponded to approximately 133 billion pounds and $161 billion worth of food in 2010." [13]

3. DATA

a. Users

Every good project first needs to really understand and establish its users and their needs, like wise this project before diving into the particulars of what the project is really going to be and how it would done, has establish a broad idea of the kind users it would be targeting or more importantly would be benefitable to. The user categories are to great extent informed by the demographics that city of Philadelphia's free meal and food programs target and from reach on types of people that

face food insecurity and are facing digital divide. On a comprehensive scale, the user categories would target demographics based on lack or minimal access to education, low or no income, no job or low household income which generally indicate that a person is either struggling financially or required aid to get access to one of the basic amenities such as food.



The 6 categories are: The homeless: people who don't have basic amenities, don't have access to regular healthy and decent food and could potentially be of huge benefit with the fee meals; the elderly: people in their older years and surviving on minimal savings and don't have a study income; children to teenagers coming from families with single parent or no study income and don't have access to healthy food in their developmental years and need access to internet to participate and help complete their assignments for schools; adults looking for jobs or in between jobs and don't have access to broadband at home and could benefit from internet access to develop skills and apply for jobs; young adults joggling between parttime jobs and education who need access to internet to pursue jobs and finally families struggling financially to provide for their

families. Bases on broad understanding of the target users, I further explored the census data to extract the groups or variables that would encompass these users and narrowed down on these 5

- "B19013_001E", Median household income in the past 12 months
- "B25058_001E", Median contract rent
- "B14007F_019E", Total not enrolled in school
- "B15003_001E", Total educational attainment for the population 25 years and over
- "B15003_002E", Total no schooling completed educational attainment for the population 25 years and over

Having sorted who the users are, the next step was to understand where these potential network sites would be located at. For this, I explored the options of looking at public spaces that are easily accessible and have or are within 100m distance to existing public Wi-Fi spots which would help this project build on, in its initially stages on infrastructure that is already there in the city. This would help in rolling out the project with less fiscal constraints and leverage the infrastructure that is present currently.

The public spaces that have been narrowed down and used for this project are public parks and recreations spaces, public libraries with free Wi-Fi and Public parking lots. These spaces would allow and be able to host parking of meal van or station and also be able to accommodate users coming to either avail internet services or free food. Having said that, there are two more data sets I have considered as existing infrastructure but more in the sense of understanding how to leverage on these to their potential. One is the existing Wi-Fi stops around the cite, and other is the existing meal sites that City of Philadelphia and other private organisations provide. City of Philadelphia provides free food and means as a means to supplement the existing food pantry network to students, senior citizens, residents experiencing homelessness and hunger and to

residents (without proof of ID or income). It's vital to take into account these sites as I won't want to overlap sites in my network with the existing sites and makes it less effecting rather helps my project really looks for areas where there is a need that the existing food distribution programs do not cater to.

b. Data sources

All the data was sourced from open data Philly website, which is an open data source.

Community Parking - https://philapark.org/lots/ [14]

Parks and rec - https://www.opendataphilly.org/dataset/ppr-districts [15]

Existing food distribution sites - https://www.phila.gov/food/ [16] and

https://www.philabundance.org/find-food/food-map/ [17]

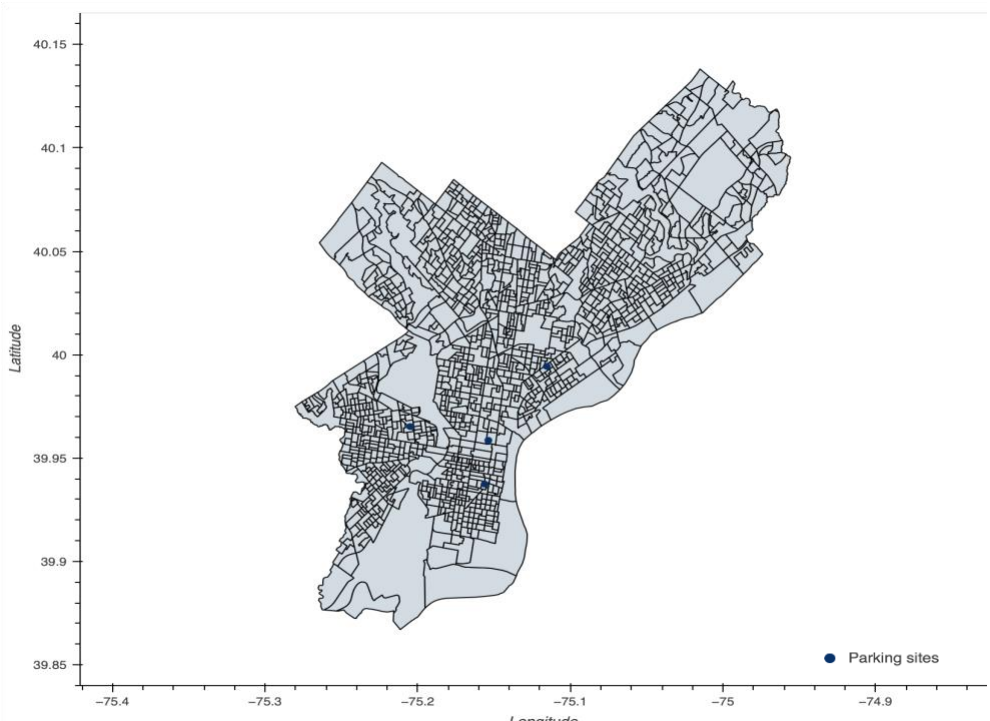
Free Library https://libwww.freelibrary.org/locations/service/wifi-access [18]

Free Wi-Fi

https://phl.maps.arcgis.com/apps/webappviewer/index.html?id=928cdaef12994bd1b3968da825a71a1a[19]

c. Data extraction and cleaning

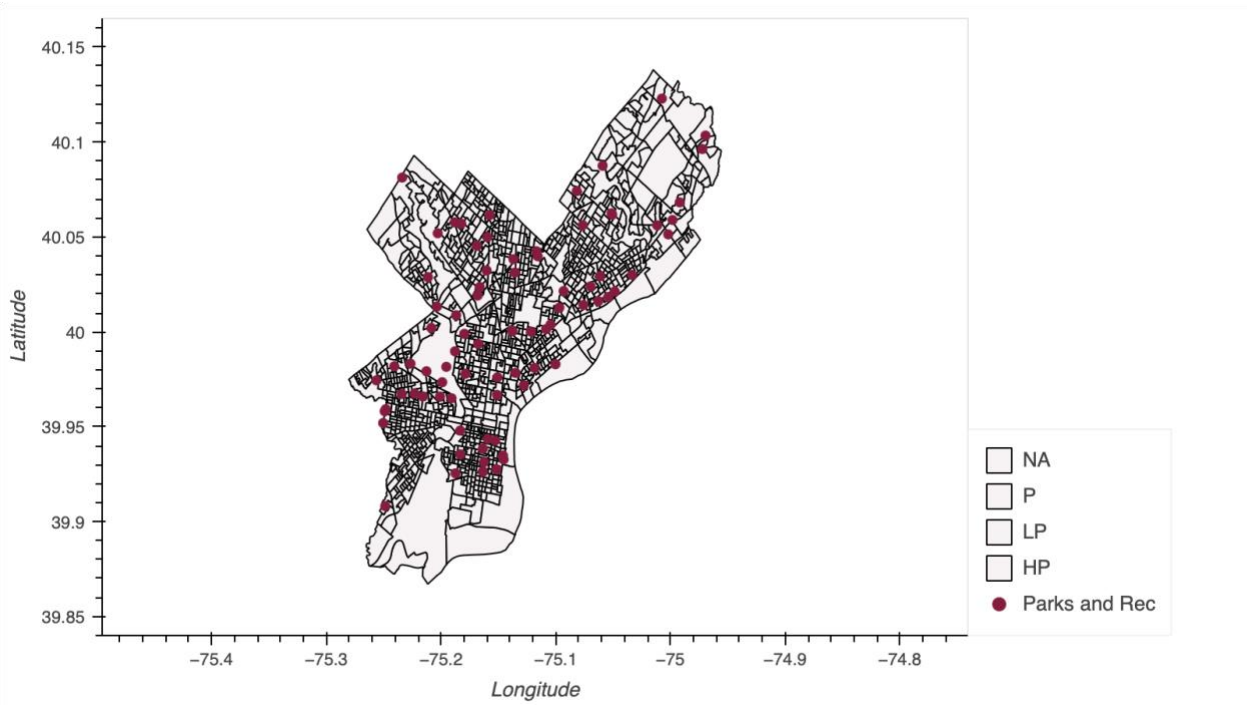
Community Parking



The required data on website was static, I used Python library called ‘request’ to extract all the data from the website and further used python library ‘beautiful soup’ to sort the extracted data to filter only the addresses of the parking lots.

Parks and Recreation

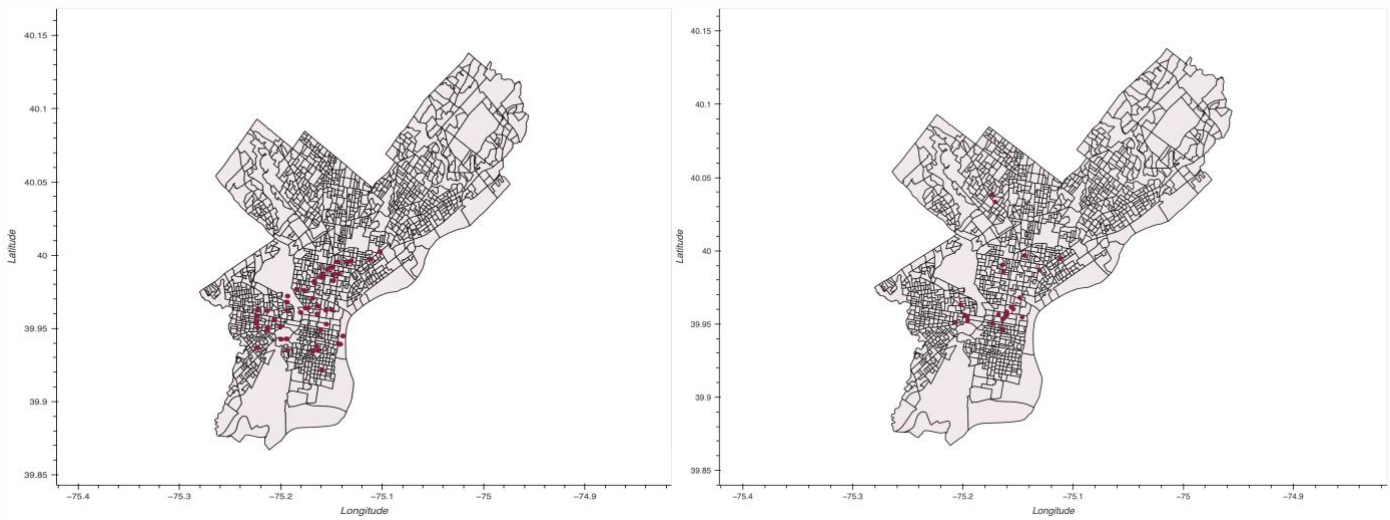
The data was available in a csv format from the open data Philly website. The csv file was further cleaned of the unnecessary columns. In this data set I was particularly interested in parks or recreational sites having a building with public Wi-Fi.



Existing food distribution sites - https://www.phila.gov/food/ and https://www.philabundance.org/find-food/food-map/

Data regarding the existing food and meal distribution was extracted from two websites, City of Philadelphia and Philabundence. The required data available on the city of Philadelphia website was dynamic and was not able to extract the data unless clicked on each individual site to expand and provide with further details of the meal site such as locations, eligibility etc. In order to

overcome this, I used Python library “selenium” which enables to me automate some of the above steps in order to extract the data and save it as a csv file. The same was done with Philabundence website, which also further required ‘beautiful soup’ to filter the desired details.



Free Library

Extracting free libraires with Wi-Fi was similar to data extraction that of community parking as it as had static content too. I used Python library called ‘request’ to extract all the data from the website and further used python library ‘beautiful soup’ to sort the extracted data to filter only the addresses of the libraries. In this data.

Free Wi-Fi

The required content was dynamic, so similar to food distribution sites, the same process was replicated using ‘selenium’ and ‘beautiful soup’

Census

We used ‘cenpy’ Python library in order to extract shape geometry coordinates of all the census tracts pertaining to city of Philadelphia. Information regarding variables (or parameters) were also called in this step.

B19013_001E - Median household income in the past 12 months

B25058_001E - Median contract rent

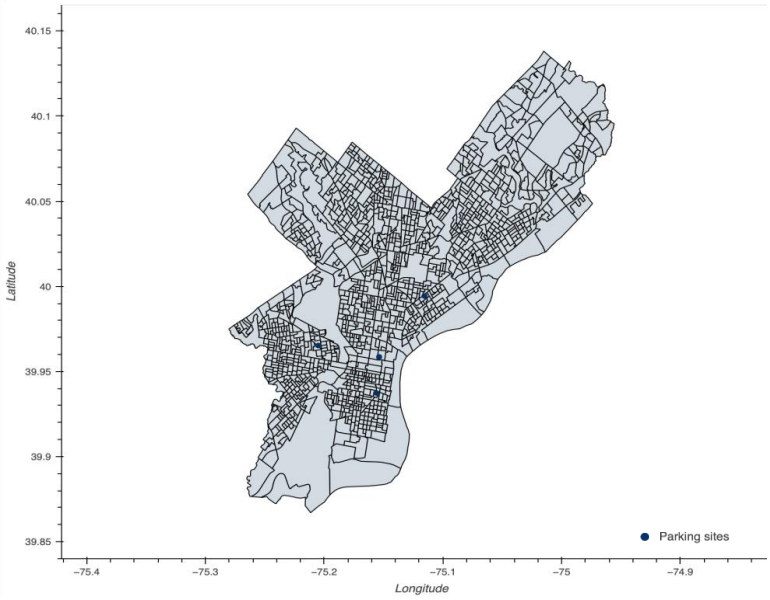
B14007F_019E – Total not enrolled in school

B15003_001E – Total educational attainment for the population 25 years and over

B15003_002E - No schooling completed educational attainment for the population

4. Analysis

Google Maps API was used to get the latitudinal and longitudinal details to supplement the addresses of all the data that was extracted. Once all the data points had latitudinal and longitudinal information, we took all the parking lots, parks and rec to examine their proximity to existing free meal and food distribution locations with 2km radius of their location and public Wi-Fi access within 100m of their locations. This was done to make sure potential network sites are not in too close proximity to the existing meal and food distribution sites to enable better coverage across the city, also to leverage the existing Wi-Fi infrastructure instead of having to establish a new infrastructure. This finally gave a consolidated data base of potential network sites.



a. Census analysis

Median household income was a very important indicator as it shows people's income which invariantly tells us about their affordability and can give an vague idea of if they could be facing challenges affording healthy food or access to internet. From this map, we can tell that for most of the city high income areas are concentrated around center city and northern most regions. and the lowest range of income households are distributed around the city.

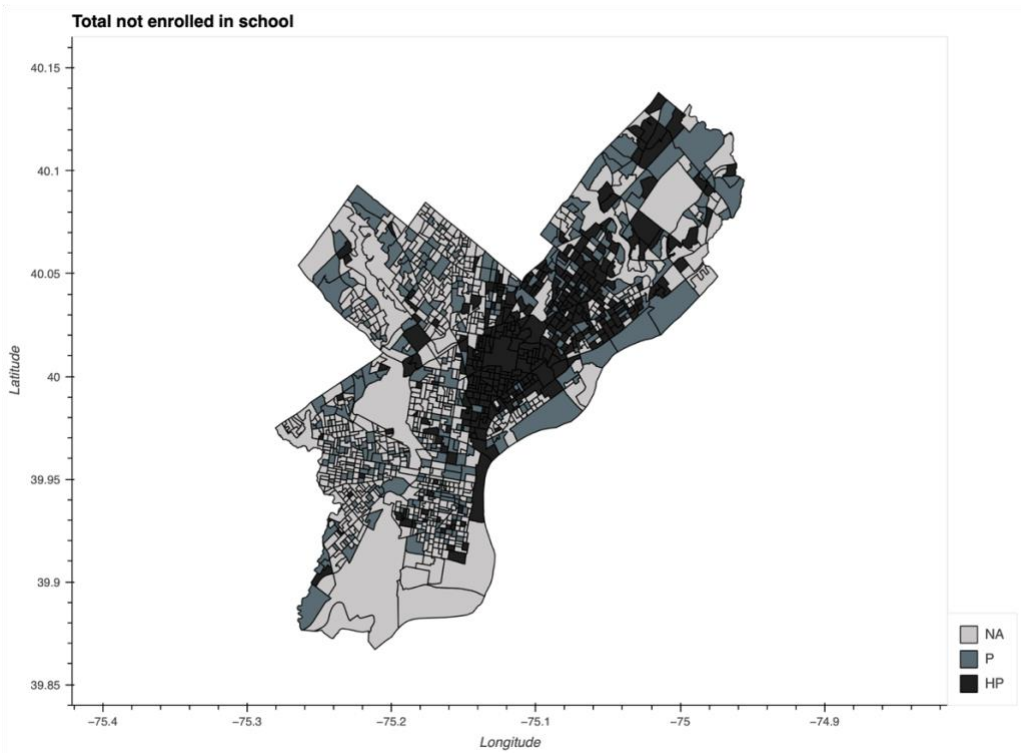

Median contract rent
40.15
40.1
40.05
40
39.95
39.9
39.85
Latitude
−75.4
−75.3
−75.2
−75.1
−75
−74.9
Longitude
NA
P
LP
HP


Median household income in the past 12 months
40.15
40.1
40.05
40
39.95
39.9
39.85
Latitude
−75.4
−75.3
−75.2
−75.1
−75
−74.9
Longitude
4000
3000
2000
1000
0

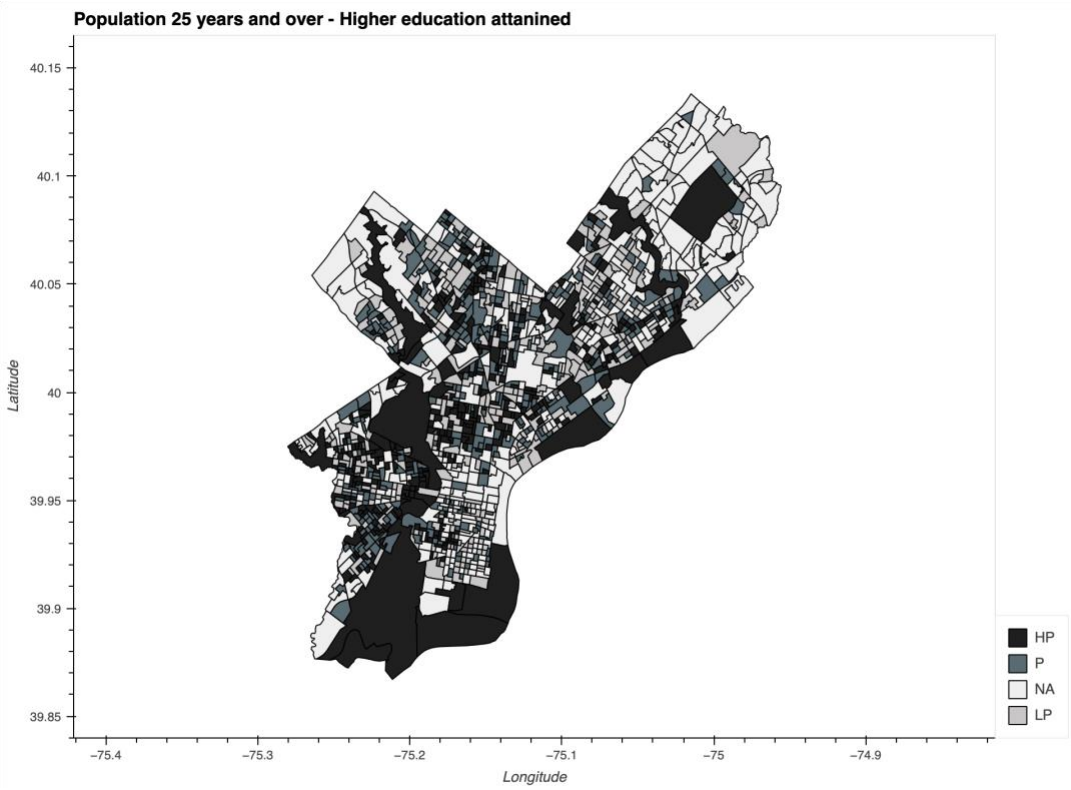
b. Process and ranking

To understand which tracts were in dire need of these network points we categorised the census tracts as 'High Priority', 'Priority', 'Low Priority' and 'Not required(N/A)' for each of the variables. One the basis of the distribution of the data, I divided the data into 4 parts for example for 'B25058_001E' - Median contract rent min-25% value range comes under " High Priority" 25%-50% value range is "priority", 50%-75% value range is 'low Priority" and 75%-Max is "Not required(N/A)" as people in this range pay a high medium contract rent and won't need any network points in these tracts.

Education being on the important factors to define a person is able to hold a steady employment or not, it was important to analysis education attainment in both adults over and under 25 years. If a region or household with children are not enrolled in school, it could directly relate to the household or parents not being able to afford enrolling children into school due to lack of financial means, which could also make children and the parents vulnerable to food insecurely and children in their developmental years need nutritious and healthy food for cognitively fully developing hence this is a variable or parameter of at most importance to target household with children that could be facing food insecurity. If someone over 25 years was not enrolled in school could mean that they are highly likely to not being able to have a steady income and might be facing food insecurity due to lack of money.


Total not enrolled in school
40.15
40.1
40.05
40
39.95
39.9
39.85
Latitude
−75.4
−75.3
−75.2
−75.1
−75
−74.9
Longitude
NA
P
HP

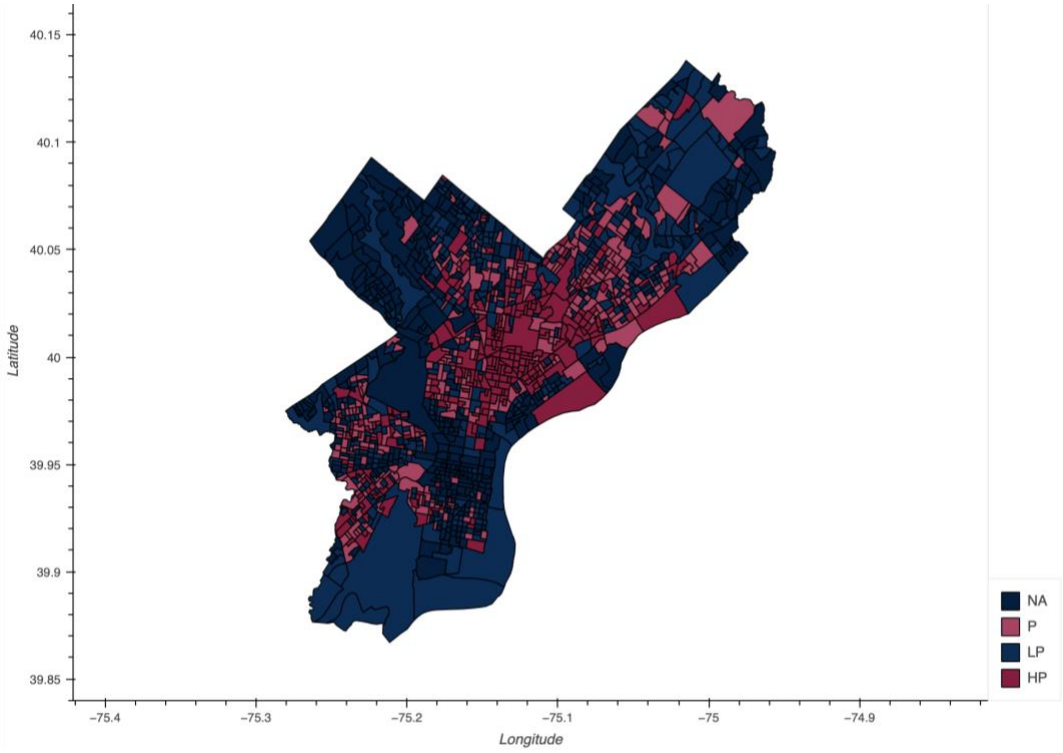

Population 25 years and under - not enrolled in school
40.15
40.1
40.05
40
39.95
39.9
39.85
Latitude
−75.4
−75.3
−75.2
−75.1
−75
−74.9
Longitude
NA
P
HP



c. Cumulative ranking

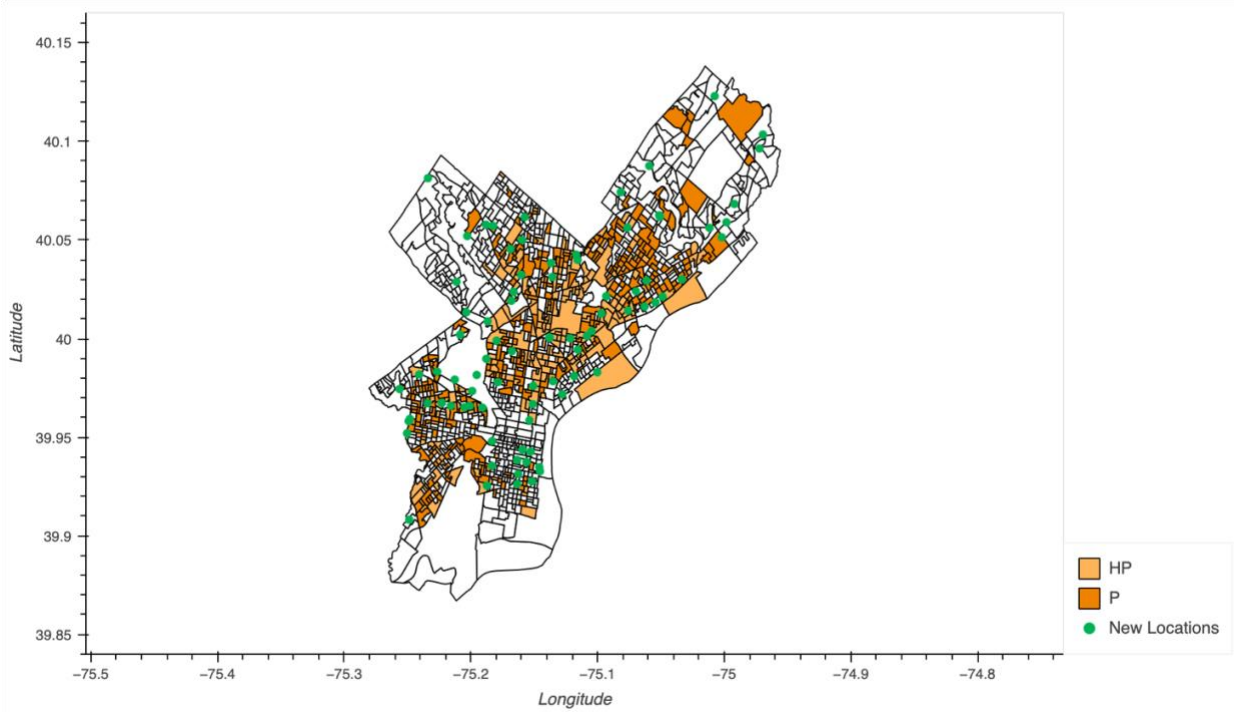
With the help of above categories, we further evaluate the census tracts and divide them into four broad rankings as ‘High Priority’, ‘Priority’, ‘Low Priority’ and ‘Not required(N/A)’. To do this we start with assigning points to every category as High Priority = 10’, ‘Priority = 5’, ‘Low Priority = 1’ and ‘Not required(N/A) = 0’. With this we were able to gauge over all requirement for each census tract according to these parameters. After this we focus on the distribution of the potential

network sites in high priority and priority regions.



5. RESULTS

My final analysis of the project is that there are numerous tracts that are in need for meal sites but lack of one, but there also tracts that are in need, but my network sites don't cover. Besides of covering tracts that need these sites, there are sites in tracts that don't need are in low priority as well, which can be either disregarded or can be used to supplement their neighbouring tracts where either that are not covered in the network or need more than one site to cater to their needs. Tracts that are in high priority or priority but are not covered by my network will tackled in a different way beyond just scouting for public parking lots or parks etc., but potentially looking at street corners or public/private empty lots, nonprofit organisations working for children and women welfare or care centers where people are more like to approach to avail their facilities, which also increases the visibility of these networking sites, subsequently maximise their usage.



One very stark outcome from the analysis of the existing meal sites is the concentration of the distribution points being mostly around center city, which gives my project plenty of scope to developed and executed into valuable solution in scouting for sites in the areas where there are no existing meal sites. Another very value insight was the lack of public Wi-Fi locations outside of center city, except for a hand full of them which makes a drawback in tackling low digital literacy rates in tracts where there is a dare need.

6. NEXT STEPS

This project can be furthered by analysis the total population of each tract and estimating how many people can a single network site accommodate based on factors such as size of the site, facilities at the site and the proximity of the site to food sources. This will help estimate the number of new sites that truly will be required on each tract to meet the demand.

To finally round the project to start implementing the project, last but a very critical step is sourcing the food from restaurants, grocery stores, cafes, and other food collection establishments. For this, we need to first analyse how much food can be sourced what the demand is for the current food insecurity in Philadelphia.

References

(OITP), O. and Force, D., 2022. *What is Digital Literacy?*. [online] Alair.ala.org. Available at: <https://alair.ala.org/handle/11213/16260> [Accessed 6 May 2022].

2022. [online] Available at: <https://literacy.ala.org/digital-literacy/> [Accessed 6 May 2022].

Center for Hunger Free Communities. 2022. *Philadelphia Hunger Increases - Center for Hunger Free Communities*. [online] Available at: <https://drexel.edu/hunger-free-center/research/briefs-and-reports/philadelphia-hunger/> [Accessed 6 May 2022].

City of Philadelphia. 2022. *A Philadelphia Business' Guide to Reducing Food Waste | Office of Sustainability*. [online] Available at: <https://www.phila.gov/2021-08-11-a-philadelphia-business-guide-to-reducing-food-waste/> [Accessed 6 May 2022].

City of Philadelphia. 2022. *A Philadelphia Business' Guide to Reducing Food Waste | Office of Sustainability*. [online] Available at: <https://www.phila.gov/2021-08-11-a-philadelphia-business-guide-to-reducing-food-waste/> [Accessed 6 May 2022].

Hunger and Health. 2022. *What Is Food Insecurity in America? | Hunger and Health*. [online] Available at: <https://hungerandhealth.feedingamerica.org/understand-food-insecurity/#_ftn1> [Accessed 6 May 2022].

Hunger and Health. 2022. *What Is Food Insecurity in America? | Hunger and Health*. [online] Available at: <https://hungerandhealth.feedingamerica.org/understand-food-insecurity/#_ftn3 https://hungerandhealth.feedingamerica.org/understand-food-insecurity/#_ftn3> [Accessed 6 May 2022].

NRDC. 2022. *Food Waste*. [online] Available at: <https://www.nrdc.org/food-waste> [Accessed 6 May 2022].

NRDC. 2022. *Food Waste*. [online] Available at: <https://www.nrdc.org/food-waste> [Accessed 6 May 2022].

Opendataphilly.org. 2022. *Parks & Recreation Districts - OpenDataPhilly*. [online] Available at: <https://www.opendataphilly.org/dataset/ppr-districts> [Accessed 6 May 2022].

Philabundance. 2022. *Hunger in Philly: 'It's a pain in my belly' - Philabundance*. [online] Available at: <https://www.philabundance.org/hunger-in-philly-its-a-pain-in-my-belly/> [Accessed 6 May 2022].

Recycle Track Systems. 2022. *Food Waste in America in 2022: Statistics & Facts | RTS*. [online] Available at: <https://www.rts.com/resources/guides/food-waste-america/> [Accessed 6 May 2022].

Researchoutput.csu.edu.au. 2022. [online] Available at: <https://researchoutput.csu.edu.au/ws/portalfiles/portal/8843534/PID40502manuscript.pdf> [Accessed 6 May 2022].

The Philadelphia Parking Authority. 2022. *Community Parking Lots | The Philadelphia Parking Authority*. [online] Available at: <https://philapark.org/lots/> [Accessed 6 May 2022].

U.S. Food and Drug Administration. 2022. *Food Loss and Waste*. [online] Available at: <https://www.fda.gov/food/consumers/food-loss-and-waste> [Accessed 6 May 2022].

Food distribution sites | City of Philadelphia. 2022. *Food distribution sites | City of Philadelphia*. [online] Available at: <https://www.phila.gov/food/> [Accessed 6 May 2022].

Philabundance. 2022. *Find A Member Agency Near You - Food Map - Philabundance*. [online] Available at: <https://www.philabundance.org/find-food/food-map/> [Accessed 6 May 2022].

Phl.maps.arcgis.com. 2022. *ArcGIS Web Application*. [online] Available at: <https://phl.maps.arcgis.com/apps/webappviewer/index.html?id=928cdaef12994bd1b3968da825a71a1a> [Accessed 6 May 2022].